Saturday, May 7, 2016

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Weekend Course

PET-MRI: Devices, Radiotracers & Applications

*Organizers:*Andrei H. Iagaru, M.D., Ryan Niederkohr, M.D., N. Jon Shah, Ph.D. & Greg Zaharchuk, M.D., Ph.D.

Room 324-326 | 7:30 - 18:00 | *Moderators:*N.Jon Shah & Greg Zaharchuk

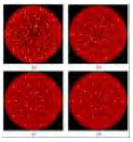
7:30 PET/MRI Scanner Overview

Jae Sung Lee

8:00 Attenuation & Motion Correction Strategies for PET Using PET/MRI

Attenuation correction (AC) for PET reconstruction using PET/MRI is not trivial. MRI-based segmentation, atlas registration, and time-of-flight derived attenuation coefficients are most commonly applied and studied approaches for AC. Motion management of PET reconstruction, aided by the temporal resolution of MR-based signal, is promising, but still requires extensive investigation and robust method development.
Youngho Seo

8:30 Time-of-Flight: Do We Need It in PET/MRI?



The aim of this presentation is to introduce the participant into Time-of-Flight (ToF) Positron Emission Tomography. General concepts of ToF-PET, fundamental limits and most important characteristics of the key components scintillator and photo detector will be discussed. The correlation between timing resolution and image SNR, which is the main benefit of the timing measurement, will be introduced by means of examples from real patient examinations and simulations. Special emphasis will be put on completely new imaging application enabled by ToF-PET and on the potential of ToF-PET for simultaneous MR/PET imaging.
Christoph Lerche

9:00 Future Directions in PET/MRI

Craig Levin

9:30 Break & Meet the Teachers

10:00 PET Radiopharmacy 101

Frederick Chin

10:30 Radiation Safety & Procedures

Knowing how to protect oneself from radiation is an important aspect in the healthcare imaging workplace. Besides self-protection, knowledge about radiation can also aid healthcare professionals safeguard the health of their patients from excessive radiation. This talk serves to provide participants a basic understanding of ionizing radiation, X-rays and radiobiology, as well as unravel the mystery of minimizing radiation doses in medical imaging.
S. Somanesan

11:00 Beyond FDG: New Tracers

PET/MRI has the potential to offer not just structure/function characterisation, but structure/function/tissue characterisation in a way that conventional CT combined with PET cannot provide. This talk will explore options beyond conventional FDG whole body PET/CT for detailed characterisation of the individual patient and their disease.
Dale Bailey

11:30 Regulatory Issues for Radiotracers around the World

This presentation will highlight the differences between PET radiopharmaceuticals and MRI contrast agents with respect to regulatory approval in order to educate those working with PET/MRI on the regulatory framework under which PET radiopharmaceuticals can be administered.
David Dick

12:00 Break & Meet the Teachers

13:30 Interpreting FDG PET images - a Crash Course

Eric Rohren

14:00 Clinical PET/MRI: Workflow Considerations

Marius Mayerhoefer

14:30 Oncological PET/MRI: Where Will it Replace PET/CT?

Thomas Hope

15:00 Cardiac PET/MRI

The development of hybrid PET/MRI imaging devices provides new perspectives in cardiovascular imaging. While these two imaging modalities (PET and MRI) have gained well-established diagnostic value in clinical practice, the ability to acquire both modalities in a single session opens new perspectives in workflow and in assessment and quantitative evaluation of cardiovascular diseases. The development of new PET tracer will certainly add to the value of clinical applications of hybrid PET/MRI in the futur
Osman Ratib

15:30 Pediatric PET/MRI

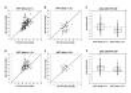
Jonathan McConathy

16:00 Break & Meet the Teachers

16:30 Role of PET/MRI in Brain Tumors

This presentation discusses the synergies that make MRI/PET a unique hybrid technology that could be used effectively to improve the diagnostic and prognostic information from each of its component modalities.
Fernando Boada

17:00 Brain Perfusion & Permeability Imaging



Educational Lecture to discuss on the clinical usefulness of combined use of PET and physiological imaging with MRI. Focus is set on chronic occlusive cerebrovascular diseases and malignant brain tumor.
Tadashi Nariai

17:30 Functional Imaging with PET/MRI

Among many potential applications of simultaneous PET and fMRI, this talk focuses on paradigms of function (fMRI) versus occupancy (PET) and combinations that investigate flow-metabolism coupling or oxygen versus glucose utilization. PET/fMRI can help clarifying aspects of receptor-based imaging using either drug or tasks that elevate neurotransmitter levels. The combined information has the potential to form new biomarkers with clinical utility. Metabolic imaging using PET in conjunction with fMRI measurements of CBF and CMRO2 can be done simultaneously within a single imaging session. This talk focuses on PET capabilities and possibilities for combining PET and fMRI information.
Joseph Mandeville

18:00 Adjournment & Meet the Teachers

Weekend Course

Molecular & Metabolic Imaging: Basic Concepts of Molecular Imaging

*Organizers:*Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 300-302 8:30 - 12:00 *Moderators:*Kejia Cai & Leo Cheng

8:30 Relaxation Based Contrast Agents

This lecture will review the fundamental properties and applications of relaxation based contrast agents. We will begin by understanding the physics of relaxation and factors influencing it. With a view towards in vivo use, we will discuss the relevant physicochemical and MR properties that influence the success of relaxation based agents for biomedical applications. We will also discuss factors that determine the pharmacokinetics of these agents and the opportunity for targeting tissue microenvironment. Finally we will review some new directions in the field outline future prospects.
Vikram Kodibagkar

9:15 Responsive Contrast Agents

Responsive contrast agents are a promising class of molecules for visualizing disease-relevant molecular events. These contrast agents undergo chemical changes in response to stimuli including enzyme activity, metal ion transport, and changes in pH and oxygen levels. The chemical changes lead to changes in contrast enhancement that can be detected with MRI. This talk will cover the basic principles behind how this class of contrast agents function and will highlight some published examples of response.
Matthew Allen

10:00 Break & Meet the Teachers

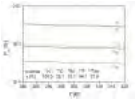
10:30 Chemical Exchange Saturation Transfer

This teaching presentation will attempt to demonstrate the power and existing present limitations of Chemical Exchange Saturation Transfer (CEST)-based MRI and its most prominent applications.
Xavier Golay

11:00 Multinuclear, Sodium & Fluorine

This presentation discusses the basic principles for the implementation and application of multi-nuclear MRI, with an emphasis on sodium MRI, in the study of disease in humans.
Fernando Boada

11:30 Fundamentals of Hyperpolarization



MRI relies on detecting signals in the radiofrequency range that are related to very small energy transitions of the spin ensemble. While this is a blessing with regard to the harmless character of the radiation, it imposes a serious problem in terms of the low sensitivity caused by almost vanishing spin polarization at ambient temperatures. Increasing the sensitivity through artificial enhancement of the net magnetization relies on so-called hyperpolarized agents for NMR and MRI. Hyperpolarization is a powerful technique that has enabled many varied applications for molecular and cellular imaging. This tutorial will summarize the methods of hyperpolarization, probe design and optimized signal encoding.

Leif Schröder

12:00 Lunch & Meet the Teachers

Weekend Course

An Update on Body MRI Protocols & Applications: Setting Up Your Body MRI Practice

Organizers: Lorenzo Mannelli, M.D., Ph.D., Ivan Pedrosa, M.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 8:00 - 10:00 *Moderators:*S. Sendhil Velan

8:00 Hardware, Patient Preparation, & Monitoring Considerations for Body MRI

In clinical body MRI, diagnostic radiologists often make choices in hardware, patient preparation or monitoring that impact workflow or image quality. In this session, we will review choices with potential effects in your day-to-day clinical practice and go through scenarios centered on body MR protocols.
Richard Do

8:30 Optimize Your MRI Sequences for Abdomen & Pelvis Examinations

The major factors that influence MR sequence optimisation for abdominal and pelvic exams will be outlined and discussed. Typical body and pelvic exams will be used to illustrate the key issues regarding selection of coils, imaging planes and sequence parameters.
David Lomas

9:00 Contrast Agents: Which one Should You Choose?

Objectives: 1. To review chemical properties of commercially available gadolinium based contrast agents (GBCAs) 2. To review applications of commercially available GBCAs 3. To review current recommendations for safe use of GBCAs
Ruth Lim

9:30 Break & Meet the Teachers

Weekend Course

An Update on Body MRI Protocols & Applications: Diagnostic Approach to Focal Liver Lesions

*Organizers:*Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 10:00 - 11:00 *Moderators:*Ivan Pedrosa

10:00 MRI of Lesions in the Non-Cirrhotic Liver

Valerie Vilgrain

10:30 MRI Charaterization of Lesions in the Cirrhotic Liver

The most frequent malignant tumor in cirrhotic liver is hepatocellular carcinoma (HCC). In a typical case, the imaging-based diagnosis of HCC is simple: hypervascular in arterial phase and washout in portal-venous/delayed phase. However, we often encounter atypical cases: hypovascular HCCs. Gadoxetic acid has advantage in hepatobiliary phase imaging, which helps distinguish HCC from pre-malignant lesion. “Hypovascular hypointense nodule in gadoxetic acid-enhanced MRI” is a new concept observed in cirrhotic patients, which suggests early HCC and develop hypervascular (typical) HCC subsequently. In this lecture, I will cover hypovascular HCCs with a special emphasis on “hypovascular hypointense nodule”.
Utaroh Motosugi

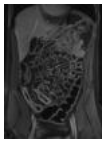
Weekend Course

An Update on Body MRI Protocols & Applications: Gastrointestinal

*Organizers:*Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 11:00 - 12:00 *Moderators:*Suraj Serai

11:00 MR Enterography



Jordi Rimola

11:30 Rectal CA Staging

Highlights · Use of MRI for rectal carcinoma staging and learn the clinical and therapeutic implications of rectal carcinoma

Target Audience: Radiologists and MRI technicians.

Objectives: Understand the anatomical and pathological basis for MRI rectal carcinoma staging and its impact on therapeutic options.

Methods: Basic anatomy and pathology of rectal carcinoma will be introduced followed by case examples.

Results: Participants will be able to understand the important anatomical and pathological MRI findings in rectal carcinoma.

Bertrand Ang

12:00 Lunch & Meet the Teachers

Weekend Course

Neuro 1: Stroke Triage

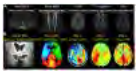
*Organizers:*Jonathan H. Gillard, M.D., FRCR, MBA, Jennifer A McNab, Ph.D. & Howard A Rowley, M.D.

Room 334-336 7:30 - 9:30 *Moderators:*Audrey Fan & Henk-Jan Mutsaerts

7:30 Stroke Triage: The Radiologist's Perspective

Acute ischemic stroke is a heterogeneous disease, with major stroke caused by proximal artery occlusions representing the stroke subtype with the most devastating outcomes. With the recent success of the endovascular clot retrieval trials for major stroke, the primary role of the radiologist to identify the patients suitable for treatment rapidly and accurately. The most common way to get this information is with non contrast CT, and CT angiography. In present clinical practice, time is dominant (<6hr) over physiology for decisions related to implementing therapy. There is evidence from the recent trials that it may be possible to extend the selection criteria to include a larger group of patients that will still benefit from IA therapy. However, this will require clinical trials to demonstrate that advanced imaging techniques to select these patients for treatment, leads to improved outcomes.
Patricia Desmond

8:15 Stroke Triage: The Physicist's Perspective



The overall goal of this presentation is to provide a summary of the major unmet clinical needs in stroke imaging and management from a physicist's perspective. Stroke imaging can broadly be considered in terms of (i) characterizing hemodynamic compensation mechanisms with the goal of stratifying treatments to prevent stroke, (ii) identifying viable tissue at risk for infarction in the setting of acute stroke, and (iii) evaluating chronic, post-stroke hemodynamic and neurochemical processes that may portend functional recovery.
Manus Donahue

9:00 Panel Discussion

9:30 Break & Meet the Teachers

Weekend Course

Neuro 1: Tumor Tutorial

*Organizers:*Jonathan H. Gillard, M.D., FRCR, MBA & Jennifer A. McNab, Ph.D.

Room 334-336 10:00 - 12:00 *Moderators:*Stephen Price & Yi-Fen Yen

10:00 Tumor Tutorial: The Radiologist's Perspective

Different aspect of the problems facing the radiologist when evaluating brain tumours and the possible support of advance MR imaging methods as well as new imaging biomarkers will be presented..
Pia Maly Sundgren

10:30 Tumor Tutorial: The Physicist's Perspective

This presentation will review selected new techniques and applications for the imaging of human brain tumors, from the point of view of the MR physicist. A particular emphasis will be on metabolic MR neuroimaging techniques, including chemical exchange saturation transfer methods. The challenges involved in developing a new MR imaging technique for clinical use in humans will be considered.
Peter Barker

11:00 Tumor Tutorial: The Neuro-Oncologist's Perspective

Tham Chee Kian

11:30 Discussion

12:00 Adjournment & Meet the Teachers

Weekend Course

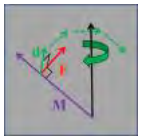
Physics for Physicists

*Organizers:*Thomas K. F. Foo, Ph.D. & N. Jon Shah, Ph.D.

Summit 1 8:30 - 17:30 *Moderators:*Seung-Kyun Lee & Ed Wu

8:30 MRI: The Classical Description

The NMR (Nuclear Magnetic Resonance) signal can be described classically by considering the motion of the net magnetisation (the vector sum of magnetic moments of individual nuclei). By considering individual isochromats – i.e. subsets of the spins that are behaving identically– we can visualise how the received



signal will decay away due to T_1, T_2 and T_2* relaxation. By additionally considering the effects of magnetic field gradients, we can spatially localise the signal, extending NMR to MRI (Magnetic Resonance Imaging). All these effects can be described by the Bloch equations, which give complete classical description of the behaviour of magnetisation.

Gareth Barker

9:00 MRI: A Systems Overview

• Basic understanding of how an MRI works can be achieved by comprehending its major functional subsystems.

• The subsystem currently experiencing the greatest innovation is RF transmission.

• Software defines the look and feel of the system and is the most important differentiator between systems.

Mark Ladd

9:30 Basic MR Safety (Magnetic Fields, Peripheral Nerve Stimulation, etc.)

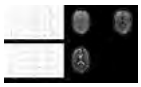
Magnetic resonance techniques are considered to be not harmful. The three electromagnetic fields used for MR - static magnetic field, switched gradient fields, and radio frequency field - do not result in irreversible changes of human tissue, as long as certain limits are not exceeded. However, the applied fields show effects, which may cause severe hazards for patients, staff, and material, if MR examinations are not performed properly.
Harald Kugel

10:00 Break & Meet the Teachers

10:30 Bloch Equations & Typical MRI Contrast

Nikolaus Weiskopf

11:00 Sequences and Simulations



This presentation will provide an overview of the main gradient echo based (gradient spoiled, RF spoiled and balanced steady state free precession) and conventional/fast spin echo based pulse sequences and will illustrate some methods by which their behaviour can be simulated
Martin Graves

11:30 Pulse Sequence Check: Reality vs. Ideal

The effect of any pulse sequence on the magnetization in an object can be predicted very accurately using the Bloch equation. A general algebraic inversion of the Bloch equation is not possible and thus, the full set of object and system properties and parameters cannot be derived from measurement data directly. Using a few assumptions and neglecting possible deviations, the contrast of a given pulse sequence can be calculated and the spatial encoding can be inverted to reconstruct an image.
Oliver Speck

12:00 Lunch & Meet the Teachers

13:30 Basics of an EPI Acquisition

Echo Planar Imaging (1), or EPI, is a prototype for pulse sequences that sample two dimensions of K-space after a single excitation. 2D scanning after a single excitation means that signal modulations unrelated to applied gradient fields, such as transverse relaxation and resonance offsets, distribute across two dimensions in k-space and image space. EPI is highly demanding of gradient performance and fidelity. Gradient hardware advances have enabled the implementation of EPI, and continue to improve the utility and robustness of EPI. There are complex tradeoffs involved in the design of EPI pulse sequences and selection of EPI parameters with regard to gradient performance, SNR, image artifacts, ramp sampling, and other pulse sequence features.
Eric Wong

14:00 EPI Applications: What we Can See Using EPI as an Engine

Introduction to the uses of EPI as an acquisition 'engine' in advanced structural and functional pulse sequences · Overview of the principles of functional MRI, arterial spin labelling, diffusion imaging and chemical exchange saturation transfer imaging. · Description of the pulse sequence modules required to achieve these image contrasts. · Summary of the different flavours of each method, and the tricks required to minimize confounding artifacts.
Peter Jezzard

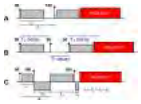
14:30 EPI Artifacts and Correections

Since its conception in 1977 echo planar imaging (EPI) remains famous for being a host of a variety of artefacts. Recent improvements in the gradient

technology and the availability of receiver arrays offset some of the problems, which however was quickly counterbalanced by a general trend of increasing the main magnetic field strength and a common demand of increasing spatial resolution. Therefore understanding the physics behind the EPI artefacts continues to be important, as it allows one both to compose optimal protocols minimizing the possible damage at source and devise suitable post-acquisition strategies for correcting remaining imperfections.
Maxim Zaitsev

15:00 Break & Meet the Teachers

15:30 Diffusion Weighted Imaging & Applications



Diffusion-weighted imaging (DWI) makes use of molecular water motion to probe tissue microstructure. This lecture will focus on the basic principles of DWI acquisition. After introducing the most commonly used diffusion modules, the main acquisition challenges will be discussed. Typical acquisition approaches will be presented, including single-shot and multi-shot sequences. Examples of frequent DWI image artefacts will be shown, and some of the approaches available for minimizing or correcting for their effect will be presented. The main applications of DWI to brain and body imaging will also be presented, focusing on stroke and lesion characterization.
Rita Nunes

16:00 Diffusion Tensor Imaging & Applications

The presentation will discuss, among others, the diffusion tensor model and diffusion indices, acquisition and data sampling strategies, validation of DTI and applications: tractography in neurosurgery, brain connectivity in vivo, gray matter structure and connectivity in fixed tissue.
Ana-Maria Oros-Peusquens

16:30 Beyond the Tensor Model

Diffusion tensor imaging (DTI) is widely employed to characterize diffusion anisotropy in multi-directional diffusion MR acquisitions. However, the DTI model has well-known limitations primarily because it assumes diffusion to be Gaussian. In this talk, DTI's limitations will be discussed for three cases: (i) the presence of orientational complexity, (ii) nonlinearity of the signal decay curves, and (iii) dependence on the timing parameters of the sequence. Several alternative approaches will be outlined and it will be argued that a cost-benefit analysis has to be performed before abandoning the diffusion tensor model.
Evren Ozarslan

17:00 q-Space: What is it?

In this lecture the concepts behind q-space and q-space imaging will be reviewed. Starting from an historical overview on the major advances, the development of the q-space formalism and the concept of the diffusion propagator will be described and used to explain the origin of diffraction peaks and their possible application to infer pore sizes and other microstructural features. Q-space and Propagator based imaging techniques will then be introduced highlighting advantages and limitations of these techniques. Finally, the use of diffusion time as an new contrast to probe microstructure at different length scales will be discussed.
Flavio Dell'Acqua

17:30 Adjournment & Meet the Teachers

Weekend Course

MR Systems Engineering

*Organizers:*Thomas K. F. Foo, Ph.D. & Simone A. Winkler, Ph.D.

Summit 2 8:30 - 17:00 *Moderators:*Ergin Atalar & Simone Winkler

8:30 MR Systems Overview

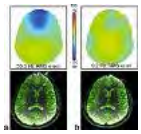
A general overview of the Magnetic Resonance Imaging (MRI) system design is presented with focus on main subsystems, their desired properties and impacts on imaging system performance.
Saban Kurucay

9:00 Magnet Design, Manufacturing & Installation

Johannes Van Oort

9:30 Shimming: Superconducting & Passive Shims; Higher Order Shims & Application to Imaging

Having a homogeneous magnetic field is an essential requirement to ensure high image quality in MRI. Significant field inhomogeneity can result in severe

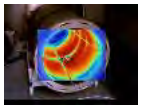


signal losses or geometric distortions. To achieve the desired uniformity, effective and efficient shimming strategies are needed. Specifically, passive and active shimming strategies have been developed to correct for both the intrinsic and extrinsic magnetic field inhomogeneities. Advantages and disadvantages of these various solutions are reviewed. In addition, specific applications in imaging experiments for some advanced shimming strategies are discussed, when the conventional shimming solutions are inadequate.

Trong-Kha Truong

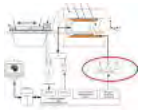
10:00 Break & Meet the Teachers

10:30 Coil Design Considerations, Manufacturing & Limitations



Improvements in resolution and speed in recent MRI scanner generations were only possible with the development of high-performant gradient systems. Present gradient technology allows gradient amplitudes of up to 80mT/m and slew rates of up to 200T/m/s simultaneously for conventional whole-body systems. Even higher amplitudes and slew rates are possible using dedicated coils and special gradient systems. In this talk we will describe gradient coil design methods including boundary conditions like available space, stray field, forces and vibration. We show limitations to the usage of the possible technical performance due to physiological conditions and other constraints. Several approaches are discussed how to overcome the different limitations.
Eva Eberlein

11:00 Gradient Drivers: Amplifier Considerations, Power, Tuning & Cooling



Gradient driver high capability is needed in the magnetic resonance imaging (MRI) for better image quality, better resolution and faster imaging. Imaging speed and SNR require increased PSD reproduction fidelity and higher power capability. Higher power has been possible with the change of implementation from linear amplifiers to much lower internal losses switched amplifiers. Switched amplifiers consist on a power stage combining multiple switching semiconductors, commanded with high performance digital control. The digital controller requires precise feedback control, gradient coil model and compensation of nonlinearities. The design has to consider efficiency for operation cost and practical thermal management.
Juan Sabate

11:30 Eddy current calibration, compensation and pre-emphasis; and gradient non linearity: Impact on application

Imperfections in applied gradient fields are manifest as deviation from ideal temporal waveforms and spatial nonlinearity. Eddy currents induced in conductive surfaces are mitigated to a great extent by pre-emphasis of gradient demand to compensate for known inductive loss thereby yielding near-ideal temporal waveforms. However, residual eddy currents do impact demanding applications and may still require post-acquisition software correction. Spatial non uniformity of applied gradient fields induce geometric distortions which are effectively removed via automatic 2D or 3D (un)warping, although there is residual bias in diffusion weighting. This lecture will focus on practical impact of these effects.
Thomas Chenevert

12:00 Lunch & Meet the Teachers

13:30 RF Transmit: Power Delivery, Decoupling, & Duty Cycle

J. Vaughan

14:00 RF Receivers: Signal Detection Chain, Digitization, System Noise Figures - from MRI Signal to Bits

This presentation provides an overview of the receive chain in an MRI scanner. Topics to be discussed are preamplifiers, device protection, analog to digital conversion, and high speed data links. Effort will in particular be placed on looking under the hood of basic ADCs to better understand how their performance limits MRI dynamic range. Finally we will look at the technology future of wireless MRI and local digital MRI receivers.
Greig Scott

14:30 Controlling the MR Subsystems: Pulse Sequence Control, Waveform Generation & Real-Time Control

J. Andrew Derbyshire

15:00 Multi-Modality Imaging in an MRI Scanner: Simultaneous Imaging & Therapy - Making the Systems Compatible

The use of MRI for treatment guidance is growing. The MRI linac is being developed for guidance of external beam radiotherapy. Linacs and MRI are not easily compatible, solutions will be described. The requirements and challenges of robotics for MRI guided brachytherapy will also be described.
Jan Lagendijk

15:30 Break & Meet the Teachers

16:00 Basic MR Safety, SAR & Power Deposition/Monitoring (Includes Effect of RF Coils & Ultra High Fields)

MR safety is an important topic for all users performing MR procedures on humans. In this presentation we want to limit us on the MR system safety without implants. The potential risk of MRI and the international standard which taking them into account will be presented. Further the topic of testing own RF coils will be discussed. In a last part the additional problems from multi transmit RF coils and their monitoring will be covered.
Roger Luechinger

16:30 Peripheral Nerve Stimulation, Implants & Devices: Safe Use & Considerations for MRI

Two of the main safety problems of MRI is discussed. First one is the safety concerns due to the gradient induced peripheral nerve stimulation. Current commercial MRI scanners have gradients which are capable of inducing electric field ın the body in a level that may cause sensation but fortunately this level is far from the possibility of causing harm. The second one is related to the safety of the patients who wear implantable medical devices. The radiofrequency pulses of MRI may induce currents on its leads. It is feared that this current may reach to a level that it can cause burns.
Ergin Atalar

17:00 Adjournment & Meet the Teachers

Weekend Course

Cardiac MRI: The Basic Principles & Applications

*Organizers:*Martin Graves Ph.D. & Jeanette Schulz-Menger M.D.

Nicoll 1 8:00 - 12:00 *Moderators:*Daniel Ennis & Jeanette Schulz-Menger

8:00 Key Clinical Cardiac MRI Concepts: How We Do It

Reza Nezafat

8:20 Key Clinical Cardiac MRI Applications: Where CMR Makes a Difference & Why

CMR has a key role in multiple clinical application where it provides unique and important information. This talk will discuss the role of CMR in a number of these applications including: evaluation of congenital heart disease, evaluation of cardiomyopathy, understanding the etiology of acute chest pain, the evaluation of cardiac masses, and the evaluation of pericardial disease. For each application, we will discuss the CMR techniques used and how and why CMR makes a difference.
Michael Salerno

8:40 Systolic Function

This course will provide an understanding of systolic function assessment using MRI that goes beyond left ventricular ejection fraction. We will delve in detail on strain quantification for regional myocardial function assessment. The attendee will be able to definition the meaning of strain and understand how to interpret the different components of strain. Each topic will include acquisition methods, post-processing and analysis methods. We will finally end with examples of a few applications of systolic function assessment from MRI.
Alistair Young

9:10 Diastolic Function

Diastolic dysfunction is a sensitive marker of cardiac disease and an important cause of heart failure. MRI offers a variety of possibilities for the diagnosis of diastolic dysfunction. MRI markers of diastolic dysfunction directly related to structural remodeling are increased left atrial sizes or left ventricular masses. Functional MR parameters of disturbed diastolic function include both altered mitral inflow curves and pulmonary vein flow curves as well as increased E/Ea values assessed by MR phase-contrast imaging. Furthermore, a comprehensive regional analysis of diastolic ventricular motion and deformation is enabled using MR Tagging, Tissue Phase Mapping or MR Feature Tracking. These methods also allow the assessment of single motion/deformation parameters such as untwist or long-axis strain-rate or velocities, as indicators of active relaxation.
Daniela Föll

9:40 Break & Meet the Teachers

10:00 Contrast Enhanced Perfusion At Rest & Stress

Sanjay Agrawal

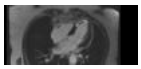
10:20 Dobutamine Stress Imaging

Sanjay Agrawal

10:40 Challenges & Limitations in Ischemia Imaging

Myocardial perfusion acquisitions have high sensitivity/specificity for the detection of ischemia though are challenged by motion, dark rim artifact, and issues with quantification. These issues are briefly addressed in this syllabus, with references to more of the work done in these areas.
Ed DiBella

11:00 Late Gadolinium Enhancement in Ischemic Heart Disease



Ulrich Kramer

11:20 Late Gadolinium Enhancement in Non-Ischemic Heart Disease

Victor Ferrari

11:40 Challenges & Limitations in Diffuse Fibrosis Imaging

Early detection of diffuse fibrosis in myocardium would offer the hope of treatment for reversing it before irreversible damage becomes evident from other symptoms. Currently there is no established early-stage clinical test for diffuse fibrosis except myocardial biopsy, but MRI may deliver this test. Most cardiac MRI of diffuse fibrosis is based on T1&ECV measurements. The T1 of myocardium and its response to Gad is therefore fundamental in understanding some limitations and is described first. Methods of cardiac T1 mapping are described with some of the issues affecting their accuracy and precision. Potential alternative diffuse fibrosis methods in MRI are mentioned briefly. Clinical research by MRI in diffuse fibrosis is plentiful as group studies, but for early-stage diffuse fibrosis assessment the scatter still defeats it. **Here is a challenge with a strong clinical call: improve MRI for individual patient diagnosis or monitoring of early changes in myocardial diffuse fibrosis.**
Peter Gatehouse

12:00 Adjournment & Meet the Teachers

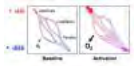
Weekend Course

Introduction to Functional MRI

*Organizers:*James Pekar, Ph.D. & Joshua Shimony, M.D., Ph.D.

Nicoll 2 8:00 - 11:30 *Moderators:*James Pekar & Joshua Shimony

8:00 The Physiological Basis of the fMRI Signal



While BOLD fMRI represents an invaluable tool to map brain function, it does not measure neural activity directly; rather, it reflects changes in blood oxygenation resulting from the relative balance between cerebral oxygen metabolism (through neural activity) and oxygen supply (through cerebral blood flow and volume). As such, there are cases in which BOLD signals might be dissociated from neural activity, leading to misleading results. The emphasis of this course is to develop a critical perspective for interpreting BOLD results, through a comprehensive consideration of BOLD's metabolic and vascular underpinnings.
Clarisse Mark

8:30 Data Acquisition Considerations

- EPI favors high bandwidth acquisitions to reduce susceptibility artifacts.
- fMRI acquisition methods critically depend on the targeted spatiotemporal resolution.
- The spatiotemporal resolution of fMRI can be optimized by a combination of k-space trajectory design, receiver coil array, and reconstruction algorithm.
- Sequences using spin-echo or gradient-echo, the echo time, and the flip angle can tune the sensitivity of fMRI acquisitions.
- Physiological noise is a dominant noise source in high-field fMRI experiments.
- Care must be taken to get the best shimming and to minimize motion as well as acoustic noise/vibration.

Fa-Hsuan Lin

9:00 Paradigm Design

A presention on fMRI paradigm design for students and researchers with no or limited experience in setting up BOLD fMRI studies in terms of paradigm (task) design
Jeroen Siero

9:30 Break & Meet the Teachers

10:00 Pre-Processing of fMRI Data

The target audience is researchers and clinicians with limited to no experience with fMRI imaging. As a result of this presentation the audience will know (i) what fMRI pre-processing is, and why it is important, (ii) the basic pre-processing steps and software packages available for implementing them, (iii) how to choose pre-processing steps for different data sets and experimental paradigms, and (iv) about recent developments in automated optimization of pre-processing of fMRI data.
Stephen Strother

10:30 Analyzing Data Using the General Linear Model

The general linear model (GLM) is the most common framework for analyzing task-based fMRI data. In this talk, we motivate its use from the precarious contrast-to-noise situation of fMRI, which requires not only modeling (or fitting) of experimental factors and confounds, but also statistical assessment of their significance in the presence of an irreducible noise floor. The presentation will feature analyses of simulated and measured fMRI data to highlight GLM parameter estimation as well as statistical inference (t-, F-tests) and its representation in Statistical Parametric Maps. Finally, limitations of the GLM and intricacies are discussed, e.g. correlated regressors or multiple comparison correction, to enable its proper use in practice.
Lars Kasper

11:00 Introduction to Resting-State fMRI & Functional Connectivity

In this education workshop, I will motivate the use of resting-state fMRI (rs-fMRI) and functional connectivity to study the human brain. I will also present example studies that use rs-fMRI as a tool to investigate brain organization, disorder and behavior. I will conclude with some existing challenges about rs-fMRI.
Thomas Yeo

11:30 Example Applications of fMRI in Basic & Clinical Neuroscience

Both task-based and resting-state fMRI have been widely used to understand the functional organization of the brain. Both techniques have also been applied in patients for guiding neurosurgery, distinguishing disease phenotypes, supporting clinical management, and evaluating treatment response. Nonetheless, several technical and pathophysiological issues will need to be considered for clinical fMRI.
Kai-Hsiang Chuang

12:00 Adjournment & Meet the Teachers

Weekend Course

Diffusion MRI Light

*Organizers:*Daniel C. Alexander, Ph.D., Chunlei Liu, Ph.D. & Stephan E. Maier, M.D., Ph.D.

Nicoll 3 8:30 - 12:00 *Moderators:*Chunlei Liu & Stephan Maier

8:30 Introduction to Diffusion Weighted Imaging

Diffusion MRI is a technique that can probe direction-dependent diffusivity of water molecules to reflect, on a statistical basis, the displacement distribution of the water molecules present within a MRI voxel. The observation of this displacement distribution may thus provide unique clues to the structure and geometric organization of tissues. Here, I will review the principle of diffusion MRI and its applications in neuroscience.
Ching-Po Lin

9:00 Diffusion Tensor Imaging & Higher Order Methods

In this lecture, we will explore the non-Gaussian diffusion signal as measured in biological tisues by varying both the gradient wave vector q and the diffusion time t, the time over which the molecules diffuse. The concepts of q-space imaging, diffusion tensor imaging (DTI) and diffusion kurtosis imaging (DKI) will be covered, as well as other higher order diffusion methods. In addition, we will illustrate how varying the diffusion time t provides complimentary information about microstructural length scales.
Els Fieremans

9:30 Probing Microstructure with Diffusion MRI

Diffusion MRI can be used to non-invasively quantify brain microstructure by using analysis methods and models more accurate than diffusion tensor imaging. Biophysical models of diffusion MRI describe the MR signal as originating from diffusion in distinct tissue components, such as the intra-axonal or extracellular space. Comparment sizes, e.g., the average axon diameter, can be estimated using diffusion MRI, provided that the size is above the resolution limit of the acquisition protocol. Orientation dispersion is essential to include in white matter diffusion models.
Markus Nilsson

10:00 Break & Meet the Teachers

10:15 Diffusion Tractography: Principles & Methods

The audience will learn the basic principles of diffusion tractography and be cautious of the limitations of current methods. In particular, the audience will learn the difference between Diffusion Tensor Imaging (DTI) and High Angular Resolution Diffusion Imaging (HARDI) tracotgraphy, from both a deterministic and probabilistic point of view.
Maxime Descoteaux

10:45 Applying Diffusion MRI in Population Studies

The talk will cover various aspects of processing and analysis of diffusion data, from the perspective of population studies. Specifically it will discuss connectome creation, connectomic analysis, automated tract extraction and biomarker creation. In addition to describing the protocol for cross-sectional studies, we will also discuss the extension of these methods to longitudinal studies. In addition to the description of methods, application to clinical populations will be presented.
Ragini Verma

11:15 Flip Charts - Meet the Experts

12:00 Adjournment & Meet the Teachers

Weekend Course

Molecular & Metabolic Imaging: Initial Clinical Experience with Molecular Imaging

*Organizers:*Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 300-302 13:30 - 17:00 *Moderators:*Guanshu Liu & Jannie Wijnen

13:30 Clinical Experience with Hyperpolarized MRI

Craig Malloy

14:00 Multiparametric "Molecular" MR Imaging

Various contrast mechanisms are available using MRI to emphasize specific molecular and cellular features of tissues that have applications in research and clinical management. These intrinsic mechanisms do not require exogenous agents and can be obtained on the same standard equipment as used for routine imaging.
John Gore

14:30 Metabolic Imaging with Spectroscopy

Combining metabolic imaging methods with spectroscopy methods allows for the appreciation of spatial patterns of physiology and metabolism and the complexities of normal and pathological physiology. A variety of approaches, including traditional spectroscopy, metabolic mapping, and indirect detection of metabolites, are available.
Bruce Damon

15:00 Break & Meet the Teachers

15:30 Cell Labeling & Tracking

This educational session will describe how MRI can be used to detect cells in preclinical models and clinical scenarios. Contrast agent selection and use will be covered, as will MRI acquisition and data analysis methods.
Erik Shapiro

16:00 MR Molecular Imaging Biomarkers in Pharmaceutical Applications

The rapid shift to targeted and personalized therapies by the pharmaceutical industry has led to increasing need for specific and predictive biomarkers of therapeutic response [1]. Imaging methods including MRI provide many approaches to the use of biomarkers that are importantly non-invasive, translational and spatially resolved. Many MRI based molecular biomarkers have been, and continue to be used by the pharmaceutical industry [2-5], though use and related success has been modest so far. A number of new MR Molecular Imaging applications many associated with imaging agents [6], highlight new promise for clinical biomarkers that can be used reliably for state of the art molecular targets and therapeutic paradigms currently in discovery and soon to be in clinical trials. This course presentation will outline the way the pharmaceutical industry integrates, uses and needs biomarkers and how MRI biomarkers and new molecular imaging assays fit this need. Reference to prevalence of MRI biomarkers in pharmaceutical literature and clinical trials will be provided. A number of the latest and most promising areas for MRI pharmaceutical applications will be described.

Patrick McConville

16:30 Clinical Translation of MR Molecular Imaging

This presentation will discuss the advantages and clinical applications of MR molecular imaging, the path and challenges for clinical translation, factors affecting the clinical translation, design considerations of clinically translatable MR molecular imaging technology, examples and recent progress of promising MR molecular imaging technologies.
Zheng-Rong Lu

17:00 Adjourment & Meet the Teachers

Weekend Course

An Update on Body MRI Protocols & Applications: Pelvis MRI

*Organizers:*Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 13:30 - 15:00 *Moderators:*Vikas Gulani

13:30 Uterus: Benign Disease

Tracy Jaffe

14:00 Uterus: Malignant Disease

This presentation will highlight the value of MRI for risk-stratification and appropriate treatment selection in patients with new diagnosis of endometrial and cervical cancer. It will also illustrate the central role of MRI prior to fertility sparing treatments in patients with endometrial and cervical cancer, respectively. At the end of the presentation, the attendees will be able to recognize and report clinically pertinent imaging findings when evaluating patients with new diagnosis of endometrial or cervical cancer. This information is important for the radiologist to serve as an effective consultant to the referring physician.
Yulia Lakhman

14:30 Adnexal Masses

MR imaging of adnexal masses can optimally characterise lesions aiding treatment selection. This talk aims to discuss typical and unusual imaging appearances to guide the radiologist with discussion of imaging algorithms and clinical case discussion.
Helen Addley

15:00 Break & Meet the Teachers

Weekend Course

An Update on Body MRI Protocols & Applications: Genitourinary MRI

*Organizers:*Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 15:30 - 16:30 *Moderators:*Vikas Gulani

15:30 Adrenal & Renal MRI

The role of radiologist and imaging is evolving from traditional role of identifying renal lesion and detecting enhancement, to predicting aggressiveness and biology of the renal tumor as well as providing operative guidance. MR imaging can play a very important role not only as a problem solving tool but also as a 'first-line' examination for assessment of renal tumors. Additional information garnered from MRI has a potential to significantly impact management by guiding therapeutic decisions.
Hersh Chandarana

16:00 MR Urography & Bladder CA Staging

Urothelial cancer is the most common malignancy of the urinary tract. Most patients present with hematuria and undergo initial imaging with CT and/or ultrasound for the assessment of potential etiologies of this symptom. A cystoscopy and biopsy are necessary to confirm the diagnosis of bladder cancer. The potential role of MRI is to triage patients to different forms of treatment according to the cancer's stage.
Hebert Alberto Vargas

16:30 Adjourment & Meet the Teachers

Weekend Course

Neuro 1: Head & Neck

*Organizers:*Jonathan H. Gillard, M.D., FRCR, MBA & Jennifer A. McNab, Ph.D.

Room 334-336 | 13:30 - 15:30 | *Moderators:*Priti Balchandani & Jennifer McNab

13:30 Head & Neck: The Surgeon's Perspective

Thomas Loh Kwok Seng

14:00 Head & Neck: The Radiologist's Perspective

Eric Ting

14:30 Head and Neck: MRI of Laryngeal and Hypopharyngeal Cancers

Laryngeal and hypopharyngeal cancers have traditionally been staged using CT. These areas have previously been difficult to assess with MRI, given the small structures and prohibitive imaging times. However, with improvements in both hardware and software, thin slice MR images of these areas can now be performed within a reasonable amount of time, with superior soft tissue resolution compared to CT. This allows identification of important features that affect management decisions and help direct treatment, even in recurrent disease. MRI has now become a powerful tool in the management of these neoplasms.
Julian Goh

15:00 Discussion

15:30 Break & Meet the Teachers

Weekend Course

Neuro 1: Neonate

*Organizers:*Jonathan H. Gillard, M.D., FRCR, MBA & Jennifer A. McNab, Ph.D.

Room 334-336 | 16:00 - 18:00 | *Moderators:*Robert Mckinstry

16:00 Neonate: The Neonatologist's Perspective "Preterm newborns: How imaging contributes to the understanding of the preterm infants neurodevelopmental outcome"

This educational presentation will summarize the imaging tools to study the brain of preterm infants, detect brain injury and predict neurodevelopment outcome
Petra Hüppi

16:30 Neonate: The Physicist's Perspective

Simon Warfield

17:00 Term newborns: How imaging contributes to the understanding of the development of brain injury after birth asphyxia

Term newborns are at risk to develop brain injury. Magnetic resonance imaging has permitted to better understand how brain injury develops despite standard available treatments. The use of magnetic resonance imaging has also given clues of which newborns would benefit from additional treatments, and indications for possible alternative treatments. However, magnetic resonance imaging in these newborns remains challenging, and must imperatively be improved to allow further detection and treatment. This education session will cover the advantages and limitations of magnetic resonance imaging in term newborns.
Pia Wintermark

17:30 Discussion

18:00 Adjournment & Meet the Teachers

Weekend Course

Cardiovascular MRI: Vascular Flow & Angiography

*Organizers:*Daniel Ennis, Ph.D. & Harald Kramer, M.D.

Nicoll 1 | 14:00 - 17:30 | *Moderators:*Martin Graves & Harald Kramer

14:00 Contrast & Non-contrast Enhanced Methods - Technical Perspectives

Both contrast enhanced (CE) and non-contrast enhanced (NCE) MRA techniques are introduced. In CE-MRA, developing trends including bolus timing estimation, temporal and spatial resolution improvement, and low dose gadolinium (Gd) MRA are revisited. In NCE-MRA, recent developments, including inflow, flow-dependent, and spin labeling techniques are introduced. Clinical applications of these NCE-MRA techniques are also demonstrated.

Mitsue Miyazaki

14:30 Contrast & Non-contrast Enhanced Methods - Clinical Applications

This presentation will demonstrate the technical and clinical applications of contrast enhanced and non-contrast magnetic resonance angiography (MRA). MRA is routinely used to evaluate the vasculature in a non–invasive fashion. Contrast enhanced MRA can be implemented as a conventional timed flow arrest protocol or as time resolved dynamic imaging. The technical aspects of both of these approaches will be described in detail. Several different Gadolinium based contrast agents are routinely used for CEMRA including both extracellular and blood pool agents. Methods for optimal utilization of contrast agents for MRA will be described. Because of the risk of NSF with gadolinium use in patients with renal failure, there has been renewed interest in non contrast MRA techniques. Several of these NCMRA approaches will be discussed. Through a series of case presentations, this talk will attempt to illustrate the optimal use of all of these techniques in clinical practice. At the end of this lecture, attendees should understand the basic technical principles for CEMRA and NCMRA and will also be more familiar with the appropriate clinical indications for using these techniques.

James Carr

15:00 Break & Meet the Teachers

15:15 Definition of Terms: Static & Dynamic CE-MRA & 2D/4D Flow

Over the last decades, many methodological advances have been introduced to expand the capabilities of anatomical and functional MRA beyond the basic MR acquisition principles. These innovations provide new opportunities and challenges. Here we will review several key concepts with a special focus on their terminology, protocol choices available to the clinical and research user, and implications on the resulting images in the context of contrast-enhanced MRA and flow MRI.

Oliver Wieben

15:45 Practical Challenges of MRA & Flow

MRA and phase contrast flow measurements involve the measurement of moving bodies, specifically blood (or in some cases CSF). Motion will produces artifact in MR images. While some of these artifacts are advantageous for the purpose of MRA (TOF) and flow images, unanticipated motion will degrade the quality of the exam. This educational section will discuss the practical considerations and challenges when protocolling MRA and flow measurements.

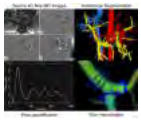
Alex Barker

16:15 Break & Meet the Teachers

16:30 Clinical Applications of MRA

Winfried Willinek

17:00 Clinical Applications of 2D & 4D Flow



Conventional flow-sensitive magnetic resonance imaging (MRI) using two-dimensional (2D) slice selection, cardiac gating, and phase contrast (PC) velocity encoding in one direction is an excellent quantitative alternative to measure blood flow in different vascular territories. Recent advances allow for the acquisition of MRI data sets with three-directional velocity encoding over a 3D volume throughout the cardiac cycle in clinically feasible scan times of 20 minutes and less. This presentation will discuss clinical applications of 2D and 4D flow MRI.

Alejandro Roldan-Alzate

17:30 Adjournment & Meet the Teachers

Weekend Course

Advanced fMRI: Techniques & Applications

*Organizers:*Jay J. Pillai, M.D. & Jonathan R. Polimeni, Ph.D.

Nicoll 2 13:30 - 17:20 *Moderators:*Jay Pillai & Jonathan Polimeni

13:30 Dynamic Functional Connectivity

Dynamic functional connectivity (dFC) uses region-of-interest or data driven methods to elucidate temporally-varying changes in resting-state brain networks. Challenges are the lack of a gold standard for dFC, the difficulty in discriminating signal from non-neurally generated BOLD fluctuations, and the tradeoffs between temporal resolution of the neural dynamics and the statistical significance of the resulting networks. This talk will describe the methods and pitfalls to be avoided in applying these techniques, as well as results that correlate with independently acquired measures of behavior and psychometrics.
Gary Glover

14:05 Network Analysis

Figure 1. Figure illustrates common graph metrics in connectomics (described in the text).
Martijn van den Heuvel

14:40 Clinical Applications of Functional Connectivity

Steven Stufflebeam

15:15 Break & Meet the Teachers

15:50 Calibrated BOLD fMRI

Calibrated fMRI techniques are used to extract the oxidative metabolism component from the BOLD signal measured in response to a task. Oxidative metabolism is isolated by first estimating the vascular component of the BOLD response through a calibration manipulation and a biophysical model. Various calibration methods have been proposed using mild hypercapnia, hyperoxia, or a combination of the two. Extensions of these techniques now allow measurement of baseline oxidative metabolism. This course will allow fMRI users to learn about calibrated fMRI and how it can be used to obtain quantitative measures of brain activity and resting metabolism.
Claudine Gauthier

16:25 Multi-Band EPI Applications to fMRI

Multi-band EPI is becoming a standard acquisition scheme for functional MRI. Here we will evaluate how multi-band acceleration benefits fMRI. We will address how accelerating to increase temporal resolution leads to de-aliasing of nuisance physiological signals and supports resolving complex BOLD activity. In accelerating to increase spatial resolution, we will consider temporal signal-to-noise ratio losses due to high resolution, and how multi-band compensates through imaging more volumes. We will assess multi-band multi-echo fMRI, which incorporates T2* relaxometric techniques for susceptibility artifact compensation and thermal noise reduction. Lastly, we will review the multi-band EPI configuration of the Human Connectome Project and clinical translatability of its multi-band approach.
Prantik Kundu

17:00 Adjournment & Meet the Teachers

Weekend Course

Diffusion MRI Applied

*Organizers:*Daniel C. Alexander, Ph.D., Chunlei Liu, Ph.D. & Stephan E. Maier, M.D., Ph.D.

Nicoll 3 13:30 - 18:00 *Moderators:*Els Fieremans & Stephan Maier

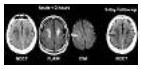
13:30 Diffusion MRI of Neurodevelopment

Pratik Mukherjee

13:55 Diffusion MRI of Aging & Neurodegeneration

Diffusion MRI can provide not only parametric and but also directional information, which quantify white matter fiber integrity and cellular density as well as neural connectivity between nodes in the brain. In this talk, we will give the audience how to preprocess imaging data, for example, distortion and bias correction. Then, we will show several results for parametric analyses and structural connectivity measured by diffusion MRI in normal aging and neurodegenerative disorders.
Osamu Abe

14:20 Diffusion MRI of Stroke



Stroke is the second leading cause of death world-wide. Diffusion-weighted MRI (DWI) is very sensitive to early acute ischemic injury, with mean diffusivity reduced in the hyperacute stage, but elevated in the chronic stages. In addition, DWI can potentially be combined with other MRI sequences to stage extent of ischemic injury and identify potentially salvageable tissue. Diffusion-tensor MRI and high angular resolution diffusion MRI techniques can be used to evaluate ultrastructural injury post-stroke. DWI has been shown to critical for improving the diagnosis, prognosis and management of acute ischemic stroke patients and for monitoring post-stroke recovery.
Ona Wu

14:45 Diffusion MRI of Psychiatric Disorders

Diffusion MRI has proven to be a very popular brain imaging technique for the study of psychiatric disorders. In schizophrenia alone, there are 570 publications that use diffusion tensor imaging. Diffusion MRI data has been used in many ways including: assessment of white matter integrity, tractography and structural connectivity analyses. Many different analytic approaches have been developed. Like other MR modalities, diffusion MRI is also subject to artifacts from multiple sources which can result in erroneous values. Diffusion models, other than the tensor model, are beginning to become popular as fast imaging techniques make them more feasible for clinical populations.
Kelvin Lim

15:10 Diffusion MRI in Forensic Medicine

Educational lecture on Diffusion MR Imaging in forensic medicine and research.
Kathrin Yen

15:35 Break & Meet the Teachers

16:00 Water Diffusion Characteristics of Tumors

Thomas Chenevert

16:25 Diffusion MRI of Brain Tumors

The presentation will provide the diagnostic tips of brain tumors and tumefactive lesions by using DWI and ADC.
Fumiyuki Yamasaki

16:50 Diffusion MRI of Tumors Outside the Brain

Taro Takahara

17:15 Musculoskeletal Applications of Diffusion MRI

In this educational contribution the use of diffusion-tensor (DT-) MRI muscle fiber tracking for studying muscle architectural properties will be discussed. Topics include the importance of muscle structure to muscle function, how muscle architecture is typically assessed, and DT-MRI and its application to muscle. Examples will be given of how DT-MRI data have been used to provide new insights into muscle function, and lastly, important future research directions will be highlighted.
Gustav Strijkers

17:40 Adjournment & Meet the Teachers

Sunday, May 8, 2016

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Weekend Course

Clinical Cancer MRI: Case-Based: Guidelines & Reporting Standards

*Organizers:*Linda Moy, M.D. & Valeria Panebianco, M.D.

Room 300-302 8:15 - 17:15 *Moderators:*Linda Moy & Valeria Panebianco

8:15 MRI Interpretation of Liver Nodules in Cirrhosis — A Standardized Approach Using LI-RADS

This case-based lecture will briefly review basic LI-RADS concepts and then illustrate the use of LI-RADS to categorize liver observations.
Claude Sirlin

8:45 DWI for diagnosis of breast cancer

There are already several established advantages of using DWI to diagnose breast cancer. Standardization and improvement of technology should be made to expand the clinical application of DWI in the future.
Naoko Mori

9:15 Synopsis of the PI-RADS v2 Guidelines for Multiparametric Prostate Magnetic Resonance Imaging and Recommendations for Use*

This presentation provides a short description of PI-RADS v2. It provides discussion of some of the key differences and improvements comparedwith PI-RADS v1 and is focussed on the assessment criteria for detection and diagnosis of significant PCa on mpMRI examinations and clinical uses and limitations.
Jelle Barentsz

9:45 Roundtable

10:00 Break & Meet the Teachers

Weekend Course

Clinical Cancer MRI: Case-Based: Addressing Clinical Needs

*Organizers:*Linda Moy, M.D. & Valeria Panebianco, M.D.

Room 300-302 10:15 - 12:00 *Moderators:*Linda Moy & Valeria Panebianco

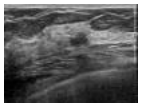
10:15 Overdiagnosis & Over Treatment

Overdiagnosis is an important issue in oncologic radiology. Avoiding diagnosis of disease altogether in order to avoid overdiagnosis is, however, probably not the best solution to the problem. Choosing appropriate Treatment based on Imaging as well as proteomic and genomic Information is probably more useful. Moreover, overdiagnosis is not the most important concern of current Screening programs - rather, under-diagnosis is. MRI is probably the best method to avoid both, over- as well as underdiagnosis
Christiane Kuhl

10:45 Tumour Recurrance & Pseudo-Progression in Glioma

Alberto Bizzi

11:15 Finding Cancer in the Dense Breast: Ultrasound & MRI



Features of undiagnosed breast cancers on prior screening US and screening MRI of patients with breast cancers diagnosed on subsequent screening examinations will be presented.
Nariya Cho

11:45 Roundtable

12:00 Lunch & Meet the Teachers

Weekend Course

Preclinical Imaging

*Organizers:*Peter Caravan, Ph.D., Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 324-326 8:30 - 16:15 *Moderators:*Yen-Yu Ian Shih & Kai Zhong

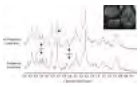
8:30 MR Physics for Preclinical Imaging

Magnetic resonance imaging (MRI) is a powerful and versatile modality for preclinical studies. A particular strength of MRI is the wide variety of different image “contrasts”, many of which do not involve use of external contrast agents, that are available in imaging studies. These contrasts derive from the rich physics associated with the interaction of nuclear spins with external magnetic fields. This talk will provide an introduction to these physical principles. The presentation will be didactic in nature, with an emphasis on principles and insights, rather than equations and mathematics.
Joel Garbow

9:00 Technical Aspects for Performing Small Animal MRI

Among the imaging modalities commonly encountered in small animal imaging, MRI is arguably the most versatile imaging modality because of the rich tissue contrasts it provides. In designing and implementing small animal MRI studies, there are several technical aspects, mainly related to the unique anatomy and physiology of small animals, that need to be considered, including but not limited to: pros and cons of in vivo and ex vivo MRI; imaging resolution and speed; and image contrasts. Instead of providing a one-size-fit-all solution, this course tries to provide a general guide for people interested in this topic.
Jiangyang Zhang

9:30 Technical Aspects for Performing Small Animal MRS & MRSI



Neurochemical profiling of rat or mouse brain by MRS and MRSI requires optimization of many steps. Despite a strong magnetic field and the latest RF coil technology available, the spectral quality obtained might not be as expected. This presentation will give an overview of other factors that could be considered to achieve a consistent high quality spectroscopic dataset.
René in 't Zandt

10:00 Break & Meet the Teachers

10:30 Advantages & Disadvantages of Low Field MRI for Animal Molecular Imaging

MRI imaging provides very high spatial resolution and is very adept at morphological imaging and functional imaging (Molecular imaging, 2016). MRI imaging is non-invasive, making it possible for repetitive observations. Field strength is an important factor in selecting an MRI system for Animal Molecular imaging. The purpose of this talk is to explicate the important role of MRI for animal molecular imaging, the characterization of MRI imaging field strength, advantages and disadvantages of low field MRI for animal molecular imaging, the types of magnet technologies for low field preclinical MRI, and the strength and weakness of MRI systems using different magnet technologies. An understanding of both the advantages and disadvantages of different field strength choices and different magnet technologies is beneficial in determining a threshold of performance where going higher in field strength yields diminishing results for animal molecular imaging. Going through this exercise and determining that threshold will result in an optimum choice of MRI field strength for animal molecular imaging. Although High Field MRI (above 4.7T) has advantages for neurobiology applications, Low Field MRI for animal molecular imaging (1.5T to 4.7T) can provide more than adequate performance for most applications and can offer the benefits of lower cost, significantly easier siting, and remarkably low maintenance.
Vera Zhang

11:00 Maintaining Animal Physiology

MRI of small rodents requires a longer data acquisition than human subjects due to the small anatomic structures requiring high image resolution with high SNR. Thus, maintenance of animal physiology throughout the study plays a crucial role in a successful small animal MRI study. Among all physiological parameters, core temperature and physiological respiration is the most critically important. Avoiding non-physiological respiration due to hypothermia and inappropriate physical restraints will reduce animal stress and mortality. Examples of how this can be achieved in a typical small animal scanner will be described.
Sheng-Kwei Song

11:30 Data Processing

Experimental magnetic resonance imaging is a powerful tool in biomedical research that can provide unique insight into the structure, function, and composition of tissue *in vivo*. MRI data and associated analyses range in complexity and may be comprised of multiple sets of software tools and processes. In this lecture, we will survey common approaches to processing MRI data, and tools and practices that facilitate the integration and use of experimental MRI in routine biomedical research.
James Bankson

12:00 Lunch & Meet the Teachers

13:30 Ex vivo MRI – Beyond Rodents

Over the past few decades, the use of ex vivo MRI has become widespread. This phenomenon was largely driven by the early development of various mammalian 'brain atlases' for neuroscientific applications as well as the need to characterize metabolism and other pathways in cells, isolated organs and cancer models. These early studies set the stage for more unconventional applications of ex vivo MRI. Recent advances in MRI hardware, RF coil design, pulse sequence design, image processing and visualization software, the availability of complementary modalities such as optical and micro-CT imaging, and affordable computational power have driven a slew of new applications of ex vivo MRI. Therefore, recent applications of ex vivo MRI that are 'off the beaten path', or 'beyond rodents' are the focus of this lecture.
Arvind Pathak

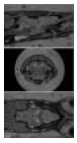
14:00 MRI of Standard Large Animals

Large animal models are frequently used to develop new MRI pulse sequences, devices, or drug therapies. In addition, MRI and MRS studies in large animals can aid with the mechanistic understanding of many diseases. Recently, the use of spontaneous disease models in pets has been gaining traction for rapid translation from bench to bedside. Tricks and tips for both MRI in both traditional laboratory large animal and pets will be discussed.

Dara Kraitchman

14:30 Break & Meet the Teachers

14:45 Exciting and Relaxing Fish



Exciting and relaxing fish. A detailed session on the methods and pitfalls of MRI of fish. The session covers, preparation, imaging and post-processing of fish MRI.

Andrew Janke

15:15 MRI of Unusual Animals

Preclinical research relies heavily on the use of traditional research animals which are well-characterized and share our mammalian ancestry. However, in some cases there exist untraditional research animals that are more suited to study specific preclinical questions. This is formulated in the August Krogh Principle: "For a large number of problems there will be some animal of choice or a few such animals on which it can be most conveniently studied". This applies to a number of MRI experiments in which the use of unusual animal models is justified because of certain capabilities that cannot be mimicked in traditional models.
Henrik Lauridsen

15:45 Adjourment & Meet the Teachers

Weekend Course

Challenges in Imaging the Musculoskeletal System After Treatment

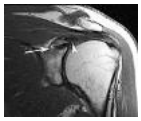
*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Room 331-332 8:00 - 15:30 *Moderators:*Laura Bancroft & Jenny Bencardino

8:00 MR Imaging After Rotator Cuff Repair

Radiologists should understand and pay great degree of attention on the technical aspects of the operation, such as anchor types, suture patterns, suture materials, and instruments as well as expected and abnormal MR findings when read the post-operative MRI after rotator cuff repair surgery.
Young Cheol Yoon

8:30 Imaging Following Shoulder Instability Surgery



Imaging following shoulder instability surgery depends on suspected pathology. Direct anatomic repair of labral tears may be perfomed in conjunction with capsular shift. There should be no separation of the labrocapsular complex and glenoid margin with intact labral repair. Overall accuracy of MR arthrography for detecting labral tears after prior instability repair is > 90%. Arthroscopic Bankart repair may be performed in conjunction with remplissage procedure in patients with engaging Hill-Sachs lesion. MRI will show reattachment of posterior structures into the defect, along with anchor embedded in the trough. Postoperative imaging of Laterjet procedure must assess incorporation of the bone block and any recurrent imaging features of instability.
Laura Bancroft, MD

9:00 MRI of the Postoperative Elbow

Hollis Potter, MD

9:30 Post Treatment Wrist

Shadpour Demehri

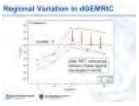
10:00 Break & Meet the Teachers

10:30 Imaging Following Cartilage Repair

Michael Recht

11:00 Postoperative Hip: FAI & Dysplasia

dGEMRIC is a biochemical imaging technique that can assess the charge density of cartilage. Cartilage can respond to increased mechanical loading by



increasing charge density. In acetabular dysplasia, there is increased mechanical load due to the shallow acetabulum, which will normalize after pelvic osteotomy. Prospective monitoring of the hip cartilage before and after osteotomy using dGEMRIC demonstrates that cartilage responds appropriately to alterations in hip mechanics after osteotomy for dysplastic hips.
Young-Jo Kim

11:30 Entrapment Neuropathies of the Pelvis Following Surgery

Entrapment neuropathies of the pelvis following surgery are rare but important causes for a negative outcome or complications after surgery.
Gustav Andreisek

12:00 Lunch & Meet the Teachers

13:30 Postoperative Ankle

James Linklater

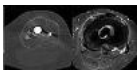
14:00 Postoperative Knee: Menisci

In this lecture, the meniscal anatomy and the important role the meniscus plays in the structure and function of the knee will reviewed, followed by a discussion of the three surgical strategies for operative treatment of meniscal tears (resection, repair, and replacement). MR protocol choices for postoperative assessment of the meniscus will be presented as well as normal and abnormal MR imaging findings in the postoperative meniscus after each of the different surgical procedures.
Edwin Oei

14:30 Postoperative Knee: Ligaments

James Griffith

15:00 Postoperative Knee: Total Knee Replacement



The purpose of this presentation is to provide an overview of the possibilities and restrictions of todays MARS MR imaging techniques in patients after total knee replacement. After following this presentation, the learners will understand the major clinical problems faced by orthopedists after total knee replacement, how MR imaging can contribute in these situations and where the limitations of today's technical possibilities are in a clinical setting.

Florian Buck

15:30 Adjournment & Meet the Teachers

Weekend Course

Neuro 2: Spine & Plexus

Organizers: Toshiaki Taoka, M.D., Ph.D. & Kelvin Lim, MD

Room 334-336 7:30 - 9:30 *Moderators:*Alex MacKay

7:30 Advanced Mutimodal Imaging of the Spine

The role of diffusion weighted imaging has expanded beyond the brain to whole body applications. This presentation will explore the contribution of DWI in the routine evaluation of spinal conditions focusing on its role in the detection, characterization and surveillance of neoplastic, degenerative and infectious diseases. MR spectroscopy has the power to delineate the chemical signature of tissues in health and disease. Research suggests detection of key MRS biomarkers may have a role analogous to provocative discography in identification of the painful disc. This presentation will cover the key findings in the painful disc and review the research work done to date.
Lawrence Tanenbaum

8:00 Plexopathy

Review of the anatomy of the brachial plexus and lumbosacral plexus and the pathologies resulting in plexopathy and their imaging characteristics.
Cynthia Chin

8:30 New Imaging Techniques for Spine & Plexus

While multi-parametric MRI (mpMRI, which includes functional MRI, diffusion tensor imaging, etc.) has become popular for brain imaging, it is still difficult to

apply these techniques to the spine because of complex issues related to acquisition and processing of the data. In this review we will examine several key aspects of mpMRI in the spine, namely: hardware, pulse sequences and image processing techniques – discussing their present status, unresolved issues, and future directions.
Julien Cohen-Adad

9:00 Discussion

9:30 Break & Meet the Teachers

Weekend Course

Neuro 2: Pediatric

*Organizers:*Kelvin Lim, M.D. & Toshiaki Taoka, M.D., Ph.D.

Room 334-336 10:00 - 12:00 *Moderators:*Suchandrima Banerjee

10:00 Malformations of Cortical Development

This lecture presents an update on the genetics, signaling pathways and abnormal microstructure that lead to malformations of cortical development. The organization of this talk is one framework for moving beyond description of the phenotype to a mechanistic understanding of cortical malformations.
Robert McKinstry

10:30 Pediatric: Tumours

Pediatric brain tumors are a leading cause of cancer-related death in children. In recent years, new technologies of molecular and genetic analysis of pediatric brain tumors have provided abundance of biological information. This has resulted in refining tumor classification into subgroups with potential clinical implications and treatment. This lecture demonstrates imaging findings and pathology of pediatric brain tumors and associated genetic syndromes, and an overview of recent developments in molecular biology and genetics. This knowledge is important for the diagnosis, management and future treatment of pediatric brain tumors as well as guiding future research.
Toshio Moritani

11:00 Perinatal Brain Injury & Mimics

P. Ellen Grant

11:30 Discussion

12:00 Lunch & Meet the Teachers

Weekend Course

RF Engineering: Coils

*Organizers:*Nicola F. De Zanche, Ph.D. & Graham C. Wiggins, D.Phil.

Summit 1 8:30 - 16:45 *Moderators:*John Andrew Derbyshire & Graham Wiggins

8:30 Basics of Transmission Lines & Power Transfer

Fundamentals of transmission lines and power transfer are presented to help in the understanding, design, implementation and performance evaluation of MRI hardware.
Natalia Gudino

9:00 Volume & Surface Coils

Highlights: RF coils are an essential part of a MRI system to excite and receive MR signals. Their performance is very important for the quality of MR imaging.

· Volume coils provide relatively uniform sensitivity over a large volume.

· Surface coils are designed to maximize SNR and enable parallel imaging

· Volume coils and surface coils usually work together in the RF system to optimize the RF excitation and reception performances at the same time

· Decoupling technologies are needed in the design to minimize coupling between transmit and receive coil elements

Bei Zhang

9:30 Multi-Tuned Coils

Dual-tuned coils provide metabolic information (x-nuclei module) and co-registered anatomical images and B0 shim settings (1H module) and without repositioning the subject or coil. X-nuclei signal strength is typically less than 1/1,000× that of 1H (1). Therefore it is important to maximize x-nuclei receive sensitivity while simultaneously providing adequate 1H sensitivity. We will discuss prevalent dual-tuning techniques and considerations for performance characterization and interfacing dual-tuned coils.
Ryan Brown

10:00 Break & Meet the Teachers

10:30 Receive Arrays & Circuitry

Boris Keil

11:00 Transmit Arrays & Circuitry

Transmit arrays enable finer RF driving over the RF field distribution in exciting the MR signals.

In this session the following issues will be introduced.

- Transmit Arrays

- Decoupling and Matching/Tuning Techniques for Multi-element coil

- Individually Driven Coil Element

- SAR and Tissue Heating

Yeun Chul Ryu

11:30 RF Modelling

RF modelling is now routinely performed in the design and analysis of MRI RF systems. This talk shares insights into technical details of implementing the most popular numerical electromagnetic (EM) methods. In particular, hybrid full-wave EM methods and parallel computing are highlighted, which creates a powerful theoretical prototyping platform for the design of novel RF coil systems. It is hoped that this talk can aid those who intend to implement demanding computational experiments for the research and development of RF coil designs for high-field MRI applications.
Feng Liu

12:00 Lunch & Meet the Teachers

14:00 Dielectric Materials & Resonators

This session explains the source of dielectric effects in MRI. It is furthermore explained how the dielectric effects can be used to improve image and spectra quality.
Sebastian Aussenhofer

14:30 Dipoles & Traveling Waves

NMR and MRI signal detection is traditionally based on Faraday induction. The local magnetic moment produced by the nuclear spins is thereby excited and detected by near-field magnetic interaction with the coil. However, the basic physical regime governing the electrodynamics of the RF detector alters at ultra-high frequencies and therefore the instruments applied in these systems have to cope with a different situation than at lower field strengths. The emergence of field propagation phenomena and radiation allows and necessitates the application of new RF topologies that are not only targeted at producing and detecting magnetic fields in their reactive near field.
David Brunner

15:00 Break & Meet the Teachers

15:30 Construction of Rx Arrays

In this live demonstration of RF coil construction, we will first present general RF-coil construction methods and some useful accessories and tools built in our lab. We will then guide the audience through all main design and construction steps while building a simple (but rather unconventional) Rx array. We will show some alternative decoupling techniques (not relying on preamplifier decoupling) to compensate mutual inductance and minimise coil-coil coupling. The presented methods will be easily applicable to construct other simple RF coil arrays, including Tx/Rx arrays. Finally, we will present some imaging results on a human wrist using this array.

Ewald Weber

16:15 Adjournment & Meet the Teachers

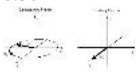
Weekend Course

Image Acquisition & Reconstruction

*Organizers:*Thomas K. F. Foo, Ph.D. & N. Jon Shah, Ph.D.

Summit 2 8:30 - 17:00 *Moderators:*Desmond Teck Beng Yeo & Yong Zhou

8:30 RF Pulse Design



Excitation is a necessary process for MRI in order to create observable magnetization to image. In this work, we develop the basic principles of excitation using the Bloch Equations, written for the rotating frame, which makes it easier to visualize the effects of applied rotating magnetic field used for excitation. The small tip angle approximation is shown to be useful for understanding slice profile and multidimensional excitation. Large tip-angles requires different approaches, such as the Shinnar-LeRoux algorithm. Lastly, excitation k-space, similar to k-space for image acquisition, is a concept that can be used to design complicated patterns of excitation.
Douglas Noll

9:00 Systems Calibrations (Bo, B1, Flip Angle Mapping, Shimming)

Lawrence Wald

9:30 Prescan: Transmit/Receive Gain Settings, Frequency Calibration

RF transmit/receive gain and transmit/receive frequency must be adjusted for each patient exam. The problem is similar to parameter mapping but over a smaller volume. Transmit gain accuracy ideally produces the desired flip angle, however B1 field non-uniformity prevents this in practice. The receive gain is ideally set so that the maximum signal does not saturate the A/D converters which would produce shading, and the noise standard deviation is at least one bit to avoid quantization error. Transmit/receive frequency accuracy is required for accurate localization, good EPI and spiral image quality and for fat suppression pulses to work optimally.
Kevin King

10:00 Break & Meet the Teachers

10:30 Motion Compensation Methods

MRI's relatively long scan times can result in increased vulnerability to motion artifacts, producing degraded image quality, more complex patient workflow, and the need in some cases for patient sedation, restraint, or rescanning. Most commercial scanners employ a range of methods to ameliorate motion problems, including gating, triggering, and respiratory navigation techniques. In addition, a number of new technologies are under investigation. These include advanced two and three dimensional navigator methods, and self-navigation techniques, which correct for motion using the imaging data themselves, without the need for separate motion-tracking sequences.
Christopher Hardy

11:00 External Sensors & Real-Time Compensation

This talk will provide an overview on current methods in prospective motion correction for head MRI. It includes both optical motion correction methods as well as NMR-based methods. A selection of currently available technologies will be discussed, including moiré phase tracking, self-encoded optical markers, and gradient tones.
Maximilian Haeberlin

11:30 Non-Cartesian Methods (Radial, Spiral) & Considerations

Xiaohong Zhou

12:00 Lunch & Meet the Teachers

13:30 Reconstruction of Non-Cartesian k-Space Data

The most common reconstruction strategy for non-Cartesian data is to interpolate the data onto a Cartesian k-space grid, followed by a Fast Fourier Transform to the image domain. However, interpolation has important consequences for the final image, so it must be properly chosen and compensated, though several packages yield good results using standard parameters. In addition, iterative techniques, both with and without regridding, can be used to incorporate an

enormous range of imaging strategies.
Gigi Galiana

14:00 Parallel Imaging & Multi-Coil Image Reconstruction

Parallel imaging reconstructions using multiple receiver coil data will be discussed, with a focus on Cartesian parallel imaging methods. SENSE and GRAPPA will be used as the representative techniques that are both widely used, and help understand a variety of other technologies.
Vikas Gulani

14:30 Compressed Sensing Reconstruction

Many methods have been proposed to address the spatio-temporal resolution tradeoff in MRI. Compressed sensing (CS) is the latest among these and holds great promise. This talk covers the basics of compressed sensing reconstruction and also touches on more advanced CS methods that incorporate parallel imaging and redundant coil information.

Manojkumar Saranathan

15:00 Break & Meet the Teachers

15:30 MR Fingerprinting

Mark Griswold

16:00 Synthetic MRI

Synthetic MRI has been a long-standing dream in MRI, which recently gained more attention. Quantification techniques improve and access to clinical application becomes more facilitated. This lecture will explain the technique of synthetic MRI, its limitations and clinical impact.
Marcel Warntjes

16:30 Using MR Phase: Temperature Mapping & Phase-Sensitive Reconstruction

Nathan McDannold

17:00 Adjournment & Meet the Teachers

Weekend Course

Pediatric & Neonatal MRI

*Organizers:*Neal K. Bangerter, Ph.D. & Michael S. Hansen, Ph.D.

Nicoll 1 9:00 - 12:00 *Moderators:*Shreyas Vasanawala

9:00 Logistics of Imaging Children

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yup

Kendall O'Brien

9:30 Technologies for Pediatric Neuroimaging

This educational session will introduce technologies for brain imaging of pediatric subjects. A brief overview of key differences between the developing brain and adult brain will be discussed. The presentation will be focused on the variety of neuroimaging sequences, anatomical and functional, and post-processing techniques for improved characterization of the maturing brain. Translational studies will also be presented to highlight the importance of advancing pediatric brain imaging not only in research but also in clinical care, and further identify the area of needs to spur interests from the audience.
Duan Xu

10:00 Coils & Acceleration

Michael Lustig

10:30 Break & Meet the Teachers

11:00 Pediatric Imaging

MRI is an outstanding modality for pediatric body imaging, and offers the prime advantage of lack of ionizing radiation. However, it is often under-utilized due to challenges with patient cooperation and reliable image quality. Many of these issues stem from motion artifacts and bloated protocols. This presentation will cover common imaging indications in the extremities, pelvis, abdomen, and chest, providing streamlined protocols for each. Several methods for rapid musculoskeletal imaging will be reviewed. These include targeted protocols and higher-dimensional acquisitions. An approach to abdominal and pelvic MRI will be presented that uses only a couple of sequences to obtain T2-weighted and post-contrast T1 weighted scans. Tradeoffs between various methods of T2 weighted imaging will be reviewed. Further, for MRA and MR venography of the torso, streamlined protocols will be presented that are well-suited to sedated children. Contrast-enhanced imaging techniques that minimize motion will be presented.
Shreyas Vasanawala

11:30 Cardiac

Paediatric cardiac disease is often complex, requiring comprehensive anatomical and hemodynamic assessment. C Paediatric cardiac disease is often complex, requiring comprehensive anatomical and hemodynamic assessment. Cardiac MRI offers a reference standard method of assessing the cardiovascular system. However, conventional cardiac MRI can be difficult to perform on children due to poor patient compliance. Therefore, accelerated real-time imaging techniques are increasingly used. These will be discussed with particular reference to studies that have demonstrated proven benefit in the pediatric population.
Vivek Muthurangu

12:00 Adjournment & Meet the Teachers

Weekend Course

Magnetic Susceptibility Imaging

*Organizers:*Chunlei Liu, Ph.D. & Peter van Zijl, Ph.D.

Nicoll 2 7:55 - 12:00 *Moderators:*Chunlei Liu & Peter van Zijl

7:55 Susceptibility Properties of Tissue

To review some basic material on magnetic susceptibility in materials and biological tissues
Jürgen Reichenbach

8:20 Susceptibility Weighted Imaging (SWI)

Susceptibility Weighted Images are produced by multiplying T2*-weighted gradient-echo magnitude and filtered phase images to give a distinctive tissue contrast that highlights tissue magnetic susceptibility variations including those due to haemorrhages, iron deposition and calcifications. SWI has become a widespread clinical tool, particularly for vascular pathologies and neuroimaging with musculoskeletal, cancer and other applications emerging. SWI is qualitative, suffering from the orientation-dependent and non-local nature of phase contrast and cannot help to distinguish between positive and negative susceptibilities. Quantitative Susceptibility Mapping (QSM) overcomes these disadvantages and can even be combined with magnitude images to give a single susceptibility-sensitive image.
Karin Shmueli

8:45 Quantitative Susceptibility Mapping (QSM) Basics

Quantitative susceptibility mapping allows the generation of three-dimensional maps showing the variation of the relative magnetic susceptibility within the human body. A number of processing steps are needed to produce susceptibility maps: to convert the wrapped phase measurements into a map of the field variation inside the region of interest; to separate the field perturbation generated by tissue in the region of interest from that produced by external sources; to calculate the susceptibility map from the field perturbation. Each step will be described here, along with a brief discussion of the relationship between susceptibility and magnetic field perturbation.
Richard Bowtell

9:10 Break & Meet the Teachers

9:20 Translation of QSM to the Clinic - Fast Single Orientation Methods

In this lecture, we will take a look at recent progress toward fast data acquisition and susceptibility map reconstruction that will ultimately set the foundation for a successful translation of QSM to the clinic.
Ferdinand Schweser

9:45 Iron & Susceptibility in Young & Old Brains

The brain is a unique organ with respect to its non-uniformity of iron distribution, both regionally and cellularly, and because of its iron accumulation pattern across the life span. MRI allows to non-invasively map the iron content and therefore provides a window into age and disease dependent mechanisms that are poorly understood. This presentation will give an overview on the most relevant iron compounds in the brain, their magnetic properties, and their cellular distribution. Additionally, susceptibility related MRI methods for iron mapping will be presented and their limitations will be discussed.
Stefan Ropele

10:10 Tissue Anisotropy Origin (Brain, Heart, Muscle)

In this educational presentation, the origins of magnetic susceptibility induced signal anisotropy will be discussed. The observations of magnitude and phase signal anisotropy in gradient echo have been reported in the brain, heart, muscle and kidney. I will explain the sources (e.g. microstructural anisotropy and susceptibility anisotropy) for the observed signal anisotropy. Potential applications of the signal anisotropy will be discussed.
Jongho Lee

10:35 Break & Meet the Teachers

10:45 Tissue Anisotropy Mapping

Many recent studies have found out that macroscopic magnetic susceptibility at the scale of a MR imaging voxel is anisotropic in tissues with ordered microstructure such as white matter fibers. This lecture reviews some of such experimental evidences and introduces methods to map such tissue anisotropy. First, we go over the theory, acquisition and processing methods of susceptibility tensor imaging (STI) which uses MR phase measurements collected at different sample orientations with respect to the main field. We then review some other mapping methods using susceptibility related MR measures that are orientation dependent such as R2* and frequency difference.
Xu Li

11:10 Susceptibility MRI Outside the Brain

There is growing research interest in the development of QSM techniques for extra-cranial applications. These techniques are faced with additional challenges beyond those typically encountered in brain QSM. By addressing important challenges such as the presence of motion, fat, and large susceptibility shifts, these techniques may enable novel QSM applications for research and clinical applications in multiple organs, including heart, liver, kidney, pancreas, breast as well as whole-body applications.
Diego Hernando

11:35 Pediatric QSM

Deqiang Qiu

12:00 Adjournment & Meet the Teachers

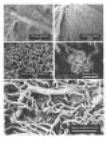
Weekend Course

The Basics of Perfusion & Permeability Imaging

*Organizers:*Linda Knutsson, Ph.D. & Steven Sourbron, Ph.D.

Nicoll 3 8:00 - 12:00 *Moderators:*Ganesh Adluru & Andre Ahlgren

8:00 The Physiology of Perfusion & Permeability



This talk provides an overview of several different parameters that are associated with microvascular physiology, such as perfusion, transit time, and capillary permeability. Their biological meaning is explored, as well as their relevance in the context of various disease settings. Finally, the three main MRI techniques for measuring microvascular physiology (DCE-MRI, DSC-MRI, and ASL) are briefly introduced in relation to the parameters they are capable of measuring.
Hai-Ling Cheng

8:35 Tracer-Kinetic Analysis

This lecture explains the basic principles in tracer-kinetic analysis, assumptions underlying tracer-kinetic analysis models, and limitations and issues in the implementation of these models for perfusion and permeability measurements.
Dennis Cheong

9:10 Break & Meet the Teachers

9:20 Contrast Agent Methods - Data Acquisition

The goal of this lecture is to describe optimal DSC- and DCE-MRI data acquisition techniques and how pulse sequences can be designed to leverage the underlying contrast mechanisms in order to assess unique and complementary biological features.
Chad Quarles

9:55 Contrast Agent Methods - Post-Processing

This presentation will cover key steps involved in processing dynamic contrast-enhanced MRI (DCE-MRI) and dynamic susceptibility contrast MRI (DSC-MRI) data to extract useful information. In addition to key methods for understanding the time course signals, methods for reducing the impact of motion and artefacts will be considered. Examples will be given in a range of organs and diseases.
Geoff Parker

10:30 Break & Meet the Teachers

10:40 ASL - Data Acquisition

In this talk, we will discuss the following aspects regarding ASL – Data acquisition.

A. Basic principles
B. Labeling schemes
    1. Pulsed ASL
        a) STAR and variants
        b) FAIR and variants
    2. Continuous ASL
    3. Velocity selective ASL
C. Background suppression
D. Readout options
E. Advanced methods to combine ASL with other measurements

Jun Hua

11:15 ASL- Post-Processing

This educational talk will review the current status of ASL post processing methods. Based on reasonable assumptions, established ASL post-processing methods enable robust quantitative perfusion maps. Extensions of these post-processing methods address potential issues with ASL and enable new capabilities, including dynamic ASL.
Craig Meyer

11:50 Adjournment & Meet the Teachers

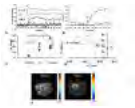
Weekend Course

Clinical Cancer MRI: Case-Based: Tumour Microenvironment

*Organizers:*Linda Moy, M.D. & Valeria Panebianco, M.D.

Room 300-302 13:30 - 15:15 *Moderators:*Utaroh Motosugi & Harriet Thoeny

13:30 Tumour Microenvironment



Historically, radiology/imaging has served to identify tumors in terms of location, size, and metastatic spread. It is increasingly recognized that tumors may exhibit very different micro environmental characteristics, which can influence therapeutic success. A new goal is precision oncology, whereby individual tumors are further characterized based on potential prognostic imagine biomarkers. Tumor hypoxia is associated with aggressive phenotypes and resistance to therapy and may be the most significant factor influencing therapy outcomes for solid tumors. Many NMR approaches are being developed and evaluated to measure tumor oxygenation. This review will consider human applications of oxygen sensitive MRI in the context of pre-clinical developments. Strengths and weaknesses in terms of temporal and spatial resolution, precision and accuracy, ease of implementation and robustness of observations will be considered. Methods may provide qualitative or quantitative insights including dynamic response to interventions.
Ralph Mason

14:00 Collagen & Stroma

The tumor stroma, and in particular the Col1 fiber meshwork, plays an important role in cancer migration and metastasis. Novel MRI approaches such as macromolecular contrast agent based DCE MRI and DTI can be applied to noninvasively detect critical features of the Col1 fiber network in tumors.
Kristine Glunde

14:30 Tumor Associated Inflammation: Biology & Imaging

Heike Daldrup-Link

15:00 Roundtable

15:15 Break & Meet the Teachers

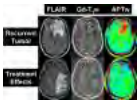
Weekend Course

Clinical Cancer MRI: Case-Based: New Horizons

*Organizers:*Linda Moy, M.D. & Valeria Panebianco, M.D.

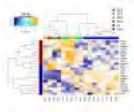
Room 300-302 15:30 - 17:15 *Moderators:*Utaroh Motosugi & Harriet Thoeny

15:30 A semi-quantitative overview of tumor CEST MRI



Tumor CEST MRI has emerged as a molecular imaging approach to characterize complex microenvironment, including protein/peptide, glutamate, exogenous glucose and artificial reporter gene MRI. Despite their diverse names, variant CEST imaging methods provide complementary information about the underlying tumor pathophysiology and it is helpful to provide a semi-quantitative overview to understand their potential clinical applications.
Phillip Zhe Sun

16:00 Radiomics the New Buzzword



"Radiomics" refers to the extraction and analysis of large amounts of advanced quantitative imaging features from medical images using high throughput methods. In this syllabus MRI radiomics features and extraction are described; second, examples of applications of radiomics in glioblastoma multiforme (GBM) and prostate cancer are reviewed and lastly the importance of incorporating radiomics features in clinical databases is discussed.
Radka Stoyanova

16:30 Interventional MRI of Cancer

Carlo Catalano

17:00 Roundtable

17:15 Adjournment & Meet the Teachers

Weekend Course

Neuro 2: CNS Infections

*Organizers:*Kelvin Lim, M.D. & Toshiaki Taoka, M.D., Ph.D.

Room 334-336 13:30 - 15:30 *Moderators:*Toshiaki Taoka

13:30 CNS Infections: Tropical

In today's highly connected world, radiologists should be familiar with typical MRI findings of CNS manifestations of common tropical diseases, as well as the limitations of neuroimaging in differential diagnosis. Multi-disciplinary consultations between radiologists, neurologist, infectious disease specialists and neurosurgeons are often helpful to refine the clinical diagnosis and plan a rational approach to management. Newer techniques, including MR spectroscopic and perfusion imaging, may also be helpful for differential diagnosis. This presentation will focus on differential diagnosis in schistosomiasis and neurocysticercosis, and outbreaks of Nipah virus, group B streptococcus agalactiae infection.
CC Tchoyoson Lim

14:00 CNS Infections: Bacterial/Fungal

Seung Hong Choi

14:30 CNS Infections: Viral

Viruses that tend to affect the central nervous system are usually neurotropic. The specific diagnosis of viral encephali s requires PCR, serum biomarkers, or culture which are not available at acute se ng, while clinical and laboratory findings are o en non-specific. MR Imaging study is important in confirming the CNS involvement. Imaging lesion detec on can prompt early an viral treatment un l proven otherwise. Imaging approaches to viral CNS infec on require background knowledge of the pa ents, such as ages, host immunity, clinical presenta ons, geographic considera ons and endemics. This lecture will review the basic concepts of MR imaging approaches to common neurotropic viral encephali s.
Cheng-Yu Chen

15:00 Discussion

15:30 Break & Meet the Teachers

Weekend Course

Neuro 2: Psychiatric Disease

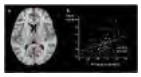
*Organizers:*Kelvin Lim, M.D. & Toshiaki Taoka, M.D., Ph.D.

Room 334-336 16:00 - 18:00 *Moderators:*Kelvin Lim

16:00 Biological Origin of Depression: Evidence from Infant Brain Imaging and Genetics

Qiu Anqi

16:40 Psychiatric Disease: Post-Traumatic Stress Disorder



This lecture will provide a brief review on the Post-Traumatic Stress Disorder （PTSD） in general，and an overview of the PTSD related brain abnormalities discovered with the use of psychiatric MR, with particular emphasis on the circuitry impairment as observed from the circuit- and network-based analysis. Methodological challenges and opportunities will be discussed, along with the assessment of the clinical usefulness of the research findings using psychiatric MR imaging into the objective diagnosis, prognostic prediction and treatment evaluation of patients with PTSD.
Qiyong Gong

17:20 Discussion

18:00 Adjournment & Meet the Teachers

Weekend Course

Advanced MR Spectroscopy in Operation

*Organizers:*Anke Henning, Ph.D. & Carolyn E. Mountford, D.Phil.(Oxon)

Nicoll 1 13:30 - 17:40 *Moderators:*Anke Henning & Carolyn Mountford

13:30 Basic Principles & Sequences for Whole Organ MRSI - Brain & Body

In this course, the basics of maximizing SNR while minimizing sensitivity to system imperfections in MRSI of the human body are discussed using example applications in brain, prostate, breast, and body tuned for the nucleus of ^{1}H, ^{31}P and ^{19}F.
Dennis Klomp

13:50 Whole Brain (Organ) MRSI Analysis

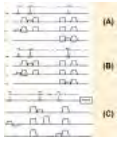
The efficient and accurate analysis of whole brain MR spectroscopic imaging (MRSI) data is critical for the acceptance of this technique into both research and clinical usage. This presentation will review methods for the processing of MRSI data collected with extended brain coverage and high spatial resolution, quantitive analysis methods, creation of metabolic images, and recognition/removal of unwanted artifacts.
Peter Barker

14:10 Applications of Whole Organ MRSI - Brain & Body

MR spectroscopic imaging (MRSI) makes it possible to study changes in metabolism that are associated with disease progression and response to therapy. Advances in MR hardware and software have provided new opportunities for obtaining data in a clinical feasible time and have therefore opened the door to a much broader range of applications than was previously considered. These applications will be demonstrated and future opportunities described.
Sarah Nelson

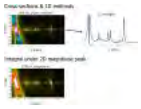
14:30 Break & Meet the Teachers

14:50 Basic Principles & Sequences for 2D MRS



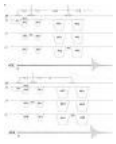
In one-dimensional (1D) MR Spectroscopy (MRS), it is difficult to resolve the multitude of metabolite peaks that exist over a small spectral range. Spectral-editing techniques target a particular J-coupled metabolite selectively, such as lactate, GABA, glutamate, etc. with a drawback that only one metabolite is selected for each recording. Due to the added 2nd dimension, two-dimensional (2D) MRS can unambiguously resolve many overlapping peaks non-selectively. Instead of a standard 1D spectrum plotting intensity versus a single-axis (i.e., chemical shift + J-coupling), 2D MRS techniques produce a 2D spectrum plotting intensity versus two frequency axes, the dimensions of which depend on the specific 2D MRS technique. A major goal of this presentation is to give an overview of the basics of 2D MRS and describe several localized 2D MRS sequences which have been implemented on the whole body 1.5T, 3T, and 7T MRI scanners.
M. Thomas

15:10 Data Analysis for 2D MRS: Spectral Fitting



Main goal of in vivo Magnetic Resonance Spectroscopy (MRS) is the determination of individual metabolite concentrations in organs like the brain. Spectrally two-dimensional spectroscopy can help to encode more spectral information during the acquisition, and hence disentangle the overcrowded proton spectra. In order to quantify the 2D spectra most accurately, it is necessary to fit them to 2D metabolite basis spectra, hence utilising the full amount of available prior information. Reasons for fitting along with the actual fitting methods are explained in this educational talk.
Rolf Schulte

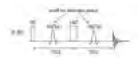
15:30 Applications of 2D MRS: Brain & Body



Different types of 2D MRS can offer different types of information to understand the complexities underlying pathophysiology of disease. Technical developments specific to 2D method development and advanced post-processing methods will allow for the identification of biomarkers of diseases at an early stage. Acceleration of signal acquisition, as well as automated data processing algorithms are essential to introduce 2D MRS methods into the clinic.
Saadallah Ramadan

15:50 Break & Meet the Teachers

16:10 Basic Principles and Sequences for Difference and Multiple Quantum Editing



In-vivo proton magnetic resonance spectra exhibit poor spectral resolution due to the overlap of peaks with similar chemical shifts. Spectral editing techniques have been designed and implemented to enable retention of peaks from metabolites of interest while suppressing background contaminating peaks. The purpose of the lecture is to describe two important spectral editing techniques, namely, difference editing and multiple quantum filtering. Basic principles and pulse sequences for each of the methods is presented along with how spatial localization can be incorporated. In addition, examples of applications of the sequences are provided.
Atiyah Yahya

16:30 Data Analysis for Spectral Editing

This presentation will cover the major steps required for the analysis of edited spectra, which include the standard steps used for all spectroscopy (Fourier transformation, windowing/filtering, integration/fitting) and some steps that are specifically required by editing (subtraction, frequency-and-phase correction of time-resolved data).
Richard Edden

16:50 Applications of Spectral Editing

Performing proton MR spectroscopy (^{1}H-MRS) at higher static magnetic field strengths (B_0) generally improves spectral resolution and, thereby, allows detection of a larger number of metabolites. However, even at very high B_0 and in particular on clinical MR scanners the spectral resolution is often not sufficient for an unambiguous quantification of several important J-coupled metabolites such as GABA, GSH, 2GH, Asc, or Lac. Their resonances are strongly overlapping with other more abundant metabolite resonances, which makes their accurate and reliable quantification via conventional ^{1}H-MRS difficult. Spectral editing methods can be applied to selectively quantify these J-coupled metabolites. This opens the window for numerous clinical and neuro-scientific applications.
Wolfgang Bogner

17:10 Roundtable

17:40 Adjournment & Meet the Teachers

Weekend Course

Validation of Structural Measurements with Diffusion MRI

*Organizers:*Daniel C. Alexander, Ph.D., Derek K. Jones, Ph.D. & Guoying Liu, Ph.D.

Nicoll 2 13:30 - 17:00 *Moderators:*Geoffrey Parker & Carlo Pierpaoli

13:30 Introduction

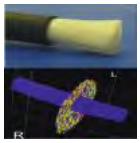
13:40 Theoretical Underpinnings of Building a Validation Framework of Diffusion Experiments

Diffusion magnetic resonance is a powerful probe into tissue microstructure. Theoretical investigations commonly focus on establishing the relationships between simplified environments with the magnetic resonance signal. In this talk, the essential tools and a brief description of the building blocks of a comprehensive model of diffusion taking place in tissue will be discussed. Main mathematical approaches will be reviewed at some depth.
Evren Ozarslan

14:10 Numerical Phantoms

Numerical phantoms have played and will continue to play an important role in the development and validation of advanced diffusion MRI techniques. They complement biological phantoms (in vitro, ex vivo and in vivo) with their controllability and physical phantoms with their flexibility. This talk will review the aspects of diffusion MRI techniques that have benefited from validation with numerical phantoms and the range of numerical phantoms currently available. Examples of using numerical phantoms for validating the mapping of tissue microstructure and structural connectivity in the brain will be presented.
Gary Zhang

14:40 Physical hardware phantoms for the validation of diffusion MRI



Physical hardware diffusion phantoms with a well-defined structure, composition and architectural organization can serve as a gold standard for the validation of diffusion MRI. In this lecture, we aim to provide guidelines on how to choose or manufacture a synthetic diffusion phantom that addresses the needs of your project, going from setting up a quality assessment diffusion protocol on a clinical scanner, developing and testing a novel diffusion sequence, validating biophysical models to evaluating tractography models.
Els Fieremans

15:10 Break & Meet the Teachers

15:30 Validation of Inferences About Tissue Microstructure

Diffusion MRI is unique in its ability to derive microstructural tissue information. However, since structure is inferred from measurements of diffusion, validating DWI findings with other modalities is important for a complete understanding of diffusion MRI and its relationship to the true underlying tissue microstructure. This session will provide an overview of methods to validate and quantify the relationship between diffusion MRI findings and the true underlying biology.
Matthew Budde

16:00 Validation of White-Matter Pathways Reconstructed with Diffusion Tractography

This presentation reviews the techniques that can be used to validate WM pathway reconstructions derived from diffusion MRI in humans and non-human primates. The relative merits of the techniques are discussed. The potential for an integrative approach that uses complimentary information from chemical tracing in non-human primates, optical imaging in human tissue, as well *ex vivo* diffusion MRI at microscopic spatial resolutions, is outlined.
Anastasia Yendiki

16:30 Accuracy & Reliability in Population Studies & Clinical Applications

Despite the large body of research studies in humans published using Diffusion MRI, and the availability of very sophisticated models for diffusion MRI data analysis, advanced diffusion MRI applications still have not percolated into clinical practice. In this talk we will review factors affecting accuracy and reliability of Diffusion MRI that have hindered a larger clinical dissemination of this technique and the most promising solutions to this problem.
carlo pierpaoli

17:00 Panel Discussion & Questions/Comments from the Audience

17:30 Adjournment & Meet the Teachers

Weekend Course

Quantitative Physiology: Imaging Oxygenation

*Organizers:*Steven Sourbron PhD, Jonathan R. Polimeni, Ph.D. & Eric C. Wong, M.D., Ph.D.

Nicoll 3 | 13:30 - 16:50 | *Moderators:*Audrey Fan & Andreas Pohlmann

13:30 The Role of Oxygen in Brain Tissue Function

While our brains utilize oxygen and glucose at rapid rates, they have little energy reserves and require constant supplies of glucose and oxygen to maintain normal brain function. Cerebral blood flow serves as the means through which these energy sources are delivered to the brain. This presentation will introduce the concepts of cerebral oxygen metabolism, the approaches to measure it, and the applications of these approaches to discern the interplay between CBF, OEF, and CMRO2 in both normal and pathophysiological conditions. Emphases will be made, when possible, to compare PET and MR approaches that provide similar physiological measures and their in vivo results.
Weili Lin

14:00 Imaging of Oxygenation Using MR

Quantitative evaluation of brain hemodynamics and metabolism, particularly the relationship between brain function and oxygen utilization, is important for understanding normal human brain operation as well as pathophysiology of neurological disorders. It can also be of great importance for evaluation of hypoxia within tumors of the brain and other organs. Most of the currently used methods are based on measuring blood oxygenation level and directly related to it oxygen extraction fraction, OEF. Combining measurement of OEF with measurement of CBF allows evaluation of oxygen consumption, CMRO2.
Dmitriy Yablonskiy

14:30 Imaging of Oxygenation in the Brain

· The brain has a uniquely high oxygen metabolic demand, and the ability to noninvasively image brain oxygenation is critical to understand normal brain function and many cerebrovascular and neurological disorders.

· Three classes of MRI contrast mechanisms to image oxygenation have been explored, including (1) extravascular blood oxygenation level dependent (BOLD); (2) intravascular T2-relaxation; and (3) magnetic susceptibility in cerebral veins. These methods have different abilities to localize regional oxygenation and different strengths and weaknesses.

· Because MRI methods to image oxygenation are fairly new, additional studies are needed to validate oxygenation measurements with each other, and with the PET reference standard. Promising clinical studies in patients highlight the promise of MRI oxygenation imaging and will benefit from optimized and robust protocols to quantify oxygen metabolism.

Audrey Fan

15:00 Break & Meet the Teachers

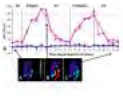
15:20 Imaging of Oxygenation in the Kidney

Unlike most organs, in the kidneys, oxygen consumption changes with blood flow and increased blood flow doesn't necessary lead to increased oxygen delivery. This leads to a need for independent measures of perfusion and oxygentation BOLD MRI is the only non-invasive method to evaluate renal oxygenation. It is most useful for detecting acute changes following pharmacologic/physiologic maneuvers. Based on evidence from pre-clinical models, translation to the clinic is being pursued. Limitations in conventional ROI analysis have been identified, creating an interest in alternative methods, including whole kidney analysis. Alternate methods to measure oxygenation include electron paramagnetic resonance and fluorine-19 MRI, both involving exogenous materials to be used.
Pottumarthi Prasad

15:50 Imaging of Oxygenation in the Lung

The lung is a gas exchange organ, so it's primary function is transfer of oxygen from the atmosphere to the blood and CO2 from the blood back to the atmosphere. To quantify this we need more than just measurements of alveolar ventilation (V). We also need to know the capillary perfusion (Q), and most importantly, how well these are matched (the V/Q ratio). In this talk I will focus on some novel methods to image pulmonary ventilation and perfusion with conventional proton MRI, and discuss the technical challenges that need to be overcome to make physiological measurements of lung function.
David Dubowitz

16:20 Imaging of Oxygenation in Tumors



Tumor hypoxia is associated with aggressive phenotypes and resistance to therapy. Several MRI approaches are being developed and evaluated to measure tumor oxygenation. Many use exogenous reporter molecules, whilst some exploit endogenous signal. This review will present strengths and weaknesses in terms of temporal and spatial resolution, precision and accuracy, ease of implementation and robustness of observations. Methods may provide qualitative or quantitative insights including dynamic response to interventions. Some are limited to pre-clinical studies, while others offer ready translation to human patients.
Ralph Mason

16:50 Adjournment & Meet the Teachers

Other

Opening Reception

Exhibition Hall 17:45 - 19:15

Monday, May 9, 2016

Go to top

Plenary Session

Mansfield Lecture

Plenary Hall 8:30 - 9:15

Mansfield Lecture -MR Imaging in Personalised Medicine

XIAOYING WANG[1]

[1]*PEKING UNIVERSITY FIRST HOSPITAL*

XIAOYING WANG

Plenary Session

The MR Value Initiative

*Organizers:*Mark A. Griswold, Ph.D. & James G. Pipe, Ph.D.

Plenary Hall 8:30 - 10:15 *Moderators*:James Pipe

Introduction & Membership Thoughts

Panel Discussion - What is Needed Across the World

The High-Value Exam Campaign: A Contest with Consequences

Adjournment

Plenary Session

Welcome & Awards

7:30 - 8:30

Traditional Poster : Neuro

Exhibition Hall 10:45 - 12:45 *(no CME credit)*

Electronic Poster : Cancer

Exhibition Hall 10:45 - 11:45 *(no CME credit)*

Electronic Poster : CV

Exhibition Hall 10:45 - 11:45 *(no CME credit)*

Study Groups

MR Flow & Motion Quantitation

Hall 405 E 10:45 - 12:45

Study Groups

MR Engineering

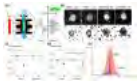
Hall 406 D 10:45 - 12:45

Power Pitch

Diffusion at the Cutting Edge

Power Pitch Theatre, Exhibition Hall 10:45 - 11:45 *Moderators:*Robin Heidemann & Yi-Fen Yen

1 10:45

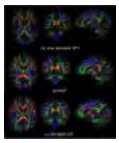


DWI^2: exploring the MRI-phase for imaging diffusion

Ralph Sinkus[1], Simon Auguste Lambert[1], Lucas Hadjilucas[1], Shaihan Malik[2], Anirban Biswas[1], Francesco Padormo[2], Jack Lee[1], and Joseph V Hajnal[2]

[1]Imaging Sciences & Biomedical Engineering Division Kings College, King's College London, London, United Kingdom, [2]Centre for the Developing Brain & Department Biomedical Engineering, King's College London, London, United Kingdom

2 10:48

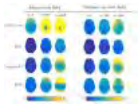


High resolution diffusion tensor reconstruction from simultaneous multi-slice acquisitions in a clinically feasible scan time

Gwendolyn Van Steenkiste[1], Ben Jeurissen[1], Steven Baete[2,3], Arnold J den Dekker[1,4], Dirk H.J. Poot[5,6], Fernando Boada[2,3], and Jan Sijbers[1]

[1]iMinds-Vision Lab, University of Antwerp, Antwerp, Belgium, [2]Center for Advanced Imaging Innovation and Research (CAI2R), NYU School of Medicine, New York, NY, United States, [3]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [4]Delft Center for Systems and Control, Delft University of Technology, Delft, Netherlands, [5]Imaging Science and Technology, Delft University of Technology, Delft, Netherlands, [6]Biomedical Imaging Group Rotterdam, Erasmus Medical Center Rotterdam, Rotterdam, Rotterdam, Netherlands

3 magna cum laude 10:51



Quantitative evaluation of eddy-current and motion correction techniques for diffusion-weighted MRI

Mark S Graham[1], Ivana Drobnjak[1], and Hui Zhang[1]

[1]Centre for Medical Image Computing & Department of Computer Science, UCL, London, United Kingdom

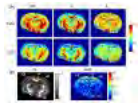
4 10:54

A Mathematical Model and an Efficient Simulation Framework for Diffusion Cardiac Imaging: Application to Quantification of Cardiac Deformation on the Diffusion Signal

Imen Mekkaoui[1], Kévin Moulin[2,3], Jérôme Pousin[1], and Magalie Viallon[2,4]

[1]ICJ, INSA-Lyon, Villeurbanne, France, [2]Creatis, INSA-Lyon, Lyon, France, [3]Siemens Healthcare, Saint-Denis, France, [4]Department of Radiology, Université J. Monnet, Saint Etienne, France

5 magna cum laude 10:57

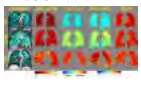


Diffusion Kurtosis at varying diffusion times in the normal and injured mouse brains

Dan Wu[1], Frances J Northington[2], and Jiangyang Zhang[1,3]

[1]Radiology, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [2]Pediatrics, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [3]Radiology, New York University School of Medicine, New Yourk, NY, United States

6 11:00

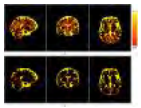


Can the Stretched Exponential Model of Gas Diffusion Provide Clinically -Relevant Parenchyma Measurements of Lung Disease?

Alexei Ouriadov[1], Eric Lessard[1], David G McCormack[2], and Grace Parraga[1]

[1]Robarts Research Institute, The University of Western Ontario, London, ON, Canada, [2]Department of Medicine, The University of Western Ontario, London, ON, Canada

7 11:03



Overestimation of CSF fraction in NODDI: possible correction techniques and the effect on neurite density and orientation dispersion measures

Samira Bouyagoub[1], Nicholas G. Dowell[1], Samuel A. Hurley[2], Tobias C. Wood[3], and Mara Cercignani[1]

[1]Clinical Imaging Sciences Centre, Brighton and Sussex Medical School, Brighton, United Kingdom, [2]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [3]Neuroimaging, IoPPN, King's College London, London, United Kingdom

8 11:06

Quantitative Assessment of Microstructure Properties of Human Corpus Callosum and Distinct Connectivity to Projected Cortices using Parametric T1 Imaging and Diffusion Tractography

Byeong-Yeul Lee[1], Xiao-Hong Zhu[1], and Wei Chen[1]

[1]*Center for Magnetic Resonance Research, Radiology, University of Minnesota, Minneapolis, MN, United States*

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9 magna cum laude

11:09

Fibre directionality and information flow through the white matter: Preliminary results on the fusion of diffusion MRI and EEG

Samuel Deslauriers-Gauthier[1], Jean-Marc Lina[2], Russell Butler[3], Kevin Whittingstall[3], Pierre-Michel Bernier[4], and Maxime Descoteaux[1]

[1]*Computer Science department, Université de Sherbrooke, Sherbrooke, QC, Canada,* [2]*École de Technologie Supérieure, Montréal, QC, Canada,* [3]*Department of Diagnostic Radiology, Université de Sherbrooke, Sherbrooke, QC, Canada,* [4]*Department of Kinanthropology, Université de Sherbrooke, Sherbrooke, QC, Canada*

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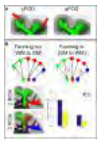
10 magna cum laude

11:12



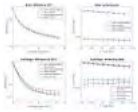
Improved tractography by modelling sub-voxel fibre patterns using asymmetric fibre orientation distributions

Matteo Bastiani[1], Michiel Cottaar[1], Krikor Dikranian[2], Aurobrata Ghosh[3], Hui Zhang[3], Daniel C. Alexander[3], Timothy Behrens[1], Saad Jbabdi[1], and Stamatios N. Sotiropoulos[1]

[1]*FMRIB Centre, University of Oxford, Oxford, United Kingdom,* [2]*Department of Anatomy & Neurobiology, Washington University, St. Louis, MO, United States,* [3]*Department of Computer Science & Centre for Medical Image Computing, University College London, London, United Kingdom*

11

11:15



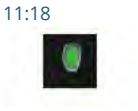
Investigation of the influence of the extracellular matrix on water diffusion in brain and cartilage

Jakob Georgi[1], Riccardo Metere[1], Markus Morawski[2], Carsten Jäger[2], and Harald E. Möller[1]

[1]*Max-Planck-Institute for Human Cognitive and Brain Sciences, Leipzig, Germany,* [2]*Paul-Flechsig-Institute for Brain Research, Leipzig, Germany*

12

11:18



Measurement of the Effect of Tissue Fixation on Tumour Microstructure using VERDICT Diffusion-MRI

Ben Jordan[1], Tom Roberts[1], Angela D'Esposito[1], John Connell[1], Andrada Ianus[2], Eleftheria Panagiotaki[2], Daniel Alexander[2], Mark Lythgoe[1], and Simon Walker-Samuel[1]

[1]*Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom,* [2]*Centre for Medical Image Computing, University College London, London, United Kingdom*

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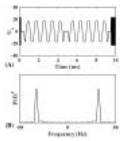
13 summa cum laude

11:21



Validation of Surface-to-Volume Ratio derived from Oscillating Gradient Spin Echo on a clinical scanner using anisotropic fiber phantoms

Gregory Lemberskiy[1], Steven H. Baete[1], Martijn A. Cloos[1], Dmitry S. Novikov[1], and Els Fieremans[1]

[1]*Radiology, NYU School of Medicine, New York, NY, United States*

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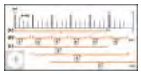
14 magna cum laude

11:24



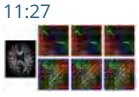
Demonstration of a Sliding-Window Diffusion Tensor Technique for Temporal Study of Post-Exercise Skeletal Muscle Dynamics

Conrad P Rockel[1,2] and Michael D Noseworthy[1,2,3]

[1]*School of Biomedical Engineering, McMaster University, Hamilton, ON, Canada,* [2]*Imaging Research Centre, St Josephs Healthcare, Hamilton, ON, Canada,* [3]*Electrical and Computer Engineering, McMaster University, Hamilton, ON, Canada*

15

11:27



Denoising Diffusion-Weighted Images Using x-q Space Non-Local Means

Geng Chen[1,2], Yafeng Wu[1], Dinggang Shen[2], and Pew-Thian Yap[2]

[1]*Data Processing Center, Northwestern Polytechnical University, Xi'an, China, People's Republic of,* [2]*Department of Radiology and BRIC, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States*

Oral

MRS Methods: What's New?

Room 300-302 10:45 - 12:45 *Moderators:*Graham Galloway & Naranamangalam Jagannathan

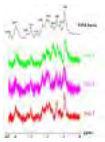
16

10:45

Characterization of the macromolecular baseline with a metabolite-cycled double-inversion recovery sequence in the human brain at 9.4T

Ioannis Angelos Giapitzakis[1,2], Roland Kreis [3], and Anke Henning [1,4]

[1]*Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*IMPRS for Cognitive and Systems Neuroscience, University of Tuebingen,*



Tuebingen, Germany, [3]Depts. Radiology and Clinical Research, University of Bern, Bern, Switzerland, [4]Institute of Biomedical Engineering, University and ETH, Zürich, Switzerland

Macromolecular resonances (MM) overlap with metabolites resulting in inaccurate quantification of the metabolites due to baseline distortion. This effect becomes even more severe in case of short echo times (TE). The purpose of this study was the development of an adiabatic pulse for double inversion recovery and investigation of impact to include MM into quantification of 9.4T MRS data of human brain. This is the first study where MC-STEAM is combined with a double inversion technique. The results showed the advantages of UHF and MC as well as the necessity of the inclusion of MM baseline in the basis set.

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17 10:57

Evidence for regional and spectral differences of macromolecule signals in human brain using a crusher coil at 7 Tesla

Nicolas Geades[1], Carrie Wismans[2], Mariska Damen[2], Penny Gowland[1], Hans Hoogduin[2], Vincent Boer[2], Dennis Klomp[2], and Jannie Wijnen[2]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Department of Radiology, University Medical Centre Utrecht, Utrecht, Netherlands

The regional, spectral and relaxation differences of macromolecules (MM) in the human brain were investigated using T1 mapping, metabolite nulling and high resolution MRSI with a crusher coil at 7T. Differences between macromolecular signal of GM and WM were observed by all three methods. The T1 mapping showed different T1 relaxation time of MM in GM and WM. Metabolic maps created by fitting an averaged WM spectrum showed differences in M1 and M2. The macromolecules in the metabolite nulled data showed a different M4 in GM and WM. Some of these differences can be explained by differences in T1 relaxation.

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18 11:09

Improvement of 2-hydroxyglutarate detectability using optimized triple-refocusing difference editing at 7T in vivo

Sandeep K Ganji[1], Zhongxu An[1], Vivek Tiwari[1], Marco Pinho[2], Edward Pan[3], Bruce Mickey[4], Elizabeth Maher[5], and Changho Choi[1]

[1]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [2]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [3]Neurology and Neurotherapeutic, UT Southwestern Medical Center, Dallas, TX, United States, [4]Neurological Surgery, UT Southwestern Medical Center, Dallas, TX, United States, [5]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States

2-hydroxyglutarate (2HG) has become an important biomarker in the diagnosis and management of glioma patients as well as in the workup of an undiagnosed mass. The 1H MRS signals of 2HG are extensively overlapped with other metabolite signals. Specifically, uncertainty in 2HG evaluation arising from the spectral overlap of the 2HG 2.25-ppm signal with the GABA 2.29-ppm resonance may be a major obstacle when the 2HG level is relatively low. Here we report a novel triple-refocusing difference editing that provides complete differentiation between 2HG and GABA signals at 7T.

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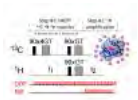
19 11:21



Indirectly-Detected and Spin-Amplified Heteronuclear MRS and MRI

Chencai Wang[1], Chaohsiung Hsu[1], Stephanie Wolohan[1], and Yung-Ya Lin[1]

[1]Department of Chemistry and Biochemistry, UCLA, Los Angeles, CA, United States

A general indirect-detection and spin-amplification scheme has been developed to enhance the sensitivity of heteronuclear MRS and MRI based on dynamic instability of the solvent proton magnetization under collective feedback fields of radiation damping and the distant dipolar field. The heteronuclear solute spins are first detected by the solvent proton spins through various magnetization transfer mechanisms and serve as small “input” signals to perturb the solvent proton magnetization, which is prepared in an unstable state. The weakly detected signal is then amplified through subsequent nonlinear evolution of the solvent proton magnetization to achieve 10x SNR improvement for 13C MRS and MRI.

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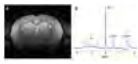
20 11:33



Remodeling of energy metabolism revealed by 31P magnetization transfer in a transgenic rat model of Huntington’s disease

Brice Tiret[1,2], Maria-Angeles Carrillo-de Sauvage[1,2], Huu Phuc Nguyen[3,4], Nicole El Massioui[5,6], Valérie Doyère[5,6], Vincent Lebon[1,2], Emmanuel Brouillet[1,2], and Julien Valette[1,2]

[1]CEA/DSV/I2BM/MIRCen, Fontenay-aux-Roses, France, [2]CNRS Université Paris-Saclay UMR 9199, Fontenay-aux-Roses, France, [3]Institute of Medical Genetics and Applied Genomics, University of Tuebingen, Tuebingen, Germany, [4]Centre for Rare Diseases, University of Tuebingen, Tuebingen, Germany, [5]Paris-Saclay Institute of Neuroscience, Université Paris-Sud, UMR 9197, Orsay, France, [6]Centre National de la Recherche Scientifique, Orsay, France

Localized ^{31}P MRS with progressive magnetization transfer (MT) is performed in the BACHD transgenic rat model of Huntington’s disease to assess energy metabolism. Localized measurements of the ATP formation rate through creatine kinase and oxidative phosphorylation (ATPsynthase) are performed in the rat brain for the first time. Results show that ATPsynthase rate is reduced by a factor 2, which is partly compensated by higher cerebral concentrations of phosphocreatine to generate ATP via creatine kinase.

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21 11:45

Investigating machine learning approaches for quality control of brain tumor spectra

Sreenath P Kyathanahally[1], Victor Mocioiu[2], Nuno Miguel Pedrosa de Barros[3], Johannes Slotboom[3], Alan J Wright[4], Margarida Julià-Sapé[2], Carles Arús[2], and Roland Kreis[1]

[1]Depts. Radiology and Clinical Research, University of Bern, Bern, Switzerland, [2]Centro de Investigación Biomédica en Red en Bioingeniería, Biomateriales y Nanomedicina (CIBER-BBN), Universitat Autònoma de Barcelona, Barcelona, Spain, [3]DRNN, Institute of Diagnostic and Interventional Neuroradiology/SCAN, University Hospital Bern, Bern, Switzerland, [4]CRUK Cambridge Institute, University of Cambridge,

Cambridge, United Kingdom

Despite many potential applications of MR spectroscopy in the clinic, its usage is limited – and the need for human experts to identify bad quality spectra may contribute to this. Previous studies have shown that machine learning methods can be developed to accept or reject a spectrum automatically. In this study, we extend this to different machine learning methods on 1916 spectra from the eTUMOUR and INTERPRET databases. The RUSBoost classifier, which handles unbalanced data, improved specificity and accuracy compared to other classifiers, in particular in combination with an extended feature set and multi-class labels.

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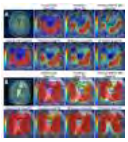
22 11:57



Automatic quality assessment of short and long-TE brain tumour MRSI data using novel Spectral Features
Nuno Miguel Pedrosa de Barros[1,2], Urspeter Knecht[1], Richard McKinley[1], Jonathan Giezendanner[1], Roland Wiest[1], and Johannes Slotboom[1]

[1]Institute for Diagnostic and Interventional Neuroradiology, Inselspital, Bern, Switzerland, [2]University of Bern, Bern, Switzerland

MRSI-data frequently contains bad-quality spectra which strongly limits its clinical-use. Current clinical practice in our institute is that these bad-quality spectra are filtered out by an MRS-expert, at the expense of long processing times. In this work we present a new method for automatic quality assessment of both long ***and*** short-TE MRSI brain tumour data. This method is based upon a novel set of spectral features, and it is as accurate as an expert but considerably faster (3/4 minutes vs 3seconds).

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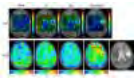
23 12:09



Fast frequency–sweep spectroscopic imaging with an ultra-low flip angle
Junyu Guo[1], Zoltan Patay[1], and Wilbrun E. Reddick[1]

[1]St Jude Children's Research Hospital, Memphis, TN, United States

We present a novel, simple and fast MR spectroscopic imaging technique and show its conceptual validation with simulations and demonstrate proof-of-principle with phantom and human studies. First, compared to the conventional spectroscopic imaging in the time-domain, our method acquires data in the frequency domain, allowing flexible non-uniform sampling to speed up the acquisition. Second, using ultra-small RF pulses offers intrinsic water and fat suppression, greatly simplifying the scanning procedures. Third, this new technique has hundreds of times lower energy deposition than conventional MRI scans. We believe our method could allow spectroscopic imaging to play a larger role in clinical applications.

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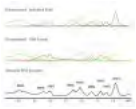
24 12:21



Parameterization of measured macromolecular background in ultra-short acquisition delay ^{1}H MRSI in the brain at 7T
Michal Považan[1,2], Gilbert Hangel[1], Bernhard Strasser[1], Eva Heckova[1], Lukas Hingerl[1], Stephan Gruber[1], Siegfried Trattnig[1,2], and Wolfgang Bogner[1]

[1]High Field MR Center, Department of Biomedical Imaging and Image-guided Therapy, Medical University Vienna, Vienna, Austria, [2]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria

Ultra-short echo/acquisition delay MRS spectra have a strong characteristic background consisting of macromolecule (MM) resonances superimposed on the signal of metabolites. Typically a single metabolite-nulled MM spectrum is included into quantification routine to account for this. To detect more prominent regional and pathologic changes, we replaced this single MM spectrum by individual MM peaks. We found that the MM peaks in a 2.3-0.5 ppm region are higher in gray matter compared to white matter, whereas the MM peaks from 2.9 to 3.2 ppm were significantly higher in white matter of healthy volunteers and one MS patient.

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25 12:33

Stochastic excitation scheme for estimating longitudinal relaxation and radiofrequency transmit inhomogeneity in single voxel spectroscopy
Assaf Tal[1]

[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel

A stochastic excitation and corresponding dictionary matching scheme is presented for quantifying metabolite concentrations, longitudinal relaxation times and transmit inhomogeneity in single voxel proton magnetic resonance spectroscopy in the human brain.

Oral

Magnetic Susceptibility

Room 324-326 10:45 - 12:45 *Moderators:*Berkin Bilgic

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26 10:45

An illustrated comparison of background field elimination methods for phase MRI and QSM
Ferdinand Schweser[1,2], Wei Li[3], Hongfu Sun[4], Dong Zhou[5], Nicola Bertolino[1], Paul Polak[1], Yi Wang[5], Alan H Wilman[4], Kristian Bredies[6], Robert Zivadinov[1], and Simon Daniel Robinson[7]

[1]Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, The State University of New York at Buffalo, Buffalo, NY, United States, [2]MRI Molecular and Translational Research Center, Jacobs School of Medicine and Biomedical Sciences, The State University of New York at Buffalo, Buffalo, NY, United States, [3]Research Imaging Institute, The University of Texas Health Science Center, San Antonio, TX, United States, [4]Department of Biomedical Engineering, University of Alberta, Edmonton, AB, Canada,

[5]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [6]Institute for Mathematics and Scientific Computing, University of Graz, Graz, Austria, [7]High Field MR Center of Excellence, Department of Radiology, Medical University of Vienna, Vienna, Austria

Elimination of background fields is an essential step in phase MRI and QSM, with many different approaches proposed over the past years. However, it is currently unclear how the various methods perform relative to each other and what their respective strengths and weaknesses are, because a multi-center quantitative comparison of all techniques has not yet been carried out.

In this work we quantitatively compare inverse Laplace filtering, SHARP , V-SHARP, iSMV , LBV, HARPERELLA, iHARPERELLA, PDF, and RE-SHARP in a collaborative effort.

The background correction performance was similar with all methods, with iSMV and LBV yielding the best results.

27

magna cum laude

10:57

Fast Unwrapping using Discrete Gradient Evaluation (FUDGE): an analytical correction to the Laplacian-based phase unwrapping technique for discrete data.

Amanda Ching Lih Ng[1], Meei Pyng Ng[2], Sonal Josan[3], Shawna Farquharson[4], Claire Mulcahy[4], and Roger J Ordidge[1]

[1]Dept of Anatomy & Neuroscience, The University of Melbourne, Parkville, Australia, [2]Dept of Mathematics & Statistics, The University of Melbourne, Parkville, Australia, [3]Siemens Healthcare, Melbourne, Australia, [4]Imaging, The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia

Laplacian-based phase unwrapping is commonly used to pre-process phase for methods such as Quantitative Susceptibility Mapping (QSM). However, the formulation was derived with the assumption of a continuous signal and a continuous Fourier transform. When applied to discrete MRI phase data, serious errors in phase can occur, resulting in substantial errors in QSM estimates. We present a mathematically correct Laplacian-based phase unwrapping formula, based on the assumption of the discrete nature of MRI phase data and processing. Our results reflect the mathematical predictions of the old and new formulations.

28

magna cum laude

11:09

Imaging Whole Mouse Brain Cytoarchitecture by Quantitative Susceptibility Mapping at 10-μm Resolution

Hongjiang Wei[1], Luke Xie[2], Russell Dibb[3], Wei Li[4], Kyle Decker[3], G. Allan Johnson[3,5], and Chunlei Liu[1,5]

[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States, [2]Utah Center for Advanced Imaging Research, Department of Radiology, University of Utah, Salt Lake City, UT, United States, [3]Center for In Vivo Microscopy, Duke University, Durham, NC, United States, [4]Research Imaging Institute, University of Texas Health Science Center, San Antonio, TX, United States, [5]Department of Radiology, School of Medicine, Duke University, Durham, NC, United States

In this study, we demonstrate that whole brain cytoarchitecture can be revealed by QSM at 10-μm resolution at 9.4T. Using QSM, we are able to reveal exquisite anatomical details such as retina layers of the eyeball, glomeruli in olfactory bulb, barrel cortex, medium-sized spiny neurons in striatum, cell layers of cerebellum, and hippocampus. This ultra-high resolution QSM of the intact mouse brain is a powerful dataset to allow analysis and visualization of the brain cytoarchitecture in 3D.

29

magna cum laude

11:21

A Novel Method for Background Field Removal in Abdominal QSM

Debra E. Horng[1,2], Samir D. Sharma[1], Scott B. Reeder[1,2,3,4,5], and Diego Hernando[1]

[1]Radiology, University of Wisconsin, Madison, WI, United States, [2]Medical Physics, University of Wisconsin, Madison, WI, United States, [3]Medicine, University of Wisconsin, Madison, WI, United States, [4]Biomedical Engineering, University of Wisconsin, Madison, WI, United States, [5]Emergency Medicine, University of Wisconsin, Madison, WI, United States

We introduce a QSM background field removal method based on harmonic function theory. Methods based on the mean value theorem compute the value at the center of a spherical kernel. Conversely, a new method based on the extended Poisson kernel can compute the value at any location in a spherical kernel. The new kernel is evaluated for accuracy near air/tissue interfaces, resulting in low errors compared to existing methods. Our new method is fast (analytic) and is designed for performance near air/tissue interfaces in abdominal QSM.

30

11:33

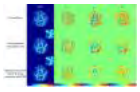
Toward Iron Distribution Mapping using Quantitative Susceptibility Mapping (QSM): A Comparison of Histological Iron Concentration Maps with Magnetic Susceptibility Maps

Andreas Deistung[1], Verena Endmayr[2], Simon Hametner[2], Hans Lassmann[2], Jürgen Rainer Reichenbach[1], Simon Daniel Robinson[3], Thomas Haider[4], Hannes Traxler[5], Evelin Haimburger[6], Siegfried Trattnig[3], and Günther Grabner[3,6]

[1]Medical Physics Group, Institute of Diagnostic and Interventional Radiology, Jena University Hospital – Friedrich Schiller University Jena, Jena, Germany, [2]Center for Brain Research, Medical University of Vienna, Vienna, Austria, [3]High Field Magnetic Resonance Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [4]University Clinic for Trauma Surgery, Medical University of Vienna, Vienna, Austria, [5]Center of Anatomy and Cellbiology, Medical University of Vienna, Vienna, Austria, [6]Department of Health Sciences and Social Work, Carinthia University of Applied Sciences, Klagenfurt, Austria

Quantitative susceptibility mapping (QSM) provides a unique view into cerebral iron distribution *in vivo*. However, not only paramagnetic iron complexes but also diamagnetic myelin around axons contribute to the magnetic susceptibility. To further validate QSM for iron mapping we present a histochemical-driven approach to quantify iron in post mortem brain tissue and compare the spatial distribution of iron with *in situ* magnetic susceptibility maps. Direct comparison between histological iron concentration and susceptibility maps revealed excellent correspondence between iron accumulations and elevated susceptibility in deep gray matter and can improve the understanding of biophysical origins of susceptibility variations within brain tissue.

31 11:45



Feasibility Study of High Resolution Mapping for Myelin Water Fraction and Frequency Shift using Tissue Susceptibility

Zhe Wu[1,2], Hongjian He[1,2], Ying Chen[1,2], Song Chen[1,2], Hui Liu[3], Yiping P. Du[2], and Jianhui Zhong[1,2]

[1]Center for Brain Imaging Science and Technology, Zhejiang University, Hangzhou, China, People's Republic of, [2]Department of Biomedical Engineering, Zhejiang University, Hangzhou, China, People's Republic of, [3]NEA MR Collaboration, Siemens Ltd., China, Shanghai, China, People's Republic of

A three-step method for high resolution myelin water fraction (MWF) and frequency shift mapping of white matter components using tissue susceptibility is presented in this study. Tissue susceptibility induced phase was calculated by the simultaneously acquired QSM from the same multi-echo GRE (mGRE) dataset, and was used as the phase part of complex data for a subsequent fitting to a three-pool white matter model. Benefit from the background phase removal and magnetic dipole deconvolution procedures during QSM calculation, the result reveals much less misfitting when comparing with direct fitting to original mGRE data. These generated quantitative maps can be potentially used for quantitative studies of demyelinated diseases.

32 11:57

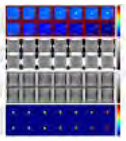
Preconditioned QSM to Determine a Large Range of Susceptibility Over The Entire Field Of View from Total Field

Zhe Liu[1], Youngwook Kee[2], Dong Zhou[2], Pascal Spincemaille[2], and Yi Wang[1,2]

[1]Biomedical Engineering, Cornell University, Ithaca, NY, United States, [2]Radiology, Weill Cornell Medical College, New York, NY, United States

We propose a Preconditioned QSM calculating susceptibility over the entire field of view (FOV), which eliminates the errors associated with background field removal. The background is regarded as part of the region with large susceptibilities, which is determined by a preconditioned conjugate gradient solver with enhanced convergence. Our data demonstrate that our preconditioned QSM provides a susceptibility map of the entire head accurately depicting skin, bone, air filled sinuses and hemorrhages.

33 12:09



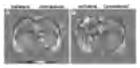
MRI in Multiple Sclerosis: The curiosity of apparent susceptibility increases at simultaneous iron loss

Vanessa Wiggermann[1,2], Simon Hametner[3], Enedino Hernandez-Torres[2,4], Verena Endmayr[3], Christian Kames[5], and Alexander Rauscher[2]

[1]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]Pediatrics, University of British Columbia, Vancouver, BC, Canada, [3]Neuroimmunology, Medical University of Vienna, Vienna, Austria, [4]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [5]Engineering Physics, University of British Columbia, Vancouver, BC, Canada

Quantitative Susceptibility Mapping has shown great potential to be used for clinical diagnoses due to its high sensitivity to change and high spatial resolution. Notably, the ability to quantify damage has been appealing. However, attributing susceptibility increases or decreases to certain mechanisms has been challenging. In particular, interpretation of MR signal changes during multiple sclerosis lesion formation is lacking consistency and histological validation. Here, we investigated the hypothesis that apparent changes of the lesion tissue may be in fact due to changes in the lesions vicinity and caution is required when interpreting the quantitative susceptibility signal in multiple sclerosis lesions.

34 12:21



Quantitative susceptibility mapping of the rat brain after traumatic brain injury

Karthik Chary[1], Mikko J. Nissi[2,3], Ramón I. Rey[4], Eppu Manninen[1], Karin Shmueli[5], Alejandra Sierra[1], and Olli Gröhn[1]

[1]Department of Neurobiology, A.I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, [2]Department of Applied Physics, University of Eastern Finland, Kuopio, Finland, [3]Finland Diagnostic Imaging Center, Kuopio University Hospital, Kuopio, Finland, [4]Department of Neurology, Clinical Neurosciences Research Laboratory, Hospital Clínico Universitario, Health Research Institute of Santiago de Compostela (IDIS), University of Santiago de Compostela, Santiago de Compostela, Spain, [5]Department of Medical Physics & Biomedical Engineering, University College London, London, United Kingdom

Our aim was to test the sensitivity of QSM to demyelination, iron and calcifications in a rat model of TBI. *Ex vivo* QSM data were obtained from five injured and four sham control rats, six months after TBI. Our results showed susceptibility changes in white matter areas consistent with myelin staining. Perilesional cortex became more diamagnetic after TBI. Thalamic nuclei showed variable responses as diamagnetic calcification and paramagnetic iron accumulation occurred in the same brain areas. Overall, QSM showed sensitivity to TBI changes. However, further studies are required to better understand the influence of potentially counteracting pathological processes.

35 12:33

Suitable reference tissues for quantitative susceptibility mapping of the brain

Sina Straub[1], Till Schneider[2,3], Martin T. Freitag[3], Christian H. Ziener[3], Heinz-Peter Schlemmer[3], Mark E. Ladd[1], and Frederik B. Laun[1]

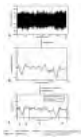
[1]Department of Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Department of Neuroradiology, University of Heidelberg, Heidelberg, Germany, [3]Department of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Since QSM is only able to quantify magnetic susceptibility relative to a reference value, a suitable reference tissue must be available to be able to compare different subjects and stages of disease. To find such a suitable reference tissue for QSM of the brain, melanoma patients with and without brain lesions were measured. 12 reference tissues were chosen and assessed in multiple measurements of the same patient and amongst different patients. The posterior limb of the internal capsule and a cerebrospinal fluid volume in the atrium of the lateral ventricles appeared to be most suitable reference tissues.

Young Investigator Awards

Room 331-332 10:45 - 12:45 *Moderators:*Brian Hargreaves & Jennifer McNab

36 10:45



Music-Based Magnetic Resonance Fingerprinting to Improve Patient Comfort During MRI Examinations

Dan Ma[1], Eric Y. Pierre[2], Yun Jiang [2], Mark D. Schluchter[3], Kawin Setsompop[4], Vikas Gulani[1], and Mark Griswold[1]

[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [3]Epidemiology & Biostatistics, Case Western Reserve University, Cleveland, OH, United States, [4]A.A Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, MA, United States

An acquisition method named MRF-Music is proposed to mitigate the acoustic noise during MRI scans by producing musical sounds directly from the switching magnetic fields while simultaneously quantifying multiple important tissue properties. MP3 music files were converted to arbitrary encoding gradients, which were then used with varying flip angles and TRs in both 2D and 3D MRF exam to generate T1, T2 and proton density maps. The MRF-Music scans were shown to significantly improve patients' comfort. T1 and T2 measured from phantom and in vivo scans were also in good agreement with those from the standard measurements and reported values.

37 11:05

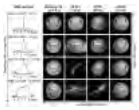
Simultaneous assessment of cardiac metabolism and perfusion using co-polarized [1-13C]pyruvate and 13C-urea

Angus Zoen Lau[1,2], Jack Miller[2,3], Matthew D Robson[1], and Damian J Tyler[1,2]

[1]Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom, [2]Department of Physiology, Anatomy, and Genetics, University of Oxford, Oxford, United Kingdom, [3]Department of Physics, Clarendon Laboratory, Oxford, United Kingdom

Assessment of cardiac metabolism and perfusion using hyperpolarized ^{13}C substrates enables discrimination between viable, hibernating, and non-viable tissue, but current methods require two separate injections of pre-polarized [1-^{13}C]pyruvate and ^{13}C-urea, respectively. We propose to use an infusion of co-polarized [1-^{13}C]pyruvate/^{13}C-urea combined with a flow-sensitized pulse sequence to simultaneously assess both of these parameters in a single injection. Perfusion and metabolic state are modulated using specific interventions, and subsequently detected using the new scan. This probe of both myocardial perfusion and metabolism is anticipated to enable metabolic study of the heart in acute scenarios.

38 11:25



xSPEN: Single-shot magnetic resonance imaging with exceptional resilience to field heterogeneities

Zhiyong Zhang[1], Amir Seginer[1], and Lucio Frydman[1]

[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel

Single-shot MRI has been constrained to acquisitions in quality magnets and homogeneous tissues. The present study introduces a methodology that can deliver such images with good SNR, under much poorer field and/or multiple shift conditions. These capabilities are achieved based on new principles whereby images are read using field gradients that are not applied along the direction being encoded. This enables one to accommodate shifts/inhomogeneities into the single-scan image generation protocol, without suffering from miss-registrations, without requiring a priori information for post-acquisition corrections, and without demanding specialized instrumentation. This enables new single-shot investigations that have hitherto escaped from MRI's scope.

39 11:45

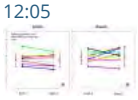
Evaluation of Upper Airway Collapsibility Using Simultaneous Multi-Slice Real-Time MRI

Ziyue Wu[1,2], Weiyi Chen[1], Michael C.K. Khoo[1], Sally L. Davidson Ward[3], and Krishna S. Nayak[1]

[1]University of Southern California, Los Angeles, CA, United States, [2]Alltech Medical Systems, Solon, OH, United States, [3]Children's Hospital Los Angeles, Los Angels, CA, United States

We present a method for simultaneous multi-slice airway collapsibility measurement based on sparse golden-angle radial CAIPIRINHA, with acceleration factor up to 33.3. We present data from patients with obstructive sleep apnea and normal controls. One interesting finding is that a narrower airway site does not always correspond to higher collapsibility. This finding may be of interest to sleep surgeons. Our results also suggest that both compliance and P_{close} were significantly different between healthy controls and OSA patients ($P<0.001$), and both measures can potentially serve as biomarkers.

40 12:05



Interstudy repeatability of self-gated quantitative myocardial perfusion MRI

Devavrat Likhite[1], Promporn Suksaranjit[2], Ganesh Adluru[1], Nan Hu[3], Cindy Weng[3], Eugene Kholmovski[1], Chris McGann[2], Brent Wilson[2], and Edward DiBella[1]

[1]Utah Center for Advanced Imaging Research, Department of Radiology, University of Utah, Salt Lake City, UT, United States, [2]Division of Cardiovascular Medicine, University of Utah, Salt Lake City, UT, United States, [3]Department of Internal Medicine, University of Utah, Salt Lake City, UT, United States

Dynamic contrast enhanced MRI is maturing as a tool in contemporary cardiovascular medicine. A self-gated method that avoids the use of ECG-gating signal has been validated by us for quantitative myocardial perfusion. Our most recent study looks at the inter-study repeatability of this quantitative self-gated method. Our findings show that the multi-slice self-gated (near-systole) approach has a comparable or better repeatability than published ECG-gated single slice studies. The purpose of this abstract is to summarize these

findings from our recent work, highlighting the simplicity, ease of use and reliability of the self-gated method for quantitative myocardial perfusion.

41 12:25

Neurovascular uncoupling in resting state fMRI demonstrated in patients with primary brain gliomas

Shruti Agarwal[1], Haris I. Sair[1], Noushin Yahyavi-Firouz-Abadi[1], Raag Airan[1], and Jay J. Pillai[1]

[1]Division of Neuroradiology, Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University School of Medicine, Baltimore, MD, United States

One of the most important potential limitations of presurgical mapping using blood oxygen level dependent functional magnetic resonance imaging (BOLD fMRI) is the phenomenon of neurovascular uncoupling (NVU). NVU can lead to erroneous interpretation of clinical fMRI examinations. The effects of brain tumor-related NVU on task-based BOLD fMRI have been previously published. The purpose of this study is to demonstrate that the problem of brain tumor-related NVU is a significant issue with respect to resting state BOLD fMRI similar to task-based BOLD fMRI, in which signal detectability can be compromised by breakdown of normal neurovascular coupling.

Oral

Artefacts: System Imperfections & Implants

Room 334-336 10:45 - 12:45 *Moderators:*Pablo Irarrazaval & Dinghui Wang

42 10:45

summa cum laude

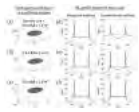
Evolution-time encoded single-scan cross spatiotemporal encoding imaging near metal implants

Zhiyong Zhang[1,2], Amir Seginer[1], and Lucio Frydman[1]

[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel, [2]Electronic Science, Xiamen University, Xiamen, China, People's Republic of

Magnetic resonance imaging (MRI) near metallic implants remains an unmet need because of severe artifacts, which mainly stem from large metal-induced field inhomogeneities. The single-scan cross spatiotemporal encoding (xSPEN) technique delivers in-plane distortion-free 2D images under such large field inhomogeneity condition, while the slice-plane displacement, “signal voids” and “pile-up” effects are proposed to be solved by applying t_1-evolution-time encoding on the multi-slicing 2D xSPEN technique. Compared to the popular “SEMAC” and “MAVIC” techniques, the remarkable time efficiency of this t_1-encoding xSPEN thus enable many advanced MRI applications near metal implants with another additional dimension, such as diffusing MRI, function MRI.

43 10:57



Fast Fourier transform-based susceptibility-to-B0 calculation without aliasing artifacts

Lee Seungkyun[1,2]

[1]Center for Neuroscience Imaging Research (CNIR), Institute for Basic Science (IBS), Suwon, Korea, Republic of, [2]Department of Biomedical Engineering, Sungkyunkwan University (SKKU), Suwon, Korea, Republic of

In the Fourier transform-based susceptibility-to-B_0 calculation, the dipolar field kernel ($1/3-k_z^2/k^2$) is discretely sampled in the k-space, which leads to aliasing artifacts in the spatial domain. We show that calculating and discretizing the dipolar field kernel in the spatial domain, before the Fourier transform, can effectively reduce the aliasing effect without resorting to large zero-filled buffers. In particular, aliasing is eliminated if the spatial-domain grid size is larger than the combined dimensions of the susceptibility source and the B_0 target regions. The new method can accelerate repeated calculations of susceptibility-induced B_0 fields.

44 11:09

Concomitant gradient effects on chemical shift encoded imaging

Timothy J Colgan[1,2], Diego Hernando[1], Samir D Sharma[1], Ann Shimakawa[3], and Scott B Reeder[1,2,4,5,6]

[1]Radiology, University of Wisconsin, Madison, WI, United States, [2]Medical Physics, University of Wisconsin, Madison, WI, United States, [3]Global Applied Science Lab, GE Healthcare, Menlo Park, CA, United States, [4]Biomedical Engineering, University of Wisconsin, Madison, WI, United States, [5]Medicine, University of Wisconsin, Madison, WI, United States, [6]Emergency Medicine, University of Wisconsin, Madison, WI, United States

Quantitative chemical shift-encoded (CSE) MRI techniques acquire complex-valued (magnitude and phase) images at multiple echo times (TE), enabling simultaneous mapping of fat-fraction, R2* (=1/T2*) and B_0 field. Applications of CSE-MRI include tissue fat quantification, iron quantification and quantitative susceptibility mapping (QSM). Recently, phase shifts due to concomitant gradients (CG) have been identified as a source of error for quantitative CSE techniques, so their effects on fat-fraction, R2* and B_0 maps are characterized in this study. CG correction of experimental data demonstrates that the detrimental effects of CG phase shifts can be removed before reconstruction to produce more accurate estimates of the fat-fraction, R2*, and field map measurements.

45 11:21

Real-Time Field Control Using Full 3rd-Order Matrix Pre-Emphasis

Yolanda Duerst[1], Bertram J. Wilm[1], Benjamin E. Dietrich[1], Simon Gross[1], Thomas Schmid[1], David O. Brunner[1], and Klaas P. Pruessmann[1]

[1]ETH Zurich, Zurich, Switzerland

Update steps of real-time field control suffer from imperfect shim responses which degrade control quality. By including full 3rd-order matrix pre-emphasis as an additional filter in the control loop, all self-term responses are shaped to be equal and all cross-term

responses are directly suppressed. This leads to disturbances being rejected faster and less noise amplification. Thus enables better field control in demanding situations such as caused by disturbance of high spatial and temporal variability.

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46 11:33

Reducing Brain MRI Artifacts Caused by Ferromagnetic Orthodontic Appliances Using Permanent Magnets

Zhiyue J Wang[1,2], Yong Jong Park[1,2], Youngseob Seo[1,2], Michael C Morriss[1,2], and Nancy K Rollins[1,2]

[1]UT Southwestern Medical Center, Dallas, TX, United States, [2]Children's Medical Center, Dallas, TX, United States

Stainless steel orthodontic appliances are commonly found in adolescents undergoing clinical brain MRI examinations. They cause severe magnetic susceptibility artifacts and failure to obtain diagnostic information from many MR techniques. The B_0 shimming capability present on clinical MR scanners cannot remove these artifacts. We have constructed devices for the correction of these artifacts at 1.5 T using small pieces of permanent magnets mounted on intra-oral mouth guards or an extra-oral mouth-band. The magnetic field from the permanent magnets cancels the B_0 inhomogeneity induced by ferromagnetic orthodontic appliances, resulting in drastic improvement of MR image quality.

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47 11:45

Accelerated Imaging of Metallic Implants Using Model-Based Nonlinear Reconstruction

Xinwei Shi[1,2], Evan G Levine[1,2], and Brian A Hargreaves[1,2]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Electrical Engineering, Stanford University, Stanford, CA, United States

3D Multi-Spectral Imaging (MSI) methods, including SEMAC, MAVRIC, and MAVRIC-SL, enable MRI near metallic implants by correcting for the metal-induced off-resonance artifacts, but their widespread application is limited by prolonged scan time. In this work, we introduce a novel model-based reconstruction method to accelerate 3D MSI. We demonstrate in phantom and in vivo experiments that the proposed method can accelerate MAVRIC-SL acquisitions by a factor of 4 when used alone, and 13-17 when combined with parallel imaging and half-Fourier acquisition. The images reconstructed by the proposed method showed sharper details and lower level of noise, compared with model-free L1-ESPIRiT.

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48 11:57

Bayesian correction of bias field and Venetian blind for high resolution ex vivo MRI with clinical scanners

Juan Eugenio Iglesias[1], Pedro Manuel Paz-Alonso[1], Garikoitz Lerma-Usabiaga[1], Ricardo Insausti[2], Karla Miller[3], and César Caballero-Gaudes[1]

[1]Basque Center on Cognition, Brain and Language (BCBL), Donostia - San Sebastián, Spain, [2]Human Neuroanatomy Laboratory, University of Castilla-La Mancha, Albacete, Spain, [3]Centre for Functional MRI of the Brain, University of Oxford, Oxford, United Kingdom

Multi-slab MRI enables the acquisition of ultra-high resolution ex vivo MRI of the whole human brain with clinical scanners, by overcoming their hardware limitations (e.g., memory size). However, multi-slab MRI produces slab boundary artifacts (SBA) that degrade the image quality and bias subsequent image analyses. Here we propose a Bayesian method that corrects for SBA and intensity inhomogeneities / bias field (BF) simultaneously. The method, which combines a probabilistic brain atlas and the Expectation Maximization algorithm, takes advantage of the interplay between the two artifacts to outperform state-of-the-art SBA and BF correction algorithms (even when used in combination).

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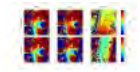
49 12:09



Breathing-induced B0 field fluctuations in the cervical spinal cord at 7T

Signe Johanna Vannesjo[1], Falk Eippert[1], Yazhuo Kong[1], Stuart Clare[1], Karla L Miller[1], and Irene Tracey[1]

[1]FMRIB centre, NDCN, University of Oxford, Oxford, United Kingdom

Spinal cord MRI at ultra-high field poses considerable technical challenges, especially related to static and dynamic B_0 field variations. We here investigated the magnitude and spatial profile of breathing-induced B_0 field fluctuations in the cervical spinal cord at 7T, by comparing field maps acquired during breath-holds in an expired vs. inspired breathing state. Breathing-related field fluctuations of up to 140Hz at the level of C7 were observed. We further implemented a proof-of-principle shim correction, demonstrating the feasibility of using the shim system to compensate for the breathing-induced fields.

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50 12:21

Robust Nyquist Ghost Correction by Incorporating Phase Errors Correction in SENSE

Victor B. Xie[1,2], Mengye Lyu[1,2], Yilong Liu[1,2], Yangqiu Feng[1,2], and Ed X. Wu[1,2]

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

In this abstract, we proposed a novel method that can fully and robustly correct EPI Nyquist ghost by incorporating high-order phase error correction into SENSE reconstruction. More importantly, this method does not induce SNR loss, greatly benefiting the final reconstructed images. Phantom and in vivo imaging results clearly demonstrated the efficacy of this method in ghost correct as well as its superior SNR performance, particularly in accelerated data set that can suffer from amplified noise problems. This novel method has great potentials to be applied in all kinds of EPI-based MRI studies, such as fMRI and DTI.

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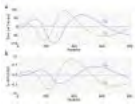
51 12:33

B0 Eddy Current Correction for Spiral MRI

Ryan K Robison[1], Dinghui Wang[1], Zhiqiang Li[1], and James G Pipe[1]



[1]*Imaging Research, Barrow Neurological Institute, Phoenix, AZ, United States*

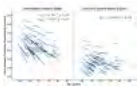
Eddy currents are a common source of artifacts in Spiral MRI. Eddy currents that effect the k-space trajectory are often the focus of eddy current correction. However, the spatially uniform but time-varying B0 eddy currents can also be a subtle but important source of artifacts in spiral images. This work demonstrates the improvement in image quality that can result from measuring and correcting the phase produced by B0 eddy currents in spiral MRI.

Oral

The Aging Brain

Hall 606 | 10:45 - 12:45 | *Moderators:*Claudine Gauthier & Hanzhang LU

52 | 10:45



Reduced functional segregation between the default mode network and the executive control network in healthy older adults: a longitudinal study

Kwun Kei Ng[1], June C. Lo[1], Michael W.L. Chee[1], and Juan Zhou[1,2]

[1]*Duke-NUS Graduate Medical School, Singapore, Singapore,* [2]*Clinical Imaging Research Centre, the Agency for Science, Technology and Research and National University of Singapore, Singapore, Singapore*

The effects of age on functional connectivity (FC) of intrinsic connectivity networks (ICNs) have largely been derived from cross sectional studies. Far less is known about longitudinal changes in FC and how they relate to ageing-related cognitive decline. We found progressive loss of functional specialization with ageing evidenced by a decline in intra-network FC within the executive control (ECN) and default mode networks (DMN). In contrast, longitudinal change in FC between ECN and DMN followed a u-shaped trajectory whereby functional segregation between these two networks initially increased over time and later decreased as participants aged. The rate of loss in ECN-DMN functional segregation was associated with decline in processing speed.

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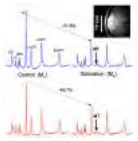
53 | 10:57



Aging Effect on Creatine Kinase Enzyme Activity in Resting Human Brain: An In Vivo 31P-MT Study at 7T

Byeong-Yeul Lee[1], Xiao-Hong Zhu[1], and Wei Chen[1]

[1]*Center for Magnetic Resonance Research, Radiology, University of Minnesota, Minneapolis, MN, United States*

In this work, we investigated the aging effect on the enzyme activity of creatine kinase (CK) in healthy human visual cortex at resting state using a newly developed *in vivo* ^{31}P magnetization transfer (^{31}P-MT) method at 7T. Our results show that there was a strong aging dependence of the CK enzyme activity in the resting brain, implying a significant decline of brain energy metabolism in elderly people. *In vivo* ^{31}P-MT technique should provide a valuable tool for clinical research aiming to study aging-related neurodegenerative diseases such as Alzheimer's disease, and potentially for other metabolic disorders/diseases.

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54 | 11:09

Cerebral venous oxygenation as a potential marker to differentiate normal aging from neurodegeneration

Zixuan Lin[1], Marilyn Albert[2], Peiying Liu[3], Anja Soldan[2], Abhay Moghekar[3], Shin-Lei Peng[4], Michael Miller[1], Peter van Zijl[3], and Hanzhang Lu[3]

[1]*Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States,* [2]*Department of Neurology, Johns Hopkins University School of Medicine, Baltimore, MD, United States,* [3]*Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States,* [4]*Department of Radiology, China Medical University, Taichung, Taiwan*

Decreased cerebral venous oxygenation (Yv) has been considered as a compensation for aging which is diminished in neurodegeneration. We substantiated this hypothesis by examining the relationship between Yv and several Alzheimer-specific hallmarks on 65 normal elderly subjects. We demonstrated that Yv is higher in ApoE4 carriers who have increased risks of AD and that higher Yv is associated with poorer cognitive performance, indicating that assessment of Yv with non-invasive MRI methods may present a potential simple opportunity to identify the transition point from normal to pathological aging.

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55 | 11:21

Hippocampal subfield diffusivity changes in healthy ageing

Daniel J Cox[1,2], Hamied A Haroon[2], Daniela Montaldi[1], and Laura M Parkes[2]

[1]*School of Psychological Sciences, University of Manchester, Manchester, United Kingdom,* [2]*Centre for Imaging Sciences, University of Manchester, Manchester, United Kingdom*

Alterations to hippocampal microstructure may precede gross volumetric changes in ageing, and these changes may occur preferentially in different hippocampal subfields. We investigated both established (FA and mADC) and novel (DOC) measurements of diffusion in these regions, in addition to volume, in order to determine where age-related changes occurred. The results showed changes across the majority of subfields for mADC and FA, but only in left CA 2/3 for DOC measures 1, 3 and >3. We suggest this could be related to differential degradation of particular cellular structures in these regions.

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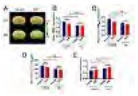
56 | 11:33

Early Shifts of Brain Metabolism by Caloric Restriction Preserve White Matter Integrity and Long-term Memory in Aging Mice

Janet Guo[1], Ailing Lin[1,2], and Vikas Bakshi[1]



[1]Department of Pharmacology & Nutritional Sciences, University of Kentucky, Lexington, KY, United States, [2]Department of Biomedical Engineering, Lexington, KY, United States

Caloric restriction (CR) has been shown to increase healthspan in various species; however, its effects on preserving brain functions in aging remain largely unexplored. We used multimodal neuroimaging (PET/MRI/MRS) and behavioral testing to determine in vivo brain glucose metabolism, energy metabolites, and white matter structural integrity in young and old mice fed with either control or 40% CR diet. Blood glucose and ketone bodies were measured. Our findings suggest CR could slow brain aging, partly due to early shift of energy metabolism caused by lower caloric intake. These results provide rationale for CR-induced sustenance of brain health with extended longevity.

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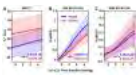

Age-dependent changes in the BOLD Cerebrovascular Reactivity Curve in Response to Progressive Hypercapnia

Alex Bhogal[1], Jill B de Vis[1], Jeroen C.W. Siero[1], Esben T Petersen[2], Peter R. Luijten[1], Jeroen Hendrikse[1], Marielle E.P. Philippens[3], and Hans Hoogduin[4]

[1]Radiology, UMC Utrecht, Utrecht, Netherlands, [2]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark, [3]Radiotherapy, UMC Utrecht, Utrecht, Netherlands, [4]Utrecht, Netherlands

Characterizing healthy, age-related changes in the BOLD-CVR response can provide a reference point from which to distinguish abnormal CVR from the otherwise normal effects of ageing. In this study, we examine age-dependent differences in grey and white matter BOLD-CVR response to progressive hypercapnia between young and elderly subjects.

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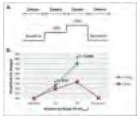
11:57



Assessment of cerebral response to exercise: effects of ageing and cardiorespiratory fitness

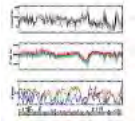
Andrew Hale[1], Penny Gowland[1], Paul Greenhaff[2], and Susan Francis[1]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [2]Faculty of Medicine & Health Sciences, Queens Medical Centre, University of Nottingham, Nottingham, United Kingdom

Although there is a general relationship between age and brain function, habitual physical activity levels may also impact on brain health. We performed a MR study involving low and moderate intensity supine exercise in healthy young and older subjects. We assess the effect of exercise on CBF response in large arteries, regional perfusion and BOLD, and the relationship of grey matter volume with physical fitness and ageing. On exercise there was a clear CBF, perfusion and BOLD response to exercise in young volunteers, whilst a reduced CBF, perfusion and BOLD response to exercise was found in the older volunteers.

59

12:09



Consistent detection of age-dependent variations of the longitudinal relaxation time in cortical brain regions investigated by MP2RAGE at 9.4T: influence of correcting for a non-uniform transmit field

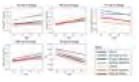
Gisela E Hagberg[1,2], Jonas Bause[1], Thomas Ethofer[2,3], Philipp Ehses[1], Thomas Dresler[3], G Shajan[1], Rolf Pohmann[1], Cornelia Herbert[3], Andreas Fallgatter[3], Christoph Laske[3], Marina Pavlova[2], and Klaus Scheffler[1,2]

[1]High Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Biomedical Magnetic Resonance, University Hospital Tübingen, Tübingen, Germany, [3]General Psychiatry&Psychotherapy, University Hospital Tübingen, Tübingen, Germany

Accurate and precise determination of T1 values is of central importance in clinical studies and for tissue segmentation based on the myeloarchitecture that transcends T1. Here we investigate whether well-described age-dependent changes can be detected by high field T1 relaxometry, and how different transmit field correction methods influence the results. We found that the intrinsic bias correction of the MP2RAGE technique is not sufficient to achieve reliable quantification of T1 at ultra high magnetic fields. But, provided that a correction for transmit field inhomogeneity is performed, T1 maps that consistently reveal age-related changes can be generated. The technique holds promise for investigation of local myeloarchitectonics for neuroscientific and clinical studies.

60

12:21



Changes in white matter structural connectivity and cortical functional connectivity over the healthy adult lifespan

Adrian Tsang[1,2,3], Catherine Lebel[1,4], Signe Bray[1,4], Brad Goodyear[1,2,3], Roberto C. Sotero[1], Cheryl McCreary[1,3], and Richard Frayne[1,2,3]

[1]Department of Radiology, University of Calgary, Calgary, AB, Canada, [2]Hotchkiss Brain Institute, Calgary, AB, Canada, [3]Seaman Family MR Research Centre, Calgary, AB, Canada, [4]Child and Adolescent Imaging Research Program, Alberta Children's Hospital Research Institute, Calgary, AB, Canada

This study investigates how both structural and functional connectivity (SC and FC) changes in the adult lifespan as well as to explore the relationship between measures that are commonly used for SC and FC in the context of normal aging. A multi-modal analysis using DTI and resting-state fMRI data was performed from 183 healthy participants aged 18 – 87 years. We found that fractional anisotropy (FA) and FC showed similar rate of change and correlation strengths with age in the 7 resting-state networks explored. However none of the SC measures showed significant correlations with FC measure.

61

12:33

Diagnostic accuracy of MRS for Hereditary Neurodegeneration at 3T and 7T

Uzay E Emir[1,2], Tianmeng Lyu[3], Dinesh K Deelchand[2], James M Joers[2], Diane Hutter[2], Christopher M Gomez[4], Khalaf O Bushara[5], Lynn E Eberly[3], and Gulin Oz[2]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [2]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [3]Division of Biostatistics, School of Public Health, University of Minnesota, Minneapolis, MN, United

States, [4]Department of Neurology, University of Chicago, Chicago, IL, United States, [5]Department of Neurology, Medical School, University of Minnesota, Minneapolis, MN, United States

To evaluate diagnostic accuracy of state-of-the-art MRS in early neurodegenerative disease, we measured neurochemical profiles in the vermis, cerebellar hemisphere and brainstem of genetically confirmed subjects with spinocerebellar ataxia type 1 and controls by 3T and 7T 1H MRS. Concentrations of major metabolites obtained at 3T and 7T were strongly correlated. While 3T showed great potential by enabling detection of abnormal metabolite levels even in the presymptomatic stage, the increased sensitivity at 7T enabled group separation with higher significance and identification of subtle neurochemical alterations in early symptomatic disease stage more robustly than at 3T.

Oral

fMRI Analysis: Post-Processing

Summit 1 | 10:45 - 12:45 | *Moderators:*José Marques

62 | 10:45

Nuisance Regression of High-frequency FMRI Data: De-noising Can Be Noisy

Jingyuan E. Chen[1,2], Hesamoddin Jahanian[2], and Gary H. Glover[1,2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States

A growing number of studies using fast sampling have demonstrated the persistence of functional connectivity (FC) in resting state (RS) networks beyond the conventional 0.1 Hz. However, some RS studies have reported frequencies (e.g., up to 5 Hz) not easily supported by canonical hemodynamic response functions. Here, we investigated the influence of a common preprocessing step – whole-band (the entire frequency band resolved by a short TR) linear nuisance regression (LNR) – on RSFC. We demonstrated via both simulation and real data that LNR can introduce network structures in HF bands, which may largely account for the observations of HF-RSFC.

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63 | 10:57

A family-constrained local canonical correlation model to improve activation detection in fMRI

Xiaowei Zhuang[1], Zhengshi Yang[1], Tim Curran[2], and Dietmar Cordes[1,2]

[1]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States, [2]Department of Psychology and Neuroscience, University of Colorado Boulder, Boulder, CO, United States

A family constrained CCA (cCCA) method was introduced to improve the accuracy of activation detection in noisy fMRI data. The cCCA was converted into a constrained multivariate multiple regression problem and solved efficiently with a numerical optimization algorithm. Results from both simulated data and real episodic memory data indicated that a higher detection sensitivity for a fixed specificity can be achieved with the proposed cCCA method as compared to the widely used mass-univariate or other conventional multivariate (CCA) approaches.

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64 | 11:09

Use of T2-weighted 3D acquisition for correction of EPI-induced distortion in fMRI

Andrea Nordio[1,2,3], Denis Peruzzo[2], Filippo Arrigoni[2], Fabio Triulzi[2,4], and Alessandra Bertoldo[1,2]

[1]Department of Information Engineering (DEI), University of Padova, Padova, Italy, [2]IRCCS E.Medea, Bosisio Parini, Lecco, Italy, [3]IRCCS Casa Sollievo della Sofferenza, San Giovanni Rotondo, Foggia, Italy, [4]IRCCS Cà Granda Ospedale Maggiore, Policlinico, Milano, Italy

Echo Planar Imaging (EPI) sequences used for acquiring fMRI time series data have a high temporal resolution but are also highly sensitive to the magnetic field inhomogeneity resulting in geometric distortions. In this work we propose an approach for correction of EPI distortion in fMRI sequences. Our method takes advantage of a non-distorted T2-weighted (T2W) 3D sequence as intermediate step between the acquired fMRI data and the anatomical image. This strategy allows to use non-linear registration functions. We validated our method on a group of healty subjects during finger-tapping task, proving that the proposed method significantly improves the group analysis results of functional data.

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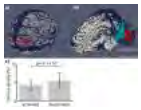
65 | 11:21



Investigating the effects of venous vasculature on the BOLD response: A combined SWI and multi-band fMRI approach

David Provencher[1], Alexandre Bizeau[1], Yves Bérubé-Lauzière[2], and Kevin Whittingstall[1,3]

[1]Radiation Sciences and Biomedical Imaging, Université de Sherbrooke, Sherbrooke, QC, Canada, [2]Electrical and Computer Engineering, Université de Sherbrooke, Sherbrooke, QC, Canada, [3]Diagnostic Radiology, Université de Sherbrooke, Sherbrooke, QC, Canada

We previously showed that venous density correlates with BOLD signal amplitude[1]. Since the BOLD contrast inherently originates in veins, we hypothesized that its temporal dynamics would also be affected by venous density. Here, we use fast multi-band fMRI imaging (TR=0.45s), SWIp vein reconstruction and different visual stimuli yielding co-localized activation, yet different BOLD dynamics. From this, we assess the effects of venous density on BOLD timing. Results show a robust association between higher vein density and shorter hemodynamic delay when comparing activated and deactivated regions. BOLD response timing differences may thus not entirely reflect neural activity, but also structural differences.

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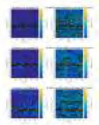
66 | 11:33

The hidden heart rate in the slice-wise BOLD-fMRI global signal.

Michael Hütel[1,2], Andrew Melbourne[1], David L Thomas[1,2], Jonathan Rohrer[2], and Sebastien Ourselin[1,2]

magna cum laude



[1]Translational Imaging Group, University College London, London, United Kingdom, [2]Dementia Research Centre, University College London, London, United Kingdom

Previous studies have shown that slow variations in the cardiac cycle are coupled with signal changes in the blood-oxygen level dependent (BOLD) contrast. The detection of neurophysiological hemodynamic changes, driven by neuronal activity, is hampered by such physiological noise. It is therefore of great importance to model and remove these physiological artefacts. The cardiac cycle causes pulsatile arterial blood flow. This pulsation is translated into brain tissue and fluids bounded by the cranial cavity. We exploit this pulsality effect and provide evidence that the heart rate is inherent in BOLD fMRI images.

67

magna cum laude

11:45

Advanced combinations of dual-echo fMRI data provide no advantages over the simple average at group-level analyses

Ádám Kettinger[1,2], Christian Windischberger[3], Christopher Hill[4], and Zoltán Nagy[4]

[1]Department of Nuclear Techniques, Budapest University of Technology and Economics, Budapest, Hungary, [2]Brain Imaging Centre, Research Centre for Natural Sciences, Hungarian Academy of Sciences, Budapest, Hungary, [3]Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria, [4]Laboratory for Social and Neural Systems Research, University of Zurich, Zurich, Switzerland

Multi-echo EPI acquisitions are used in fMRI research due to their superior BOLD sensitivity. Several advanced methods of echo combinations have been proposed. We confirmed, using dual-echo data, that CNR weighting is the optimal combination on a single subject level. However, we have shown that these advantages do not carry over to a group analysis where a simple averaging of the echos provides equally good statistical results. This is likely due to the increase of inter-subject variance of contrast-to-noise ratio. Future work aims to quantitatively compare inter-subject and intra-subject variance of dual-echo data in group studies.

68

11:57

Effect of temporal resolution and serial autocorrelations in fast fMRI

Ashish Kaul Sahib[1], Klaus Mathiak[2], Michael Erb[1], Adham Elshahabi[3], Silke Klamer[3], Klaus Scheffler[4], Niels Focke[3], and Thomas Ethofer[1]

[1]Biomedical magnetic resonance, University of tuebingen, Tuebingen, Germany, [2]5Department of Psychiatry, Psychotherapy and Psychosomatics, University Hospital Aachen, Aachen, Germany, [3]Department of Neurology/Epileptology, University of tuebingen, Tuebingen, Germany, [4]Max-Planck-Institute for Biological Cybernetics, Tuebingen, Germany

To assess the impact of colored noise on statistics and determine optimal imaging parameters in event-related fMRI (visual stimulation using checkerboards) acquired by simultaneous multi-slice imaging enabling repetition times (TR) between 2.64 to 0.26s. Optimal statistical power was obtained for a TR of 0.33s, but short TRs required higher-order autoregressive (AR) models to achieve stable statistics. Colored noise in event-related fMRI obtained at short TRs calls for more sophisticated correction of serial autocorrelations.

69

magna cum laude

12:09

Individual Subject Functional Connectivity Parcellation with Group-Level Spatial and Connectivity Priors

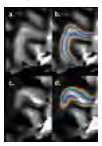
Ru Kong[1], Alexander Schaefer[1], Avram J. Holmes[2], Simon B. Eickhoff[3,4], Xi-Nian Zuo[5], and B.T. Thomas Yeo[1]

[1]Department of Electrical and Computer Engineering, ASTAR-NUS Clinical Imaging Research Centre, Singapore Institute for Neurotechnology and Memory Networks Program, National University of Singapore, Singapore, Singapore, [2]Department of Psychology, Yale University, New Haven, CT, United States, [3]Institute for Clinical Neuroscience and Medical Psychology, Heinrich-Heine University Düsseldorf, Düsseldorf, Germany, [4]Institute for Neuroscience and Medicine (INM-1), Research Center Jülich, Jülich, Germany, [5]Lab for Functional Connectome and Development Division of Cognitive and Developmental Psychology, CAS, Beijing, China, People's Republic of

We propose a hidden Markov Random Field (MRF) model to parcellate the cerebral cortex of individual subjects using resting-state fMRI (rs-fMRI). Our MRF model imposes a smoothness prior on the individual-specific parcellation, while imposing group-level population priors that capture inter-subject variability in both functional connectivity profiles and spatial distribution of functional brain networks. Experiments on a test-retest dataset suggest that the resulting parcellation estimates are better than alternative approaches at capturing stable properties of individual subjects' intrinsic brain organization, instead of transient noise or session-dependent variations.

70

12:21



High-resolution T1-mapping using inversion-recovery EPI and application to cortical depth-dependent fMRI at 7 Tesla

Sriranga Kashyap[1], Dimo Ivanov[1], Martin Havlíček[1], Benedikt A Poser[1], and Kâmil Uludağ[1]

[1]Department of Cognitive Neuroscience, Maastricht University, Maastricht, Netherlands

Cortical-depth dependent fMRI usually relies on the definition of depths on an anatomical image (eg. MPRAGE). The geometric dissimilarities of the functional compared to the anatomical data require further spatial processing of the functional data to ensure good co-registration. We propose an alternative approach that uses an optimised inversion-recovery EPI derived T_1 image, whose resolution and readout, hence distortions, are identical to that of the functional data, in order to delineate cortical depths. As a result, the cortical-depth specific fMRI data can be analysed in the native space without any spatial confounds stemming from distortion correction and inaccurate registration.

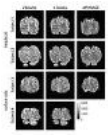
71

12:33

Distortion-matched T1-maps and bias-corrected T1w-images as anatomical reference for submillimeter-resolution fMRI

Wietske van der Zwaag[1], Pieter Buur[1], Maarten Versluis[2], and José P. Marques[3]

[1]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands, [2]Philips Healthcare, Best, Netherlands, [3]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands



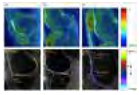
Achieving sufficiently good quality co-registration between the anatomical and functional images is currently a large stumbling block for laminar fMRI. Here, we present a distortion-matched T_1weighted/T_1-estimation mapping approach using two 3D-EPI readouts per inversion, following the MP2RAGE signal combination. 0.7mm isotropic T_1 data with matching distortions to a 0.7mm isotropic fMRI protocol can be acquired in less than two minutes.

Oral

Imaging of Joint Health & Disease

Summit 2 | 10:45 - 12:45 | *Moderators:*Emily McWalter

72 | 10:45



Imaging Cartilage-Bone Interactions in Osteoarthritis using Simultaneous 18F-NaF PET-MR imaging– the "Bone-Cartilage Connectome"
Dragana Savic[1,2], Valentina Pedoia[1], Youngho Seo[1], Matthew Bucknor[1], Benjamin Franc[1], and Sharmila Majumdar[1]

[1]University of California San Francisco, San Francisco, CA, United States, [2]University of Oxford, Oxford, United Kingdom

This first in human study evaluated cartilage biochemistry and bone function in sixteen knee osteoarthritis patients using simultaneous Time-Of-Flight (TOF) PET/MR imaging. Bone turnover and blood flow was studied using ^{18}F Sodium Fluoride (NaF) and quantitative voxel by voxel MR derived $T_{1\rho}$ relaxation times characterizing the biochemical cartilage degeneration. Increased degeneration of cartilage, was associated with increased turnover in the adjoining bone as well as in the non-adjoining compartments. These observations highlight the complex biomechanical and biochemical interactions in the whole knee joint, alluding to a "bone-cartilage connectome", that potentially changes during the natural history of the disease.

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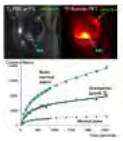
73 | 10:57



Dynamic analysis of [18F]-sodium fluoride uptake in knee osteoarthritis with PET-MRI
Audrey P Fan[1], Feliks Kogan[1], Aleema Patel[1], Edwin HG Oei[2], Andrew Quon[1], and Garry E Gold[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Erasmus MC: University Medical Center Rotterdam, Rotterdam, Netherlands

This study investigates dynamic uptake of [18F]-fluoride in bone marrow lesions (BMLs) and osteophytes observed on MRI of patients with knee osteoarthritis. Through kinetic modeling, we characterized rate constants of bone metabolism in bone pathology relative to healthy bone. BMLs and higher-grade osteophytes showed higher total bone metabolism K_i ($P < 0.01$) and higher bone mineralization rate k_3 ($P < 0.01$) relative to grade 1 osteophytes and normal bone. While a similar trend was observed for blood flow, the differences from normal tissue were subtler suggests that rate of mineralization k_3 and not blood flow is a key driver of [^{18}F]-fluoride accumulation in OA lesions. These new physiological parameters may help differentiate between different grades of OA lesions or identify which lesions are active parts of the disease process.

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74 | 11:09

Longitudinal Evaluation of Cartilage Component of Matrix-Associated Autologous Chondrocyte Transplants using Biochemical MR Imaging
Xian Xu[1], Ningyu An[1], Panli Zuo[2], and Esther Raithel[3]

[1]Department of Radiology, Chinese PLA General Hospital, Beijing, China, People's Republic of, [2]Siemens Healthcare, MR Collaborations NE Asia, Beijing, China, People's Republic of, [3]Siemens Healthcare GmbH, Berlin, Germany

This study combined T2 mapping and delayed gadolinium-enhanced MRI of cartilage (dGEMRIC) technique to evaluate the repair cartilage tissue after Matrix-associated autologous chondrocyte implantation (MACI). We found that the T2 and ΔR1 values of the repair tissue were significantly higher than the native tissue at 1, 3 and 6 months after MACI, but showed a downward trend and showed no difference with native tissue at 12 months, which suggested that the integrity of the collagen and GAG of repair tissue was similar to native cartilage.

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75 | 11:21

Loaded MRI – A Surrogate Measurement of in vivo Knee Joint Contact Mechanics
Matthew F. Koff[1], Hongsheng Wang[2], Suzanne Maher[2], Scott Rodeo[3], and Hollis G Potter[1]

[1]Department of Radiology and Imaging - MRI, Hospital for Special Surgery, New York, NY, United States, [2]Department of Biomechanics, Hospital for Special Surgery, New York, NY, United States, [3]Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, NY, United States

The relationship between calculated articular cartilage deformation when using an MR compatible loading device and actual contact mechanics has not been assessed. This study evaluated the accuracy of in vivo cartilage deformation as a surrogate for in vivo contact mechanics. Meniscal allograft transplantation patients underwent loaded MR pre-operatively and direct stress measurement intra-operatively. Good correlation, 0.72 (range: 0.56 to 0.85), between cartilage deformation and contact stress measurements was found. In vivo cartilage deformation may be a surrogate for in vivo contact mechanics.

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76 | 11:33

Incorporation of Finite Pulse Correction for Improved MT-Corrected Multicomponent T2 analysis of Cartilage
Fang Liu[1], Alexey Samsonov[1], Wally Block[2], and Richard Kijowski[1]

[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Department of Medical Physics, University of Wisconsin-Madison, Madison, WI, United States

Nuclear magnetic resonance studies have identified multiple water components within cartilage tissue. Previous studies using steady-state sequences based rapid method such as mcDESPOT and mcRISE have shown feasibility of multicomponent T2 analysis of cartilage. However, steady-state signal can be influenced by the finite pulse effect which might lead to biased parameter estimation. In this study, we incorporated the finite pulse correction in the mcRISE model and demonstrated the potential MT and finite pulse effect in-sensitive T2 parameters for multicomponent cartilage relaxometry analysis.

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77 11:45

Correlation of MRI Appearance of Total Hip Arthroplasty With Wear Metric and Histologic Evaluation

Matthew F. Koff[1], Parina H. Shah[1], Mauro Miranda[1], Christina Esposito[2], Elexis Baral[2], Kara Fields[3], Thomas Bauer[4], HSS Adult Reconstruction & Joint Replacement Division[5], Douglass Padgett[5], Timothy Wright[2], and Hollis G. Potter[1]

[1]Department of Radiology and Imaging - MRI, Hospital for Special Surgery, New York, NY, United States, [2]Department of Biomechanics, Hospital for Special Surgery, New York, NY, United States, [3]Healthcare Research Institute, Hospital for Special Surgery, New York, NY, United States, [4]Cleveland Clinic Foundation, Cleveland, OH, United States, [5]Adult Reconstruction and Joint Replacement Division, Hospital for Special Surgery, New York, NY, United States

A majority of primary total hip arthroplasty (THA) function well but implant failure may occur. We propose MRI to evaluate adverse local tissue reactions (ALTRs) in patients with THA. In this study, we correlate indirect measures of ALTRs with direct measurements of implant wear. Greater volumetric wear and visual damage was found in subjects with ALTR on MR images. MR also correlated with histologic metrics of implant wear. The results indicate that MRI allows for accurate diagnosis of different synovial patterns in THA, which correlate to wear analysis at retrieval.

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78 11:57

In Vivo Evaluation of Low-grade Cartilage Defects in the Knee using Sodium MRI at 7T

Stefan Zbyn[1,2], Vladimir Mlynarik[1], Vladimir Juras[1], Markus Schreiner[1,3], Didier Laurent[4], Joerg Goldhahn[4], Nicole Getzmann[4], Stefan Marlovits[5], and Siegfried Trattnig[1]

[1]Department of Biomedical Imaging and Image-Guided Therapy, Medical University Vienna, Vienna, Austria, [2]CD Laboratory for Clinical Molecular MR Imaging, Vienna, Austria, [3]Department of Orthopaedics, Medical University Vienna, Vienna, Austria, [4]Novartis Institutes for Biomedical Research, Basel, Switzerland, [5]Department of Trauma Surgery, Medical University Vienna, Vienna, Austria

To our best knowledge, this is the first report on employing sodium (23Na) MRI for the in vivo evaluation of low-grade cartilage defects in the knee joint. In this 7T study, regions with chondral defect, weight-bearing, and non-weight-bearing femoral cartilage were evaluated in 23Na-images of patients after knee injury. Test-retest comparison showed high robustness and repeatability of sodium data. 23Na-MRI allowed differentiation between normal-appearing cartilage and low-grade chondral defects. 23Na-MRI can be used for noninvasive follow-up of changes in GAG content associated with cartilage degeneration. This method might be particularly useful for the evaluation of cartilage regenerating therapies.

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79 12:09

Local Analysis of T1ρ, T2, and R2–R1ρ Compositional MR Imaging in Patients with ACL Injury Using Voxel-Based Relaxometry

Colin Russell[1], Valentina Pedoia[1], Keiko Amano[1], and Sharmila Majumdar[1]

[1]Radiology and Biomedical Imaging, University of California, San Francsico, San Francisco, CA, United States

This multicenter study employs VBR as a novel technique to analyze patients with ACL tears at the time of injury and 6 months after ACL reconstruction. $T_{1\rho}$ and T_2 analysis, correlation, and dispersion difference (R_2–$R_{1\rho}$) are three methods employed to highlight significant cartilage changes. The most posterior region of the posterior lateral tibia and the patella indicated partial cartilage recovery 6 months after reconstruction, demonstrated by decreasing $T_{1\rho}$ and T_2, decreased $T_{1\rho}$ T_2 correlation baseline to 6 months, and dispersion differences (R_2–$R_{1\rho}$). The trochlea displayed symptoms of cartilage degeneration, such as elevated $T_{1\rho}$ and T_2 and dispersion differences.

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80 12:21

In vivo assessment of T2* in menisci under loading conditions at 3 Tesla: preliminary results

Vladimir Juras[1,2], Lenka Hornakova[3], Petr Kubovy[3], Daniel Hadraba[3,4], Pavel Stursa[5], David Gerych[3], Pavol Szomolanyi[1], Karel Jelen[3], and Siegfried Trattnig[1,6]

[1]Department of Biomedical Imaging and Image-Guided Therapy, High Field MR Centre, Medical University of Vienna, Vienna, Austria, [2]Department of Imaging Methods, Institute for Measurement Science, Bratislava, Slovakia, [3]Department of Anatomy and Biomechanics, Faculty Of Physical Education and Sport, Prague, Czech Republic, [4]Department of Radiology, Hospital na Homolce, Prague, Czech Republic, [5]Academy of Sciences of the Czech Republic, Prague, Czech Republic, [6]Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria

Meniscus behavior under loading in vivo has been studied using parametric MR imaging. T2* has been acquired with vTE using very short first TE = 0.8 ms to secure the precise estimation. The knees of the subjects were loaded in situ with custom made compression device and T2* mapping was performed in 5 time points (without loading, and 4 consequent scans under the loading 7 min apart). The increase in T2* was observed in all compartments, significance was found in medial meniscus only. vTE T2* mapping might be a prospective marker for detecting the dynamic response of the meniscal tissue.

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81 12:33

3D UTE Cones-IDEAL Imaging of the Knee and Ankle joints: Fast Volumetric Imaging with Robust Fat/water Separation

Qun He[1,2], Michael Carl[3], Graeme Bydder[1], and Jiang Du[1]

[1]*University of California, San Diego, San Diego, CA, United States,* [2]*Ningbo Jansen NMR Technology Co., Ltd., Cixi, Zhejiang, China, People's Republic of,* [3]*Global MR Applications & Workflow, General Electric, San Diego, CA, United States*

UTE sequences combined with IDEAL processing produces high contrast images of short T_2 tissues or tissue components such as menisci, ligaments, and tendons. In this work, we report the use of 3D UTE Cones imaging and IDEAL processing (3D Cones-IDEAL) for volumetric imaging of short T_2 tissues in the knee and ankle joints at 3T. High resolution volumetric imaging of the knee and ankle joints, together with robust fat/water separation, field map estimation, R_2*/T_2* mapping and fat fraction mapping are demonstrated.

Educational Course

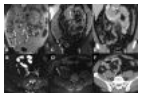
Body MRI Applications in the Emergency Department

*Organizers:*Lorenzo Mannelli, M.D., Ph.D., Ivan Pedrosa, M.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 1 | 10:45 - 12:45 | *Moderators:*Yu-Ting Kuo & Jing Yuan

10:45 Rapid MRI Protocols & Acquisitions for Emergency Patients
Jennifer Uyeda

11:15 MRI in Acute Appendicitis: The Emergency Physician Perspective



Michael D Repplinger[1]

[1]*Emergency Medicine, University of Wisconsin - Madison, Madison, WI, United States*

In this presentation, we will discuss the diagnostic accuracy of MR to diagnose appendicitis, both in the general population and in select cohorts. Additionally, we will discuss the evidence for various MR sequences (unenhanced, intravenous contrast-enhanced, and DWI) as well as the affect of radiologist expertise in abdominal MR on diagnostic accuracy. Finally, we will discuss how using MR in the emergency department setting impacts patient care, particularly their timely evaluation.

11:45 Pulmonary MRA

Jeffrey H. Maki[1]

[1]*Radiology, University of Washington, Seattle, WA, United States*

Accurately diagnosing pulmonary embolism is clinically vital, with CT Pulmonary Angiography (CTPA) the most often used diagnostic tool. CTPA, however, is not without limitations. The largest of these is ionizing radiation, which for younger patients can significantly increase lifetime attributable cancer mortality risk, especially considering a positive CTPA rate of <10%. Additionally, many patients have iodine allergies or are pregnant. Pulmonary MRA is an emerging technology that has benefited from new technical advances and recently proven to have a high negative predictive value similar to CTPA. Pulmonary MRA should be considered in the young and those where CTPA is contraindicated.

12:15 MRV
Charles Kim[1]

[1]*Radiology, Duke University Medical Center, Durham, NC, United States*

MR venography can play a vital role in the diagnosis and treatment planning for acute venous thrombosis if well-developed protocols and referral patterns are in place. The two primary emergency indications for MR venography will be discussed in detail: acute iliofemoral / lower extremity DVT and acute SVC syndrome. The ideal MR venography contrast agents will be reviewed, as well as optimized MR venography protocols. This lecture will provide the audience with pertinent clinical information, pros and cons of various competing imaging modalities, and emphasize key reporting topics for these various pathologies.

12:45 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Molecular Imaging of Inflammation & Infection

*Organizers:*Natalie J. Serkova, Ph.D.

Nicoll 2 | 10:45 - 12:45 | *Moderators:*Francesca Branzoli & Natalie Serkova

10:45 Assessing CNS Vasculature and inflammation using dual GBCA and ferumoxytol-enhanced MRI
Edward Neuwelt

Ferumoxytol as an MRI contrast can provide additional information on CNS lesions. Pre-clinical studies have used advanced neuroimaging techniques with ferumoxytol to evaluate tumor changes after different treatments in animal models as well as evaluation of acute neuroinflammation. Clinically, ferumoxytol has been used to differentiate tumor progression from pseudoprogression and also to evaluate inflammatory and vascular CNS lesions. Dual-contrast imaging may mark the beginning of a multicontrast era when different contrast agents are applied for specific purposes to evaluate CNS lesions. Improved neuroimaging can potentially be incorporated into standard of care for assessing therapy-induced changes and tumor response to therapy.

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82 11:15

Radiation-induced inflammatory response in tumor-bearing immune-compromised mice by SPIO-enhanced T2-MRI

Natalie Julie Serkova[1], Kendra M Huber[1], Barbara Frederick[2], Elizabeth R Kessler[3], Thomas W Flaig[3], and Brian D Kabanagh[2]

[1]Anesthesiology, University of Colorado Denver, Aurora, CO, United States, [2]Radiation Oncology, University of Colorado Denver, Aurora, CO, United States, [3]Medical Oncology, University of Colorado Denver, Aurora, CO, United States

Clinically, the radiation treatment (RT) is know to trigger an inflammatory response which can be beneficial for overall anti-cancer treatment efficacy. However, in pre-clinical mouse models, the tumor response to the RT is rather heterogenous. Our hypothesis is that tumor-associated macrophages which drive the pro-inflammatory response to the RT, are expressed differently in various mouse strains based on their genetic make-up. The goal of this study was to non-invasively assess the tumor inflammatory response to the RT based on iron oxide-induced changes in T2-MRI after injection of SPIO nanoparticles in two different mouse models with severely (NOD SCID) and moderately (nu/nu athymic) compromised immune system.

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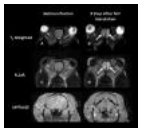
83 11:27



Neuroimaging of Nipah Virus in a Syrian Hamster Model of Infection

Margaret R. Lentz[1], Dima A. Hammoud[2], Yu Cong[1], Oscar Rojas[1], David Thomasson[1], Peter B. Jahrling[1,3], and Michael R. Holbrook[1]

[1]Integrated Research Facility, NIAID, National Institutes of Health, Frederick, MD, United States, [2]Radiology and Imaging Sciences, Clinical Center, National Institutes of Health, Bethesda, MD, United States, [3]Emerging Viral Pathogens Section, NIAID, National Insitutes of Health, Frederick, MD, United States

The purpose of this study was to utilize MRI to assess alterations in the brain that occur in a Golden Syrian hamster infected with Nipah virus (NiV) via intranasal inoculation. Within 9 days of exposure to NiV, signal alterations were observed in the olfactory bulb in T_2-weighted and FLAIR images, suggestive of inflammation and edema induced by NiV crossing the olfactory epithelium. The identification of non-invasive imaging biomarkers of acute NiV neurologic disease progression in this animal model could aid in the examination of potential vaccines and therapeutics.

11:39

Novel Imaging Tracers for Rapid and Noninvasive Assessment of Bacterial Infections

Sanjay Jain[1]

[1]Johns Hopkins Medical Institute

We are developing novel imaging tracers for rapid and noninvasive assessment of bacterial infections and to study antimicrobial pharmacokinetics.

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84 12:09

Diffusion and perfusion MR imaging indicate inflammation followed by fibrosis in a hepatitis B infected humanized mouse liver model

Prashant Chandrasekharan[1], Dahai Zheng[2], Kavita Kaur D/O Ranjit Singh[1], Qingfeng Chen[2], and Kai Hsiang Chuang[1]

*[1]A*STAR, Singapore Bio Imaging Consortium, Singapore, Singapore, [2]A*STAR, Institute of Molecular and Cell Biology, Singapore, Singapore*

Humanized mouse model of liver infection is essential to understand the role of the immune system during disease progression and therapeutic intervention. In this study we have used MRI functional imaging bio-markers to assess the pathology related to Hepatitis B infection in a humanized mouse liver model.

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85 12:21

Identifying carotid plaque inflammation using high and low molecular weight contrast agents

Jason Kraig Mendes[1], Scott McNally[1], Seong-Eun Kim[1], Bradley D. Bolster[2], Gerald S. Treiman[3], and Dennis L. Parker[1]

[1]Radiology, University of Utah, SLC, UT, United States, [2]Siemens Healthcare, SLC, UT, United States, [3]Department of Veterans Affairs, SLC, UT, United States

Carotid plaque inflammation can be measured with dynamic contrast enhanced (DCE) MRI and is a marker for plaque instability. Despite this, DCE has not become a clinically viable tool in diagnosing carotid plaque instability and the corresponding stroke risk. The barrier to progress is a DCE protocol meeting requirements for clinical use to monitor medical treatment effect or failure. This project overcomes this barrier by developing a reliable and inclusive dual contrast DCE protocol to identify carotid plaque inflammation.

12:33 Panel Discussion

12:45 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Proving Where MRI has Value

*Organizers:*Garry E. Gold, M.D. & James G. Pipe, Ph.D.

Nicoll 3 | 10:45 - 12:45 | *Moderators:*Daniel Sodickson & Garry Gold

10:45

What Makes for a Clinically Useful MR Exam?

Scott Reeder[1]

[1]*University of Wisconsin, Madison, WI, United States*

Development, validation, and translation of advanced new imaging methods is an exciting and important area of scientific development and clinical medicine. The development of standardized approaches and objective measures of new imaging technologies such as SNR and CNR, and subjective ordinal metrics are extremely helpful particularly in the early stages of technical development and translation. Subsequent studies comparing new imaging techniques with accepted reference standards, is the next step to establish the diagnostic performance of a technique for the detection and staging of disease. Ultimately, clinical effectiveness and patient outcomes are the most important metric of the impact of new technologies. Finally, there are many practical barriers that should be considered, including work flow, post-processing, that are needed to garner acceptance by technologists, radiologists, and referring physicians.

11:10

From k-Space to Pasteur's Quadrant: Your Research Can Make the World a Better Place

Richard L Ehman[1]

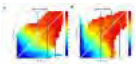
[1]*Radiology, Mayo Clinic, Rochester, MN, United States*

The ISMRM has launched the "MR Value Initiative", to encourage innovative optimization the ***value*** of MR-based diagnostic technologies. Both the numerator (clinical benefit) and the denominator (cost) of the value ratio can be targeted by scientific and technical innovation. Studies have shown that investigators in medical imaging generate innovations at a high rate, and that these inventions can often be readily translated, with extraordinary impact on patient care. This presentation focuses on identifying time-tested strategies that aspiring innovators can use to improve the chances that their work will have an impact and perhaps make the world a better place.

11:35

Panel Discussion

86 | 11:45



Reperfusion beyond 6 hours impacts Tissue Fate of Moderate Ischemia

Hongyu An[1], Andria L Ford[2], Cihat Eldeniz[1], Yasheng Chen[2], Katie D Vo[3], Hongtu Zhu[4], William J Powers[5], Weili Lin[6], and Jin-Moo Lee[2]

[1]*Washington University in St. Louis, St. Louis, MO, United States,* [2]*Neurology, Washington University in St. Louis, St. Louis, MO, United States,* [3]*Radiology, Washington University in St. Louis, St. Louis, MO, United States,* [4]*Biostatistics, University of North Carolina At Chapel Hill, Chapel Hill, NC, United States,* [5]*Neurology, University of North Carolina At Chapel Hill, Chapel Hill, NC, United States,* [6]*Radiology, University of North Carolina At Chapel Hill, Chapel Hill, NC, United States*

The fate of mild to moderate ischemic tissue is greatly impacted by both hyperacute (3-6 hr) and acute (6-24hr) perfusion changes. Thus, such regions could be targeted for intervention beyond current treatment windows.

87 | 11:57

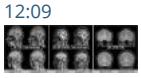
Cost Effectiveness of MRI Before Prostate Biopsy

Shivani Pahwa[1], Nicholas Schiltz[2], Lee Ponsky[3], Ziang Lu[1], Sara Dastmalchian[1], Robert Abouassaly[3], Mark Griswold[4], and Vikas Gulani[5]

[1]*Radiology, Case Western Reserve University, Cleveland, OH, United States,* [2]*Epidemiology and Biostatistics, Case Western Reserve University, Cleveland, OH, United States,* [3]*Urology, Case Western Reserve University, Cleveland, OH, United States,* [4]*Radiology and Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States,* [5]*Radiology, University Hospitals Case Medical Center, Cleveland, OH, United States*

The perception that MRI inflates health care costs impedes its incorporation into prostate cancer treatment algorithms, despite robust evidence of its accuracy. We evaluated the cost effectiveness of 13 different strategies using a decision tree model in which MRI is performed before non-targeted, transrectal ultrasound guided prostate (TRUS) biopsy. Our results show that MRI is cost effective in each of these strategies, and also adds incremental quality adjusted life years (QALY) to the patient over and above the standard practice of performing non-targeted TRUS biopsy.

88 | 12:09



Progress towards Robust Spiral MRI for Rapid Brain Exams

James Grant Pipe[1], Ashley Gould Anderson[1], Akshay Bakhru[2], Zhiqiang Li[1], Suthambhara Nagaraj[2], Melvyn B Ooi[3], Ryan K Robison[1], Dinghui Wang[1], and Nicholas R Zwart[1]

[1]*Imaging Research, Barrow Neurological Institute, Phoenix, AZ, United States,* [2]*MRI, Philips Healthcare, Bangalore, India,* [3]*MRI, Philips Healthcare, Phoenix, AZ, United States*

This work gives an overview of an effort to build the infrastructure for rapid, robust clinical Spiral MRI of the brain. The current goal is to achieve comparable or better Image quality than conventional scans with reduced overall scan time. A long-term (future) goal is to

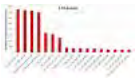
achieve a comprehensive high-quality brain MR exam in 5 minutes.

89 12:21 

The value of MRI in Traumatic Brain Injury: experiences in the Collaborative European NeuroTrauma Effectiveness Research in TBI study
Pim Pullens[1], Andrew IR Maas[2], David Menon[3], Wim van Hecke[4], Jan Verheyden[4], Lene Claes[4], Paul M Parizel[1], and On behalf of CENTER-TBI participants and investigators[5]

[1]Radiology, Antwerp University Hospital & University of Antwerp, Antwerp, Belgium, [2]Neurosurgery, Antwerp University Hospital & University of Antwerp, Antwerp, Belgium, [3]Anaesthesia, University of Cambridge, Cambridge, United Kingdom, [4]icometrix NV, Leuven, Belgium, [5]University Hospital Antwerp, Antwerp, Belgium

Traumatic Brain Injury (TBI) is regarded as “the most complex disease in our most complex organ”. Clinical outcome is unpredictable, especially in repetitive mild TBI, in terms of behavior, cognition, emotion and associated long-term effects such as dementia. The Collaborative European NeuroTrauma Effectiveness Research in TBI (CENTER-TBI) study is a pan-European prospective longitudinal observational study aiming to improve care for TBI patients. One of the key goals is to improve the quality of imaging-derived data by the application of a clinical standardized MR imaging protocol including structural, SWI, DTI and rs-fMRI, across up to 25 clinical sites in a large, heterogeneous sample of TBI patients. Harmonization of these protocols has been a challenging task. As data collection is underway, 265 datasets have been inspected for quality. Data quality is variable across sites and scanners. In order for such large-scale observational studies to be really effective, sequence harmonization and standardization is of key importance, but lacking at the moment.

90 12:33 

Capturing clinical MRI complexity: a first step towards realizing the maximum research value of neuroradiological MRI.
Marzena Wylezinska-Arridge[1], Mark J White[1,2], Indran Davagnanam[1], M Jorge Cardoso[3], Sjoerd B Vos[3,4], Sebastien Ourselin[3], Olga Ciccarelli[5], Tarek Yousry[1], and John Thornton[1,2]

[1]Neuroradiological Academic Unit, UCL Institute of Neurology, University College London, London, United Kingdom, [2]Lysholm Department of Neuroradiology, National Hospital for Neurology and Neurosurgery, London, United Kingdom, [3]Translation Imaging Group, Centre for Medical Imaging Computing, University College London, London, United Kingdom, [4]MRI Unit, Epilepsy Society, Chalfont, St Peters, United Kingdom, [5]Institute of Neurology, University College London, London, United Kingdom

The huge number of hospital MRI examinations routinely obtained for clinical purposes offers a potentially valuable “big data” resource for largescale experimental neurology. However, acquisition-scheme variation may compromise the research value of clinical imaging data. A first step towards reducing variation by prospective protocol harmonization is to systematically capture sequence-use statistics. Using an in-house tool developed to automate capture of long-term, MRI sequence deployment statistics in routine practice within our neuroradiological service, we identified “core“, most used sequences and the deployment frequency of their respective variants, to enable efficient, targeted protocol harmonization.

12:45 Adjournment & Meet the Teachers

Traditional Poster -

Exhibition Hall	14:15 - 16:15	*(no CME credit)*

Traditional Poster : Contrast Mechanisms

Exhibition Hall	16:30 - 18:30	*(no CME credit)*

Electronic Poster : Contrast Mechanisms

Exhibition Hall	14:15 - 15:15	*(no CME credit)*

Electronic Poster : Body

Exhibition Hall	15:15 - 16:15	*(no CME credit)*

Electronic Poster : Diffusion & Perfusion

Exhibition Hall	16:30 - 17:30	*(no CME credit)*

Electronic Poster : Diffusion

Exhibition Hall	16:30 - 17:30	*(no CME credit)*

Electronic Poster : CV

Exhibition Hall	17:30 - 18:30	*(no CME credit)*

Study Groups

Current Issues in Brain Function

Hall 405 E	14:15 - 16:15

Study Groups

Detection & Correction of Motion in MRI & MRS

Hall 406 D 14:15 - 16:15

Study Groups

High Field Systems & Applications; MR Safety

Hall 405 E 16:30 - 18:30

Study Groups

Hyperpolarized Media

Hall 406 D 16:30 - 18:30

Study Groups

Molecular & Cellular Imaging

Hall 406 D 18:45 - 20:45

Power Pitch

Novel Acquisitions & Reconstruction Strategies

Power Pitch Theatre, Exhibition Hall 14:15 - 15:15 *Moderators:*David Brunner & Ian Marshall

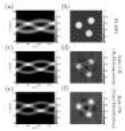
91 14:15

Phaseless Encoding

Franciszek Hennel[1] and Klaas P. Pruessmann[1]

[1]*Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland*

92 14:18



Rabi Modulated Continuous Wave Imaging

James C Korte[1], Bahman Tahayori[1], Peter M Farrell[1], Stephen M Moore[2,3], and Leigh A Johnston[1]

[1]*Dept. Electrical and Electronic Engineering, University of Melbourne, Melbourne, Australia,* [2]*IBM Research, Melbourne, Australia,* [3]*Dept. Mechanical Engineering, University of Melbourne, Melbourne, Australia*

93 14:21

Gradient Free MRI with a rotating magnet and receiver fields

Somaie Salajeghe[1], Paul Babyn[2], Logi Vidarsson[3], and Gordon E. Sarty[1]

[1]*Biomedical Engineering, University of Saskatchewan, Saskatoon, SK, Canada,* [2]*Medical Imaging, University of Saskatchewan, Saskatoon, SK, Canada,* [3]*LT Imaging, Toronto, ON, Canada*

94 14:24

Cyclic Continuous Max-Flow: Phase Processing Using the Inherent Topology of Phase

John Stuart Haberl Baxter[1], Zahra Hosseini[1], Junmin Liu[2], Maria Drangova[3], and Terry M Peters[1]

[1]*Biomedical Engineering Graduate Program, Western University, London, ON, Canada,* [2]*Imaging Laboratories, Robarts Research Institute, London, ON, Canada,* [3]*Department of Medical Biophysics, Western University, London, ON, Canada*

95 14:27

summa cum laude

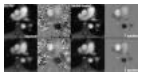
a-f BLAST: A Non-Iterative Radial k-t BLAST Reconstruction in Radon Space

Madison Kretzler[1], Jesse Hamilton[2], Mark Griswold[2,3], and Nicole Seiberlich[2,3]

[1]*Electrical Engineering, Case Western Reserve University, Cleveland, OH, United States,* [2]*Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States,* [3]*Radiology, University Hospitals, Cleveland, OH, United States*

96 14:30

Model-based Reconstruction for Real-Time Phase-Contrast Flow MRI - Improved Spatiotemporal Accuracy



Zhengguo Tan[1], Volkert Roeloffs[1], Dirk Voit[1], Arun Joseph[1], Markus Untenberger[1], Klaus-Dietmar Merboldt[1], and Jens Frahm[1]

[1]*Biomedizinische NMR Forschungs GmbH, Max-Planck-Institute for Biophysical Chemistry, Goettingen, Germany*

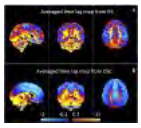
97 14:33

Acquisition of high resolution three-dimensional ocular images at 7 Tesla to generate patient-specific eye-models for clinical ray-tracing

Jan-Willem Beenakker[1], Lucia Hervella[2], Juan Tabarnero[2], Dennis Shamonin[1], Andrew Webb[1], Gregorius Luyten[1], and Pablo Artal[2]

[1]*Leiden University Medical Centre, Leiden, Netherlands,* [2]*University of Murcia, Murcia, Spain*

98 14:36

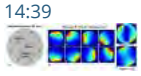


Perfusion map derived from resting state fMRI

Yunjie Tong[1], Kimberly P Lindsey[1], Lia M Hocke[2], Gordana Vitaliano[1], Dionyssios Mintzopoulos[1], and Blaise B Frederick[1]

[1]*McLean Hospital/Harvard Medical School, Belmont, MA, United States,* [2]*Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada*

99 14:39

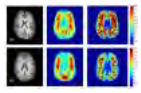


Nonlinear RF spatial encoding with multiple transmit coils based on Bloch-Siegert shift

Yuqing Wan[1], Maolin Qiu[1], Gigi Galiana[1], and R. Todd Constable[1]

[1]*Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States*

100 14:42

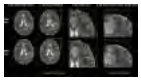


The role of brain viscoelasticity in chronically shunted hydrocephalus using Magnetic Resonance Elastography

Kristy Tan[1], Adam L. Sandler[2], Avital Meiri[1], Rick Abbott[2], James T. Goodrich[2], Eric Barnhill[3], and Mark E. Wagshul[1]

[1]*Gruss MRRC, Albert Einstein College of Medicine, Bronx, NY, United States,* [2]*Department of Neurological Surgery, Albert Einstein College of Medicine/Children's Hospital at Montefiore, Bronx NY, Bronx, NY, United States,* [3]*Clinical Research Imaging Centre, University of Edinburgh, Edinburgh, United Kingdom*

101 14:45

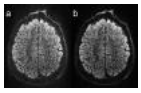


Prospective Motion Correction With NMR Markers Using Only Native Sequence Elements

Alexander Aranovitch[1], Maximilian Haeberlin[1], Simon Gross[1], Thomas Schmid[1], and Klaas Paul Pruessmann[1]

[1]*Institute for Biomedical Engineering, ETH Zurich and University of Zurich, Zurich, Switzerland*

102 14:48

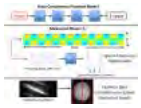


Whole-brain quantitative diffusion MRI at 660 µm resolution in 25 minutes using gSlider-SMS and SNR-enhancing joint reconstruction

Justin P Haldar[1], Qiuyun Fan[2], and Kawin Setsompop[2]

[1]*Electrical Engineering, University of Southern California, Los Angeles, CA, United States,* [2]*A. A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States*

103 14:51

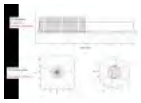


Joint K-space Trajectory and Parallel Imaging Optimization for Auto-calibrated Image Reconstruction

Stephen Cauley[1,2], Kawin Setsompop[1,2], Berkin Bilgic[1], Himanshu Bhat[3], Borjan Gagoski[2,4], Thomas Witzel[1,2], and Lawrence L. Wald[1,2,5]

[1]*MGH/HST, Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States,* [2]*Harvard Medical School, Boston, MA, United States,* [3]*Siemens Medical Solutions Inc, Malvern, PA, United States,* [4]*Fetal-Neonatal Neuroimaging & Developmental Science Center, Boston Children's Hospital, Boston, MA, United States,* [5]*Harvard-MIT Division of Health Sciences and Technology, MIT, Cambridge, MA, United States*

104 14:54

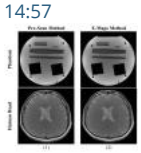


Looping star: A novel, self-refocusing zero TE imaging strategy

Ana Beatriz Solana[1], Anne Menini[1], and Florian Wiesinger[1]

[1]*GE Global Research, Garching bei Muenchen, Germany*

105 14:57



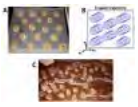
Real-time SENSE reconstruction using pre-scan and E-maps sensitivities

Muhammad Faisal Siddiqui[1], Abubakr Shafique[2], Yousif Rauf Javed[2], Talha Ahmad Khan[2], Hamza Naeem Mughal[2], Ahmed Wasif Reza[1], Hammad Omer[2], and Jeevan Kanesan[1]

[1]*Electrical Engineering, University of Malaya, Kuala Lumpur, Malaysia,* [2]*Electrical Engineering, COMSATS Institute of Information Technology, Islamabad, Pakistan*

106 15:00

Do try this at home: the role of CAIPIRINHA and non-Cartesian techniques for increased throughput and aesthetic enhancement in



baking (or vice versa)
Benedikt A Poser[1]

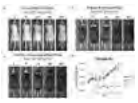
[1]*Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands*

Power Pitch

At the Cutting-Edge of Cancer Imaging

Power Pitch Theatre, Exhibition Hall 16:30 - 17:30 *Moderators:*Linda Moy

182 16:30



Immune co-stimulatory blockade permits human glioblastoma xenografting in immunocompetent mice: model validation with MRI and bioluminescence imaging
Samantha Lynn Semenkow[1], Shen Li[2], Eric Raabe[1,3], Jiadi Xu[2,4], Miroslaw Janowski[2,5], Byoung Chol Oh[6], Gerald Brandacher[6], Jeff W. Bulte[2,4], Charles Eberhart[1,3,7], and Piotr Walczak[2]

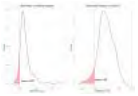
[1]*Department of Pathology, Johns Hopkins Medical Institue, Baltimore, MD, United States,* [2]*Department of Radiology and Radiological Science, Johns Hopkins Medical Institue, Baltimore, MD, United States,* [3]*Department of Oncology, Johns Hopkins Medical Institue, Baltimore, MD, United States,* [4]*F. M. Kirby Center for Functional Brain Imaging Kennedy Krieger Institute, Johns Hopkins Medical Institue, Baltimore, MD, United States,* [5]*NeuroRepair Department, Mossakowski Medical Research Centre, Warsaw, Poland,* [6]*Department of Plastic and Reconstructive Surgery, Vascularized Composite Allotransplantation (VCA) Laboratory, Johns Hopkins Medical Institue, Baltimore, MD, United States,* [7]*Department of Opthalmology, Johns Hopkins Medical Institue, Baltimore, MD, United States*

183 16:33

In vivo 1H MRS and MRI longitudinal assessment of GBM mouse xenografts derived from freshly injected human cells
Marta Lai[1], Cristina Cudalbu[2], Marie-France Hamou[3,4], Mario Lepore[2], Lijing Xin[2], Roy Thomas Daniel[4], Andreas Felix Hottinger[5], Monika Hegi[3,4], and Rolf Gruetter[1,6,7]

[1]*Laboratory of Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland,* [2]*Animal Imaging and Technology Core (AIT), Center for Biomedical Imaging (CIBM), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland,* [3]*Laboratory of Brain Tumor Biology and Genetics, Neuroscience Research Center, Lausanne University Hospital (CHUV), Lausanne, Switzerland,* [4]*Service of Neurosurgery, Department of Clinical Neurosciences, Lausanne University Hospital (CHUV), Lausanne, Switzerland,* [5]*Service of Neurology, Department of Clinical Neurosciences, Lausanne University Hospital (CHUV), Lausanne, Switzerland,* [6]*Department of Radiology, University of Geneva, Geneva, Switzerland,* [7]*Department of Radiology, University of Lausanne, Lausanne, Switzerland*

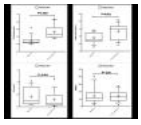
184 16:36



Multi-modal MRI Parametric Maps Combined with Receptor Information to Optimize Prediction of Pathologic Response to Neoadjuvant Chemotherapy in Breast Cancer
Hakmook Kang[1,2], Allison Hainline[1], Xia Li[3], Lori R. Arlinghaus[4], Vandana G. Abramson[5,6], A. Bapsi Chakravarthy[5,7], Brian Bingham[8], and Thomas E. Yankeelov[2,4,5,9]

[1]*Biostatistics, Vanderbilt University, Nashville, TN, United States,* [2]*Center for Quantitative Science, Vanderbilt University, Nashville, TN, United States,* [3]*GE Global Research, Niskayuna, NY, United States,* [4]*Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States,* [5]*Ingram Cancer Center, Vanderbilt University, Nashville, TN, United States,* [6]*Medical Oncology, Vanderbilt University, Nashville, TN, United States,* [7]*Radiation Oncology, Vanderbilt University, Nashville, TN, United States,* [8]*School of Medicine, Vanderbilt University, Nashville, TN, United States,* [9]*Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States*

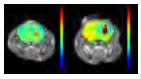
185 16:39



Early post-treatment changes of multi-parametric whole-body MRI quantitative parameters following Bortezomib induction in multiple myeloma; Preliminary results at 3.0 T
Arash Latifoltojar[1], Margaret Hall-Craggs[2], Alan Bainbridge[2], Magdalena Sokolska[2], Kwee Yong[1], Neil Rabin[2], Liam Watson[1], Michelle Siu[2], Matthew Benger[2], Nikolaos Dikaios[1], and Shonit Punwani[1]

[1]*University College London, London, United Kingdom,* [2]*University College London Hospital, London, United Kingdom*

186 16:42



The origins of glucoCEST signal: effect inhibiting glucose transport in brain tumors
Xiang Xu[1,2], Jiadi Xu[1,2], Linda Knutsson[3], Yuguo Li[1,2], Huanling Liu[1,4], Guanshu Liu[1,2], Bachchu Lal[5,6], John Laterra[5,6], Dmitri Artemov[7,8], Michael T. McMahon[1,2], Peter C.M. van Zijl[1,2], and Kannie WY Chan[1,2]

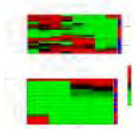
[1]*Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States,* [2]*FM Kirby Research Center, Kennedy Krieger Institute, Baltimore, MD, United States,* [3]*Department of Medical Radiation Physics, Lund University, Lund, Sweden,* [4]*Department of Ultrasound, Guangzhou Panyu Central Hospital, Panyu, China, People's Republic of,* [5]*Department of Neurology, Kennedy Krieger Institute, Baltimore, MD, United States,* [6]*Department of Neuroscience, Kennedy Krieger Institute, Baltimore, MD, United States,* [7]*Division of Cancer Imaging Research, Johns Hopkins University School of Medicine, Baltimore, MD, United States,* [8]*JHU In Vivo Cellular Molecular Imaging Center, Baltimore, MD, United States*

187 16:45

CEST Metrics for Assessing Early Response to Stereotactic Radiosurgery in Human Brain Metastases
Kimberly L. Desmond[1,2], Hatef Mehrabian[1,2], Arjun Sahgal[1,3], Hany Soliman[1,3], and Greg J. Stanisz[1,2]

[1]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Radiation Oncology, Odette Cancer Centre, Toronto, ON, Canada

188 16:48



Predicting TP53 mutational status of breast cancers on clinical DCE MRI using directional-gradient based radiogenomic descriptors

Nathaniel Braman[1], Prateek Prasanna[1], Donna Plecha[2], Hannah Gilmore[2], Lyndsay Harris[2], Kristy Miskimen[1], Tao Wan[3], Vinay Varadan[1], and Anant Madabhushi[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]University Hospitals, Cleveland, OH, United States, [3]Beihang University, Beijing, China, People's Republic of

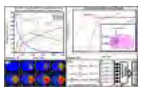
189 16:51

A Prototype Image Quality Assurance System for Accelerated Quantitative Breast DCE-MRI

Yuan Le[1], Aneela Afzal[2], Xiao Chen[3], Bruce Spottiswoode[4], Wei Huang[2], and Chen Lin[1]

[1]Radiology and Imaging Science, Indiana University School of Medicine, Indianapolis, IN, United States, [2]Advanced Imaging Research Center, Oregon Health and Science University, Portland, OR, United States, [3]Siemens Healthcare, Princeton, NJ, United States, [4]Siemens Healthcare, Chicago, IL, United States

190 16:54

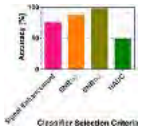


Model Evolution Concept in Dynamic Contrast Enhanced MRI for Prediction of Tumor Interstitial Fluid Pressure

Hassan Bagher-Ebadian[1,2], Azimeh NV Dehkordi[3], Rasha Alamgharibi[2], Tavarekere Nagaraja[1], David Nathanson[1], Hamid Soltanian-Zadeh[1], Stephen Brown[1], Hamed Moradi[4], Ali Arbab[5], and James R Ewing[1,2]

[1]Henry Ford Hospital, Detroit, MI, United States, [2]Oakland University, Rochester, MI, United States, [3]Shahid Beheshti University, Tehran, Iran, [4]Tarbiat Modares University, Tehran, Iran, [5]Georgia Regents University, Augusta, GA, United States

191 16:57

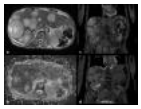


Automation of Pattern Recognition Analysis of Dynamic Contrast-Enhanced MRI Data to Assess the Tumor Microenvironment

SoHyun Han[1], Radka Stoyanova[2], Jason A. Koutcher[3], HyungJoon Cho[1], and Ellen Ackerstaff[3]

[1]Ulsan National Institute of Science and Technology, Ulsan, Korea, Republic of, [2]Miller School of Medicine, University of Miami, Miami, FL, United States, [3]Memorial Sloan Kettering Cancer Center, New York, NY, United States

192 17:00

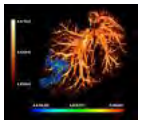


In vivo measurement of tumor T1 relaxation time using a whole body clinically feasible multiple flip angle method can predict response to chemotherapy

Harbir Singh Sidhu[1], Anna Barnes[2], Nikolaos Dikaios[1], Scott Rice[1], Alan Bainbridge[3], Robert Stein[4], Sandra Strauss[5], David Atkinson[1], Stuart Taylor[1], and Shonit Punwani[1]

[1]Centre for Medical Imaging, University College London, London, United Kingdom, [2]Institute of Nuclear Medicine, University College London Hospital, London, United Kingdom, [3]Medical Physics and Biomedical Engineering, University College London Hospital, London, United Kingdom, [4]Medical Oncology, University College London Hospital, London, United Kingdom, [5]Research Department of Oncology, University College London, London, United Kingdom

193 17:03

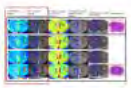


Quantitative Susceptibility Mapping to Interrogate Colorectal Metastases in Mouse Liver during Normoxia and Hyperoxia

Eoin Finnerty[1], Rajiv Ramasawmy[2], James O'Callaghan[2], Mark F Lythgoe[2], Karin Shmueli[1], David L Thomas[3], and Simon Walker-Samuel[2]

[1]Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]University College London, London, United Kingdom, [3]Institute of Neurology, University College London, London, United Kingdom

194 17:06

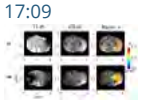


Early Brain Tumor Detection by Active-Feedback MRI

Zhao Li[1], Chaohsiung Hsu[1], Ryan Quiroz[1], and Yung-Ya Lin[1]

[1]Department of Chemistry and Biochemistry, UCLA, Los Angeles, CA, United States

195 17:09



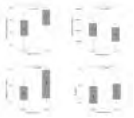
In Vivo Conductivity Imaging of Rat Tumor Model Using MRI

Jiaen Liu[1], Qi Shao[1], Yicun Wang[1], Gregor Adriany[2], John Bischof[3], Pierre-Francois Van de Moortele[2], and Bin He[1,4]

[1]Biomedical Engineering, Univeristy of Minnesota, Minneapolis, MN, United States, [2]Center for Magnetic Resonance Research, Univeristy of Minnesota, Minneapolis, MN, United States, [3]Mechanical Engineering, Univeristy of Minnesota, Minneapolis, MN, United States, [4]Institute for Engineering in Medicine, Univeristy of Minnesota, Minneapolis, MN, United States

196 17:12

Evaluation of T2W MRI-derived Textural Entropy for Assessment of Prostate Cancer Aggressiveness



Gabriel Nketiah[1], Mattijs Elschot[1], Eugene Kim [1], Tone Frost Bathen [1], and Kirsten Margrete Selnæs[1]

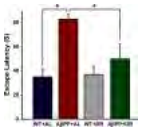
[1]Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway

Oral

Brain Metabolism

Room 300-302 14:15 - 16:15 *Moderators:*Gary Egan & Eric Schrauben

107 14:15



Dietary Restriction Improved Memory and Neuronal Metabolism in AβPP-PS1 Mouse Model of Alzheimer's Disease: A ^{1}H-[^{13}C]-NMR Study

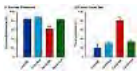
Anant Bahadur Patel[1] and Kamal Saba[1]

[1]NMR Microimaging and Spectroscopy, CSIR-Centre for Cellular and Molecular Biology, Hyderabad, India

Alzheimer's disease (AD) is the most common neurodegenerative disorders. Currently no effective treatment available for AD. Dietary restriction (DR) has been shown to improve longevity in rodents. In the present study, we evaluated the effects of DR on memory and brain energy metabolism in AβPP-PS1 mouse model of AD using ^{1}H-[^{13}C]-NMR spectroscopy in conjunction with infusion of [1,6-$^{13}C_2$]glucose. Our findings suggest that DR intervention had improved the memory and the neuro-metabolic activity in the AD mice.

108 14:27

magna cum laude



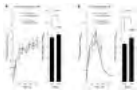
A ^{1}H-[^{13}C]-NMR Study for Understanding Antidepressant Action of Lanicemine in Chronic Unpredictable Mild Stress Model of Depression

Pravin K Mishra[1] and Anant Bahadur Patel[1]

[1]NMR Microimaging and Spectroscopy, CSIR-Centre for Cellular and Molecular Biology, Hyderabad, India

Though, ketamine possess rapid antidepressant properties, its use is limited due to addictive and psychotomimetic properties. In the current study, we have evaluated the antidepressant activity of lanicemine in CUMS model of depression by ^{1}H-[^{13}C]-NMR spectroscopy together with infusion of [1,6-$^{13}C_2$]glucose. Exposure of lanicemine restored behavioral phenotype and activity of excitatory and inhibitory neurons in depression.

109 14:39



Brain Glycogen Supercompensation: A Role in the Development of Hypoglycemia Unawareness?

Gulin Oz[1], Mauro DiNuzzo[2], Anjali Kumar[3], Amir Moheet[3], Kristine Kubisiak[4], Lynn E. Eberly[4], and Elizabeth R. Seaquist[3]

[1]Radiology, Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Museo storico della fisica e Centro di studi e ricerche Enrico Fermi, Rome, Italy, [3]Medicine, University of Minnesota, Minneapolis, MN, United States, [4]Biostatistics, School of Public Health, University of Minnesota, Minneapolis, MN, United States

Supercompensated brain glycogen levels may contribute to the development of hypoglycemia associated autonomic failure (HAAF) following recurrent hypoglycemia (RH) by providing energy for the brain during subsequent periods of hypoglycemia. To assess the role of glycogen supercompensation in the generation of HAAF, we estimated the level of brain glycogen supercompensation following RH using ^{13}C MRS and compared it to that following acute hypoglycemia (AH). Glycogen levels were found to increase after both AH and RH, but to a lesser extent after RH. These data suggest that glycogen supercompensation may be an epiphenomenon of HAAF.

110 14:51

summa cum laude

In vivo detection of hypothalamic glucose metabolism in HFD and regular fed mice

Blanca Lizarbe[1], Antonie Cherix[1], Lijing Xin[2], Hongxia Lei[2,3], and Rolf Gruetter[1,3,4]

[1]Laboratory for Functional and Metabolic Imaging (LIFMET), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]Animal imaging and technology core (AIT), Center for Biomedical Imaging (CIBM), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, Lausanne, Switzerland, [3]Department of Radiology, University of Geneva, Geneva, Switzerland, [4]Department of Radiology, University of Lausanne, Lausanne, Switzerland

Obesity is a pandemic syndrome that leads to reduced life expectancy, increasing the risk of heart disease, type-2 diabetes and some type of cancers. Noteworthy, to understand the mechanisms of obesity onset and development, several animal models, such as administration high fat diets, have been developed. We used ^{1}H-[^{13}C] MRS methods in regular and in high fat diet fed mice to investigate the effects of high caloric diets and obesity in the hypothalamus, its effects in glucose metabolism and metabolic fluxes in neurons and glia. We found differences that suggest impaired glucose metabolism in the hypothalamus of obese mice.

111 15:03

Amide proton signals as pH indicator for in vivo MRS and MRI of the brain – Responses to hypercapnia and hypothermia

Takashi Watanabe[1], Jens Frahm[1], and Thomas Michaelis[1]

[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institut für biophysikalische Chemie, Göttingen, Germany

Using proton MRS/MRI of mouse brain at 9.4 T, this work provides the first *in vivo* evidence of concurrent pH-dependent changes of amide signals and related metabolic responses to hypercapnia and hypothermia. During hypercapnia, amide MRS signals of glutamine and of unspecific compounds increase by ≥50% at 37°C and 22°C. They are strongly correlated with intracellular pH determined from a

shift in creatine phosphokinase equilibrium. In MRI, saturation transfer to water protons alters signal intensities in dependence on pH and temperature. Irradiation of aliphatic compounds at -3.5 ppm frequency offset from water predominantly saturates lipids and water associated with myelin.

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112 15:15

Assessing metabolic and structural alterations of brain cells in the APP/PS1/tauP301L mouse model of Alzheimer's disease using MRS and diffusion-weighted MRS in vivo

Clemence Ligneul[1,2], Marco Palombo[1,2], Juliette Le Douce[1,2], Pierrick Jego[1,2], Martine Guillermier[1,2], Gilles Bonvento[1,2], and Julien Valette[1,2]

[1]CEA/DSV/I2BM/MIRCen, Fontenay-aux-Roses, France, [2]CNRS Université Paris-Saclay UMR 9199, Fontenay-aux-Roses, France

In this work we use in vivo MRS and diffusion-weighted MRS to detect alterations in cellular metabolism and structure in a triple transgenic APP/PS1/tauP301L mouse model of Alzheimer's disease. We are able to detect massive remodeling of metabolic content in the hippocampus, as well as subtle but significant variations in diffusion properties of astrocytic metabolites. These results are essentially consistent with the metabolic and structural signature of activated astrocyte, a cell status represented around amyloid plaques.

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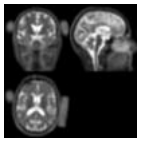

Brain Sodium MRI depicts upper motor neuron involvement in Amyotrophic Lateral Sclerosis patients

Aude-Marie Grapperon[1], Adil Maarouf[2,3], Annie Verschueren[1], Amandine Sevy[1], Elisabeth Soulier[2], Sylviane Confort-Gouny[2], Patrick Viout[2], Jean-Philippe Ranjeva[2], Maxime Guye[2,3], Sharham Attarian[1], and Wafaa Zaaraoui[2]

[1]APHM, Hôpital Timone, Pôle Neurosciences, Marseille, France, [2]CRMBM - CNRS - Aix-Marseille Université, Marseille, France, [3]APHM, Hôpital Timone, CEMEREM, Marseille, France

Amyotrophic lateral sclerosis (ALS) is a lethal neurodegenerative disease that involves the death of upper (in brain) and lower (in spine) motor neurons. As conventional MRI failed to show brain motor neurons impairment in ALS, advanced techniques are needed to improve the diagnosis of the disease and monitor its progression. ^{23}Na brain MRI was performed to 4 ALS patients and showed accumulation of sodium in the primary motor areas in the 3 patients presenting with clinical brain motor neuron signs. Besides, more patients were clinically affected, more the sodium accumulation was extended. In conclusion, sodium accumulation, which is an indicator of neuronal injury, could be a marker of ALS diagnosis and disease progression.

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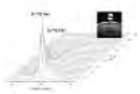
114 15:39

magna cum laude



Modulations of cerebral TCA cycle activity studied by hyperpolarized Acetate 13C MRS

Elise Vinckenbosch[1], Mor Mishkovsky[1], Arnaud Comment[2], and Rolf Gruetter[1,3]

[1]Laboratory of functional and metabolic imaging, EPFL, Lausanne, Switzerland, [2]Institute of Physics of Biological Systems, EPFL, Lausanne, Switzerland, [3]Department of Radiology, University of Lausanne and Geneva, Lausanne, Switzerland

Hyperpolarized [1-^{13}C] acetate enables for *in vivo* detection of 2-oxoglutarate, a tricarboxylic acid (TCA) cycle intermediate, in intact brain at high field. The aim of this study is to examine saturation substrate dose conditions and to compare it with a partially inhibited TCA cycle model. We conclude that 2-oxoglutarate production rate can be calculated as a function of varying substrate concentrations and is affected as well as the cerebral acetate kinetics by TCA cycle activity modulations.

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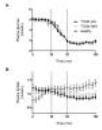

Brain lactate concentration falls in response to hypoglycemia in type 1 diabetes patients with impaired awareness of hypoglycemia

Evita Wiegers[1], Hanne Rooijackers[2], Cees Tack[2], Arend Heerschap[1], Bastiaan de Galan[2], and Marinette van der Graaf[1,3]

[1]Radiology and Nuclear Medicine, Radboud umc, Nijmegen, Netherlands, [2]Internal Medicine, Radboud umc, Nijmegen, Netherlands, [3]Pediatrics, Radboud umc, Nijmegen, Netherlands

TThe effect of hypoglycemia on cerebral lactate concentration was assessed in patients with type 1 diabetes (T1DM) and impaired awareness of hypoglycemia (IAH), patients with normal awareness of hypoglycemia (NAH) and in healthy subjects. Brain lactate concentrations were determined during stable euglycemic and stable hypoglycemic conditions using a J-editing semi-LASER ^{1}H-MRS sequence at 3T. We found a 20% decrease in brain lactate concentration in T1DM patients with IAH in response to hypoglycemia, which may reflect increased lactate oxidation. No changes in cerebral lactate concentrations were observed in the other two groups.

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116 16:03

Differential Metabolic Profiles in Rat Retrosplenial Cortex, Cingulate Cortex and Medial Prefrontal Cortex: Relationship with Cytoarchitecture and Functional Implications

Hui Zhang[1] and Hao Lei[1]

[1]National Center of Magnetic Resonance in Wuhan, State Key Laboratory of Magnetic Resonance and Atomic and Molecular Physics, Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, China, People's Republic of

In this study, we measured regional neurochemical variations in rat prelimbic cortex (PrL)/infralimbic cortex (IL), cingulate cortex (Cg) and retrosplenial cortex (RSC) with in vivo 1H-MRS at 7T. It was found that the regional metabolic variations follow cytoarchitectural/receptor-architectonical organization in these brain regions.

Diffusion Tractography

Room 324-326 14:15 - 16:15 *Moderators:*Qiuyun Fan & J-Donald Tournier

117 14:15

U-fiber Quantification in Non-Lesional Epilepsy

Rafael O'Halloran[1], Rebecca Feldman[1], Madeline Fields[1], Laura Marcuse[1], and Priti Balchandani[1]

[1]Icahn School of Medicine at Mount Sinai, New York, NY, United States

A method for the quantification of cortical-to-cortical U-fiber fraction based on 7T MRI is presented and used to demonstrate group differences in the the U-fiber fractions in non-lesional and lesional epilepsy patients compared to healthy controls. Non-lesional epilepsy patients had the lowest u-fiber fractions followed by healthy control subjects, and then by lesional epilepsy subjects with the highest u-fiber fractions.

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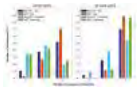

The influence of node assignment strategies and track termination criteria on diffusion MRI-based structural connectomics

Chun-Hung Yeh[1], Robert Elton Smith[1], Thijs Dhollander[1], Fernando Calamante[1], and Alan Connelly[1]

[1]The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia

This study highlights the issue of using the common strategy for assigning individual streamlines to an atlas-based brain parcellation. This process is non-trivial and can introduce ambiguity into connectome quantification. In many fibre-tracking algorithms, track termination criteria can cause premature termination of streamlines within WM or CSF, which can result in up to ~50–80% of streamlines failing in identifying pairwise connections between nodes from streamline endpoints. Our results demonstrate that such issue can be largely ameliorated through the combination of biologically meaningful track terminations and an appropriate node assignment mechanism. This could therefore be advantageous to structural connectome construction.

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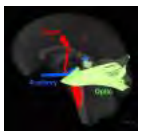


Behavioral response time as explained by a fiber-based analysis of generalized fractional anisotropy measured using diffusion spectrum imaging

Kayako Matsuo[1], Yung-Chin Hsu[2], Yasuo Takehara[3], Wen-Yih Isaac Tseng[2], and Norio Mori[1]

[1]Dept. Psychiatry, Hamamatsu University School of Medicine, Hamamatsu, Japan, [2]Institute of Medical Devices and Imaging System, National Taiwan University College of Medicine, Taipei, Taiwan, [3]Dept. Radiology, Hamamatsu University School of Medicine, Hamamatsu, Japan

DSI on a GE 3T was conducted for 22 normal controls to examine the neural basis of the response time (RT). RT was measured outside the scanner using button pressing by left or right hand in response to visual or auditory stimulation. Faster RT was associated with greater GFA of portions near the cortical hand area in the corticospinal tract (CST). Left and right hand specializations were found in the deeper CST. Greater GFA in portions near the cortex in the left auditory radiation was associated with faster RT by visual stimulations, suggesting an influence of language processing speed.

120 14:51

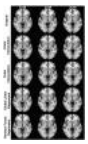


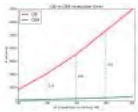
Image quality transfer benefits tractography of low-resolution data

Daniel C. Alexander[1], Aurobrata Ghosh[1], Samuel A. Hurley[2], and Stamatios N. Sotiropoulos[2]

[1]Computer Science, UCL, London, United Kingdom, [2]FMRIB, Oxford University, Oxford, United Kingdom

We show benefits of image quality transfer to tractography. Diffusion MRI super-resolution through image quality transfer enables recovery of thin tracts in a dataset with low spatial resolution (2.5mm isotropic). Specifically, we reconstruct four pathways arising from the motor area that have been distinguished before when using high (1.25mm) resolution HCP data. Quantitative results confirm that image quality transfer enhances tractography more than standard interpolation. The results highlight the major potential of image quality transfer in learning information from bespoke high quality data sets to enhance the specificity of information derived from more modest but readily available data.

121 15:03



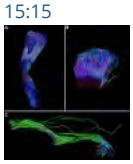
QuickBundlesX: Sequential clustering of millions of streamlines in multiple levels of detail at record execution time

Eleftherios Garyfallidis[1], Marc-Alexandre Côté[1], François Rheault[1], and Maxime Descoteaux[1]

[1]Computer Science, Université de Sherbrooke, Sherbrooke, QC, Canada

QuickBundlesX shows a remarkable 20+X speedup over it's predecessor who was until today the fastest clustering algorithm for streamlines. In addition, it returns a useful tree of clusters at different resolutions which allows to query streamlines and easily process millions of streamlines by comparing only with their neighbours.

122 15:15



Structural Fingerprinting of the Human Brain: How unique is tract shape to the individual?

Greg D Parker[1], George J.A. Evans[2], and Derek K Jones[1,3]

[1]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]School of Medicine, Newcastle University, Newcastle, United Kingdom, [3]Neuroscience and Mental Health Research Institute (NMHRI), School of Medicine, Cardiff University, Cardiff, United Kingdom

Even amongst healthy subjects, brain function and structure is known to be highly variable across individuals[1,2]. Recently[3] it was shown

that inter-subject variation in functional connectivity is sufficient to allow robust and reliable identification of individuals across different sessions and tasks. Here we demonstrate for the first time that the same is true of white matter structure; using the shape of an individual's white matter tracts we generate fingerprints that uniquely identify individuals across different scan sessions.

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123 15:27

Fibers crossing the white/gray matter boundary: a semi-global, histology-informed dMRI model

Michiel Cottaar[1], Matteo Bastiani[1], Charles Chen[2], Krikor Dikranian[2], David C. Van Essen[2], Timothy E. Behrens[1], Stamatios N. Sotiropoulos[1], and Saad Jbabdi[1]

[1]FMRIB, Oxford University, Oxford, United Kingdom, [2]Washington University School of Medicine, Saint Louis, MO, United States

Close to the cortical white/gray matter boundary surface fiber orientations sharply transition from being nearly tangential to the surface in the white matter to mostly radial in the gray matter. We propose a geometric model that describes this transition at sub-voxel resolution based on high-resolution histology data and fit this model to lower resolution diffusion MRI data. We assess its performance using qualitative comparisons with histology and test the reproducibility of the estimated parameters across multiple diffusion MRI resolutions. This model allows the in-vivo estimation of fiber orientations across the white/gray matter boundary, which may improve tracking to the cortex.

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124 15:39

Microscopic DTI for quantitative tractography of MAP6-KO mice: validation by fluorescent microscopy on cleared brains

Ulysse Gimenez[1], Franck Mauconduit[1], Benoit Boulan[2], Eric Denarier[2], Jacques Brocard[2], Sylvie Gory-Fauré[2], Annie Andrieux[2], Jean Christophe Deloulme[2], and Hana Lahrech[1]

[1]Clinatec Lab U1205, INSERM, Grenoble, France, [2]Grenoble Institute of Neurosciences, INSERM, La Tronche, France

High spatial resolution 3D DTI was developed and used for white matter tractography to quantify neuronal tract alterations on the MAP6-KO mouse. In this model, the microtubule-associated protein 6 (MAP6) which is involved in the neuromorphogenesis is deleted leading to a model characterized by severe behavior impairments, similar to the clinical features of schizophrenia. As 3D DTI tractography and fluorescent microscopy on cleared brains both show a deficiency of the post-commissural fornix, in accordance with our previous 2D DTI results, the 3D DTI tractography imaging is validated. Using 3D DTI tractography, new major alterations in different neuronal tracts are detected.

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125 15:51

Network integration and segregation differentiate between Alzheimer Disease and Vascular Dementia

Fulvia Palesi[1,2], Andrea De Rinaldis[2,3], Letizia Casiraghi[2,4], Gloria Castellazzi[2,3], Paolo Vitali[5], Nicoletta Anzalone[6], Federica Denaro[7], Elena Sinforiani[8], Giuseppe Micieli[7], Egidio D'Angelo[2,4], and Claudia Angela Michela Gandini Wheeler-Kingshott[2,9]

[1]Department of Physics, University of Pavia, Pavia, Italy, [2]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy, [3]Department of Electrical, Computer and Biomedical Engineering, University of Pavia, Pavia, Italy, [4]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy, [5]Brain MRI 3T Mondino Research Center, C. Mondino National Neurological Institute, Pavia, Italy, [6]Scientific Institute H. S. Raffaele, Milan, Italy, [7]Department of Emergency Neurology, C. Mondino National Neurological Institute, Pavia, Italy, [8]Alzheimer's Disease Assessment Unit, Laboratory of Neuropsychology, C. Mondino National Neurological Institute, Pavia, Italy, [9]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, University College London, London, United Kingdom

Dementia is the most common disorder in elderly people and comprises Alzheimer's disease (AD) and vascular disease (VaD). In this work graph theoretical approach was applied to a cohort of AD, VaD and healthy controls (HC) aimed at investigating the presence of a disease-specific pattern of alterations. Brain structural networks were built using the Cohen functional atlas (nodes) and advanced probabilistic tractography (edges). Our main finding was that VaD patients showed severe impairment in the large-scale brain networks while AD patients mainly showed inefficiency of short-range connections emphasizing the fact that alterations are restricted to specific brain regions.

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126 16:03

Estimating Network Topology in Weighted and Dense Connectomes

Luis Manuel Colon-Perez[1], Michelle Couret[2], William Triplett[3], Catherine Price[3], and Thomas H Mareci[3]

[1]Psychiatry, University of Florida, Gainesville, FL, United States, [2]Medicine, Columbia University, New York, NY, United States, [3]University of Florida, Gainesville, FL, United States

Brain networks are organized in a heterogeneous range of white-matter tract sizes suggesting that the brain is organized in broad range of white matter connection strengths. Studies of brain structure with a binary connection model have shown a small-world network topological organization of the brain. We developed a generalized framework to estimate the topological properties of brain networks using weighted connections, which offers a more realistic model of the brain compared to the binary connection model. In addition, this model reduces the need for thresholding to obtain topological properties in dense and weighted connectomes.

Oral

Tumour Response to Therapy

Room 331-332 14:15 - 16:15 *Moderators:*Richard Do & Sabrina Ronen

127 14:15

Texture Feature Analysis of Quantitative and Semi-Quantitative DCE-MRI Metrics for Early Prediction of Breast Cancer Therapy Response
Guillaume Thibault[1], Alina Tudorica[2], Aneela Afzal[2], Stephen Chui[2], Arpana Naik[2], Megan Troxell[3], Kathleen Kemmer[2], Karen Oh[2], Nicole Roy[2], Megan Holtorf[2], Wei Huang[2], and Xubo Song[2]

[1]BME, OHSU, Portland, OR, United States, [2]OHSU, Portland, OR, United States, [3]OHSU, portland, OR, United States

36 breast cancer patients underwent research DCE-MRI before and after one cycle of neoadjuvant chemotherapy. 3D tumor imaging texture features were extracted from parametric maps of quantitative pharmacokinetic (PK) and semi-quantitative DCE-MRI parameters, and correlated with pathologically measured post-therapy residual cancer burden (RCB). Texture features from quantitative PK parameters were found to be more useful than those from semi-quantitative metrics for early prediction of therapy response, while the features from the SSM PK parameters were superior to the SM counterparts for prediction of response.

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128 14:27

Role of the Intravoxel Incoherent Motion (IVIM) Imaging in the Pre-treatment Prediction and Early Response Monitoring for Neoadjuvant Chemotherapy in Locally Advanced Breast Cancer
Shunan Che[1], Chunwu Zhou[1], Xinming Zhao[1], Jing Li[1], and Bing Wu[2]

[1]department of radiology, Cancer Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing, China, People's Republic of, [2]GE Healthcare MR Research China, Beijing, China, People's Republic of

Purpose: to explore whether IVIM can determine pre-treatment differences or monitor early response in breast cancer patients receiving NAC. Materials and Methods: thirty-six patients examined with multiple-b DWI were divided into MHR and NMHR groups. Parameters between MHR and NMHR groups were compared. Results: the D and f value at the baseline and mid-treatment of NAC showed significantly differences between MHR and NMHR. ΔD and Δf were significantly higher in MHR than in NMHR. Conclusion: the D and f value showed potential value in the pre-treatment prediction and early response monitoring to NAC in local advanced breast.

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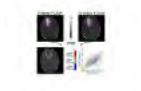
129 14:39

summa cum laude



Evaluation of FLAIR maps by PRM provides for glioma response assessment
Deborah Sharon Honrado Guest[1], Craig Galbán[1], Gary Luker[1], Thomas Chenevert[1], Benjamin Lemasson[2], Robin Johannes Marius Navest[3], Klaas Nicolaij[3], and Brian Ross[1]

[1]Radiology, University of Michigan, Ann Arbor, MI, United States, [2]Institut des Neurosciences, Université Grenoble Alpes, Grenoble, France, [3]Department of Biomedical Engineering, Technische Universiteit Eindhoven, EINDHOVEN, Netherlands

This study investigates the possibility of adapting the PRM method for use with normalized FLAIR images to predict OS and TTP for indication of tumor recurrence. Glioma patients were separated into non-responders and responders to treatment. Voxels present in the union of the VOIs for the rFLAIR images were used to evaluate the PRM_{rFLAIR} values and categorize patients into groups based on changes in signal intensity. This study shows that predicting TTP and OS is achievable using PRM with rFLAIR maps for patients treated with TMZ/IR and provides the first demonstration of quantifying FLAIR signals in patients over time.

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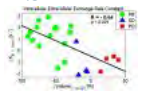
130 14:51

summa cum laude



Intracellular-extracellular water exchange as a biomarker of tumor response to stereotactic radiosurgery
Hatef Mehrabian[1,2], Kimberly L Desmond[3], Arjun Sahgal[1,4], Hany Soliman[1,4], Anne L Martel[1,2], and Greg J Stanisz[1,2]

[1]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, ON, Canada, [4]Radiation Oncology, Odette Cancer Centre, Toronto, ON, Canada

Targeted radiation treatments are expected to induce DNA damage in tumor cells which leads to apoptosis. Apoptotic cells experience an increase in cell membrane permeability and surface-to-volume ratio, both of which result in increased water exchange rate between intracellular and extracellular compartments.

Using a three compartment relaxation model we demonstrate that early changes in intracellular-extracellular water exchange correlated well with tumor volume change one-month post-treatment. Moreover, when the water exchange rate was combined with early tumor volume change and was employed in a classifier, the patients with partial response and progressing disease could be identified with a very high accuracy.

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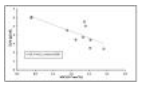
131 15:03

summa cum laude



Multimodality functional imaging in radiation therapy during treatment: relationship between DW-MRI and 18F FDG PET in head and neck squamous cell carcinoma
David Aramburu Nuñez[1,2], Antonio Lopez Medina[3], Moises Mera Iglesias[4], Francisco Salvador Gomez[5], Vaios Hatzoglou[6], Ramesh Paudyal[1], Alfonso Calzado[2], Joseph O Deasy[1], Amita Shukla-Dave[7], and Victor M Muñoz[8]

[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [2]Department of Radiology, Complutense University, Madrid, Spain, [3]Medical Physics & Radiological Protection, Galaria - Hospital do Meixoeiro – Complexo Hospitalario Universitario de Vigo, Vigo, Spain, [4]Medical Physics, Oncoserv, Santiago de los Caballeros, Dominican Republic, [5]Medical Physics and Radiological Protection, Galaria - Hospital do Meixoeiro – Complexo Hospitalario Universitario de Vigo, Vigo, Spain, [6]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [7]Medical Physics & Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [8]Radiation Oncology, Galaria - Hospital do Meixoeiro – Complexo Hospitalario Universitario de Vigo, Vigo, Spain

Biologically guided radiotherapy needs an understanding of how different functional imaging techniques interact and link together. DW-MRI and 18F FDG-PET techniques were used in this study for achieving this objective. 5 HPV-, HNSCC patients underwent 20 DW-MRI and 10 18F-FDG-PET/CT scans before and during radiation therapy. ADC maps derived from DW-MRI and SUV values from 18F-FDG were

used for evaluating tumor response. The initial evaluation of the preliminary results suggests that in these solid tumors cellularity is inversely proportional to the glucose metabolic uptake. The survival status and functional metrics show different trends for NED, AWD and DOD.

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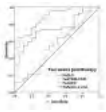
132 15:15



MRI in predicting the response of gastrointestinal stromal tumor to targeted therapy: a patient-based multi-parameter study

Lei Tang[1], Jian Li[2], Ying-Shi Sun[1], Xiao-Ting Li[1], Zi-Yu Li[3], Xiao-Yan Zhang[1], and Lin Shen [2]

[1]Radiology, Peking University Cancer Hospital & Institute, Beijing, China, People's Republic of, [2]GI medicine, Peking University Cancer Hospital & Institute, Beijing, China, People's Republic of, [3]GI surgery, Peking University Cancer Hospital & Institute, Beijing, China, People's Republic of

The percentage changes of the ADC in GIST after two weeks of targeted therapy exhibited reliable performance in response prediction, and these variables outperformed T2WI-CNR and the longest diameter. We suggest that patients continue their treatment regimens if the percentage increases in the ADC are no less than 15% after two weeks of therapy. In contrast, if the ADC decreases or exhibits almost no change, then a shortening of the follow-up time intervals is highly recommended to detect possible drug resistance at an early stage.

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133 15:27

magna cum laude

Quantitative MRI and optoacoustic imaging tracks treatment response in tumor

Prashant Chandrasekharan[1], Ghayathri Balasundaram[1], Amalina Binte Ebrahim Attia[1], Chris Jun Hui Ho[1], Xuan Vinh To[1], Hui Chien Tay[1], Kai Hsiang Chuang[1], and Malini Olivo[1]

*[1]A*STAR, Singapore Bio Imaging Consortium, Singapore, Singapore*

Quantification of oxygenation or hypoxia in a tumor plays a key role in the treatment response and the overall survival of glioma patient. This work illustrates a preclinical study with the use of multimodal imaging technique to correlate tumor oxygenation and blood perfusion, as well as to assess the changes involved in the perturbation of the tumor system using a vascular disruptive agent.

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134 15:39

summa cum laude

Assessment of early treatment response by IVIM DW-MRI and DCE-MRI in patients with brain metastases treated with stereotactic radiosurgery.

David Aramburu Nuñez[1,2], Kathryn Beal[3], Vaios Hatzoglou[4], Andrei Holodny[4], Ramesh Paudyal[1], Yonggang Lu[5], Joseph O Deasy[1], and Amita Shukla-Dave[6]

[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [2]Department of Radiology, Complutense University, Madrid, Spain, [3]Radiation Oncology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [4]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [5]Radiation Oncology, Washington University, St. Louis, MO, United States, [6]Medical Physics & Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

In clinical settings it is essential to accurately assess, whether or not a brain metastasis has been successfully treated or whether the metastasis require additional treatment. This is the first study that evaluated brain metastases with IVIM DW-MRI and DCE-MRI data both pre- and post- stereotactic radiosurgery (SRS). The preliminary results are promising as it will inform the treating physicians at an early time point about which patients will benefit from SRS (or not). The survival status and functional metrics show different trends for both AWD and DOD that need to be validated in larger patient population.

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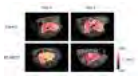
135 15:51



T_1 is a biomarker of therapy-induced cell death in the Th-*MYCN* genetically-engineered murine model of neuroblastoma.

Yann Jamin[1], Evon S.C. Poon[2], Albert Hallsworth[2], Hannah Webber[2], Laura S. Danielson[2], Dow-Mu Koh[1], Louis Chesler[2], and Simon P. Robinson[1]

[1]Division of Radiotherapy & Imaging, The Institute of Cancer Research, London, United Kingdom, [2]Division of Cancer Therapeutics and Division of Clinical Studies, The Institute of Cancer Research, London, United Kingdom

In this study we demonstrate that T_1 provides a non-invasive biomarker of response to MLN8237, a potent Aurora A kinase inhibitor, in the Th-*MYCN* genetically-engineered murine model of neuroblastoma, a childhood cancer of the nervous system. Histopathological characterisation demonstrates that T_1 is a generic biomarker of cell death in this model. T_1 quantification in pediatric early-phase clinical trials could potentially help to accelerate the development of urgently needed novel targeted therapies for children with neuroblastoma.

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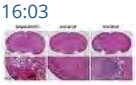
136 16:03

summa cum laude



Can anti-VEGF Antibody Reverse Radiation Necrosis? A Preclinical Investigation

Chong Duan[1], Carlos J Perez-Torres[2], Liya Yuan[3], John A Engelbach[4], Christina T Tsien[5], Keith M Rich[3,5], Robert E Schmidt[6], Joseph JH Ackerman[1,4,7,8], and Joel R Garbow[4,8]

[1]Chemistry, Washington University in St. Louis, St. Louis, MO, United States, [2]Radiological Health Sciences, Purdue University, West Lafayette, IN, United States, [3]Neurosurgery, Washington University in St. Louis, St. Louis, MO, United States, [4]Radiology, Washington University in St. Louis, St. Louis, MO, United States, [5]Radiation Oncology, Washington University in St. Louis, St. Louis, MO, United States, [6]Neuropathology, Washington University in St. Louis, St. Louis, MO, United States, [7]Medicine, Washington University in St. Louis, St. Louis, MO, United States, [8]Alvin J Siteman Cancer Center, Washington University in St. Louis, St. Louis, MO, United States

Recently, radiation necrosis (RN) has been treated clinically using bevacizumab, an anti-VEGF antibody. While bevacizumab reduces radiographic RN volume, the treatment has potentially serious complications and rebound phenomena after the discontinuation of the therapy. In the present study, we investigated the anti-VEGF treatment of pure radiation necrosis in a mouse model. Favorable

radiographic appearance of RN were observed following the anti-VEGF treatment. However, the lesions were not completely resolved histologically (e.g., focal mineral deposits were observed in the treated mice). In addition, despite the treatment, VEGF and HIF-1α were still upregulated, which presents the potential risk of recurrence of RN.

Oral

Myocardial Viability & Clinical Studies

Room 334-336 14:15 - 16:15 *Moderators:*Vincent Ho & Taehoon Shin

137 14:15

Fully Automatic Left Atrium and Pulmonary Veins Segmentation for Late Gadolinium Enhanced MRI Combining Contrast Enhanced MRA
Qian Tao[1], Esra Gucuk Ipek[2], Rahil Shahzad[1], Floris F. Berendsen[1], Saman Nazarian[2], and Rob J. van der Geest[1]

[1]Department of Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Department of Cardiology, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

The extent and distribution of left atrial (LA) scar, visualized by LGE MR, can provide important information for treatment of atrial fibrillation (AF) patients. However, in current practice, to extract such information requires substantial manual effort and expertise. In this study, a fully automatic method was developed to segment LA and PV's in LGE-MRI, combining robust multi-atlas segmentation and flexible level-set based segmentation optimization. The method demonstrated comparable accuracy to manual segmentation, with improved 3D continuity. The method enables automated generation of patient-specific LA and PV geometry models, and potentially objective LA scar assessment for individual AF patients.

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138 14:27

Dark Blood Late Gadolinium Enhanced Imaging of Myocardial Scar using First-Moment-Nulled Motion Sensitized Driven Equilibrium (m2MSDE)
Gregory J Wilson[1], Niranjan Balu[1], Jinnan Wang[1,2], Chun Yuan[1], and Jeffrey H Maki[1]

[1]University of Washington, Seattle, WA, United States, [2]Bayer Healthcare, Whippany, NJ, United States

A novel black-blood pre-pulse is described that darkens intraventricular blood pool signal in late gadolinium enhanced (LGE) imaging of myocardial scar. The pre-pulse is m_1-nulled motion-sensitized driven equilibrium (m2MSDE) with user-specified motion-sensitizing direction. The pre-pulse nulls blood signal while maintaining good myocardial image quality. Preliminary results are described.

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139 14:39

Visual quality assessment of 3D High Resolution Late Gadolinium Enhancement with Compressed-Sensing in a Clinical Setting: the impact of patient factors
Charlene Liew[1,2], Tamer Basha[1], Mehmet Akcakaya[1], Connie Tsao[1], Francesca Delling[1], Kraig Kissinger[1], Beth Goddu[1], Sophie Berg[1], Warren Manning[1,3], and Reza Nezafat[1]

[1]Division of Cardiology, Department of Medicine, Beth Israel Deaconess Medical Center, Boston, MA, United States, [2]Department of Radiology, Changi General Hospital, Singapore, Singapore, [3]Department of Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States

Compressed sensing can be used to reduce 3D LGE scan time by factor of 5 with isotropic spatial resolution. However, clinical feasibility and overall image quality of 3D LGE with compressed sensing is still unknown. In this study, we sought to assess the image quality of 3D LGE with isotropic spatial resolution of 1-1.5 mm^3 in 268 consecutive patients with known or suspected cardiovascular disease and investigate the impact of patient characteristics on overall image quality.

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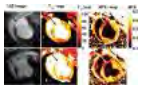
140 14:51



Detection of myocardial infarcts without contrast agent injection: Comparison of spin-lock with magnetization transfer MR imaging
Joep van Oorschot[1], Martijn Froeling[1], Thijs van den Broek[2], Frebus van Slochteren[2], Steven Chamuleau[2], Peter Luijten[1], Tim Leiner[1], and Jaco Zwanenburg[1]

[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Cardiology, University Medical Center Utrecht, Utrecht, Netherlands

Two promising techniques for endogenous myocardial infarct detection are Magnetization Transfer and T1ρ-MRI. Goal of the study was to compare the ability to detect and quantify myocardial scar tissue in a chronic infarct model using MT and T1ρ mapping. In vivo MRI was performed on a clinical 1.5 MR scanner in 3 anesthetized pigs, 4 weeks after 90 minutes occlusion of the LAD. The MTR was significantly lower in the infarcted region (0.27±0.01 ms), compared to remote myocardium (0.38±0.01 ms).The T1ρ relaxation time was significantly higher in the infarcted region (87.0±1 ms), compared to healthy remote myocardium (56.4± 1 ms).

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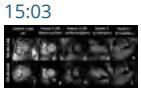
141 15:03



Free-breathing 3D late gadolinium enhancement cardiovascular magnetic resonance using outer volume suppressed projection navigators: Development and clinical validation
Rajiv G Menon[1], G Wilson Miller[2], Jean Jeudy[1], Sanjay Rajagopalan[3], and Taehoon Shin[1]

[1]Diagnostic Radiology and Nuclear Medicine, University of Maryland, Baltimore, Baltimore, MD, United States, [2]Department of Radiology and Medical Imaging, University of Virginia, Charlottesville, VA, United States, [3]Division of Cardiovascular Medicine, University of Maryland, Baltimore, Baltimore, MD, United States

We developed a free-breathing, 3D late gadolinium enhancement (FB 3D-LGE) cardiovascular magnetic resonance technique based on

outer volume suppressed 1D-projection navigators and a stack-of-spirals acquisition. The free-breathing 3D-LGE and conventional breath-hold 2D-LGE scans were performed on 29 cardiac patients. 2D and 3D techniques showed no significant differences in overall image quality scores and image artifact scores ($P > 0.1$). There was a significant correlation in the average difference in fractional scar volume (r=0.96). The FB 3D-LGE is a viable option for patients, particularly in acute settings or in patients who are unable to comply with breath-hold instructions.

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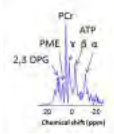
142 15:15



Cardiac 31P MRS in breast cancer patients undergoing chemotherapy

Gillian Macnaught[1,2], Christopher Rodgers[3], Martin Denvir[4], Olga Oikonomidou[5,6], Annette Cooper[1], William Clarke[3], Heather McVicars[6], Larry Hayward[6], Saeed Mirsadraee[1], and Scott Semple[1,4]

[1]Clinical Research Imaging Centre, University of Edinburgh, Edinburgh, United Kingdom, [2]the MRC Centre for inflammation Research, University of Edinburgh, Edinburgh, United Kingdom, [3]RDM Cardiovascular Medicine, University of Oxford, Oxford, United Kingdom, [4]BHF Centre for Cardiovascular Science, University of Edinburgh, Edinburgh, United Kingdom, [5]Edinburgh Cancer Research Centre, University of Edinburgh, Edinburgh, United Kingdom, [6]Edinburgh Cancer Centre, NHS Lothian, Edinburgh, United Kingdom

Anthracyclines are chemotherapy agents widely used to treat cancer but that can also induce cardiotoxicity. Techniques are required to provide an earlier warning of cardiotoxicity before irreversible myocardial damage. 9 subjects were recruited to this on-going 31P MRS study to detect changes in cardiac energetics of breast cancer patients undergoing chemotherapy. Between pre- and mid-chemotherapy four subjects experienced a greater than 20% decrease in their cardiac PCr/ATP ratio, 1 subject experienced a 13.8% decrease in left ventricular ejection fraction (LVEF) and all had increased troponin levels. Ultimately this study aims to determine whether changes in PCr/ATP precede changes in LVEF.

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143 15:27

Significant improvement of survival by T2* MRI in thalassemia major

Antonella Meloni[1], Caterina Borgna-Pignatti[2], Giovanni Carlo Del Vecchio[3], Maria Antonietta Romeo[4], Maria Rita Gamberini[5], Federico Bonetti[6], Maria Giovanna Neri[1], Elisabetta Chiodi[7], Vincenzo Positano[1], and Alessia Pepe[1]

[1]Fondazione G. Monasterio CNR-Regione Toscana, Pisa, Italy, [2]Università di Ferrara, Ferrara, Italy, [3]Uiversity of Bari, Bari, Italy, [4]University of Catania, Catania, Italy, [5]Arcispedale "S.Anna", Ferrara, Italy, [6]Policlinic Foundation San Matteo IRCCS, Pavia, Italy, [7]Arcispedale "S. Anna", Ferrara, Italy

The introduction of T2* CMR for the reproducible and non-invasive assessment of myocardial iron overload reduced the likelihood of developing decompensated cardiac failure, allowing the reduction of cardiac mortality in chronically transfused TM patients

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144 15:39

Elevated Hemoglobin A1c(HbA1c) Is Independently Associated with Large Lipid-Rich Necrotic Cores in Hypertensive Patients with Symptomatic Carotid Atherosclerosis: A 3.0T MRI Study

Huilin Zhao[1], Beibei Sun[1], Xiaosheng Liu[1], Xihai Zhao[2], Yongming Dai[3], Chun Yuan[4], and Jianrong Xu[1]

[1]Radiology, Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai, China, People's Republic of, [2]Center for Biomedical Imaging Research, Tsinghua University School of Medicine, Beijing, China, People's Republic of, [3]Philips Healthcare, Shanghai, China, People's Republic of, [4]Radiology, University of Washington, Seattle, WA, United States

Further understanding of the association of hemoglobin A_{1c}(HbA_{1c}) levels with symptomatic carotid plaque characteristics will be helpful for stroke risk stratification and treatment strategy modification. This study sought to investigate the associations of HbA_{1c} levels with MR-identified carotid plaque characteristics in hypertensive patients with acute stroke. Our key findings are that elevated HbA_{1c} was associated with carotid plaque presence, higher HbA_{1c} level tended to exhibit an increased plaque burden and larger lipid-rich necrotic core, independent of other cardiovascular risk factors. Our findings indicate that elevated HbA_{1c} may contribute to the development of advanced carotid plaques in stroke patients with hypertension.

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145 15:51

Cardiac Magnetic Resonance detects an association between aortic stiffness and epicardial fat volume in patients with increased cardiovascular risk

Rami Homsi[1], Alois Martin Sprinkart[1], Jürgen Gieseke[1,2], Julian Luetkens[1], Michael Meier-Schroers[1], Darius Dabir[1], Daniel Kuetting[1], Christian Marx[1], Hans Schild[1], and Daniel Thomas[1]

[1]Radiology, University Hospital Bonn, Bonn, Germany, [2]Philips Healthcare, Hamburg, Germany

In a Cardiac Magnetic Resonance based approach the study reveals a relationship between epicardial fat and aortic stiffness which are both associated with cardiovascular risk and disease.

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146 16:03

Intradialytic MRI for the assessment of Cardiovascular Function

Charlotte E Buchanan[1,2], Azharuddin Mohammed[2], Eleanor F Cox[1], Maarten W Taal[2], Nicholas M Selby[2], Susan T Francis[1], and Christopher W McIntyre[3]

[1]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]Division of Medical Sciences and Graduate Entry Medicine, University of Nottingham, Nottingham, United Kingdom, [3]Schulich School of Medicine and Dentistry, University of Western Ontario, London, ON, Canada

We perform the first study of intradialytic MRI to assess cardiovascular stress during dialysis. A significant reduction in cardiac output (CO), stroke volume (SV) and IVC flux was seen during dialysis. Myocardial strain measures revealed significant stunned segments in the

long axis in all individuals. No significant change in coronary artery flow was evident, and both myocardial perfusion and T_1 measures in a single short axis slice showed no significant change. The change in CO and SV was negatively correlated with dialysis ultrafiltration volume. This work demonstrates MRI can be used to assess cardiac stress during dialysis.

Oral

Dementia: Alzheimer's Disease

Hall 606 | 14:15 - 16:15 | *Moderators:* Ellen Ackerstaff & Ganesh Adluru

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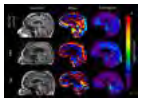
147 | 14:15



MR Elastography Demonstrates Unique Regional Brain Stiffness Patterns in Dementias

Mona ElSheikh[1], Arvin Arani[1], Avital Perry[2], Nealey Cray[2], Fredric Meyer[2], David Lake[1], Armando Manduca[3], Kevin Glaser[1], Richard L Ehman[1], and John Huston[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]Neurosurgery, Mayo Clinic, Rochester, MN, United States, [3]Physiology and Biomedical Engineering, Mayo Clinic, Rochester, MN, United States

The development of advanced MRI techniques has enabled noninvasive evalua on of subtle changes of brain architecture in demen a. We report a specific pa ern of regional brain s ffness changes using Magne c Resonance Elastography (MRE) in three different demen a groups: Alzheimer's disease, frontotemporal demen a, and normal pressure hydrocephalus. MRE offers a poten al biomarker to characterize the viscoelas c proper es of the brain in demen a pa ents, and may have a role in the diagnosis and differen a on between common subtypes of demen a.

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148 | 14:27

magna cum laude

High resolution MR elastography of the hippocampus reveals differential tissue elasticity in Alzheimer's disease – a pilot study

Andreas Fehlner[1], Lea M Gerischer[2], Agnes Flöel[2,3], Jürgen Braun[4], and Ingolf Sack[1]

[1]Department of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Department of Neurology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]NeuroCure Clinical Research Center, Charité - Universitätsmedizin Berlin, Berlin, Germany, [4]Institute of Medical Informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany

Multifrequency MR elastography (MMRE) was applied to 14 patients with Alzheimer's disease (AD) and compared to 14 age matched asymptomatic controls. We observed a marked decrease of the white-matter complex shear modulus $|G^*|$ in patients with AD. This reduction in $|G^*|$ was even more pronounced in the hippocampal region. In this region a diagnostic performance of 78% sensitivity and 92% specificity (AUROC-value 0.918) was obtained based on a viscoelasticity cutoff value of 0.9 kPa. In the future MMRE-measured $|G^*|$ could serve as a quantitative imaging marker for early diagnosis and progression monitoring of AD.

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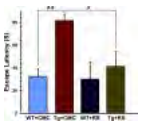
149 | 14:39



^{1}H-[^{13}C]-NMR Investigation of Neuroprotective Action of Ayurvedic Formulation in AβPP-PS1 Mouse Model of Alzheimer's Disease

Kamal Saba[1], Niharika Rajnala[1], and Anant Bahadur Patel[1]

[1]NMR Microimaging and Spectroscopy, CSIR-Centre for Cellular and Molecular Biology, Hyderabad, India

Alzheimer's disease (AD) is a progressive neurodegenerative disorder. Currently no definite treatment available for AD. We have examined the efficacy of Rasa Sindoor, an Ayurvedic formulation, for the improvement of memory and neuronal activity in AβPP-PS1 mouse model of AD. Neuronal metabolism was followed by ^{1}H-[^{13}C]-NMR spectroscopy together with an infusion of [1,6-$^{13}C_2$]glucose. Our results indicate that the Rasa-Sindoor improved memory, and excitatory and inhibitory neuronal metabolic activity in AD mice.

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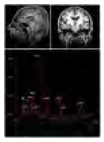
150 | 14:51

summa cum laude



Brain phospholipid and energy metabolism in mild Alzheimer's disease and healthy aging: a 31P Magnetic Resonance Spectroscopy study

Anne Rijpma[1,2], Marinette van der Graaf[3,4], Olga Meulenbroek[1,2], Marcel Olde Rikkert[1,2], and Arend Heerschap[3]

[1]Geriatric Medicine, Radboud university medical center, Nijmegen, Netherlands, [2]Radboud Alzheimer Centre, Donders Institute for Brain, Cognition and Behaviour, Radboud university medical center, Nijmegen, Netherlands, [3]Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands, [4]Paediatrics, Radboud university medical center, Nijmegen, Netherlands

In this study we assessed phospholipid and energy metabolism in patients with mild Alzheimer's disease and healthy age-matched control subjects by 3D ^{31}P MRS imaging. Four brain regions were investigated: left and right hippocampus, anterior cingulate cortex, and retrosplenial cortex. Disease specific differences as well as differences between brain regions were found.

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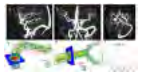
magna cum laude



4D Flow MRI for assessing flow pulsatility along the carotid siphon in Alzheimer's disease

Leonardo A Rivera-Rivera[1], Tilman Schubert[2], Kevin M Johnson[1], Sterling C Johnson[3], Oliver Wieben[1,2], and Patrick Turski[2]

[1]Medical Physics, University of Wisconsin Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin Madison, Madison, WI, United States, [3]Medicine, University of Wisconsin Madison, Madison, WI, United States

Cerebral arteries are often morphologically altered and dysfunctional in Alzheimer's disease (AD). In this study, 4D flow MRI was used to assess flow pulsatility along the carotid siphon in patients with AD, mild cognitive impairment (MCI) and in healthy age matched controls. We found the physiologic dampening of pulsatility along the distal ICA is significantly diminished in patients with AD. With the

large volume coverage and high temporal and spatial resolution, 4D flow MRI can provide additional biomarkers of vascular health that can contribute to the identifying patients who could benefit from interventions to improve circulatory system functions.

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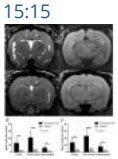

In Vivo Visualization of Iron-Rich Amyloid Plaques In Cholesterol-Fed Rabbits using Clinical Field-Strength Magnetic Resonance Imaging

Yuanxin Chen[1], Yong Wang[1,2], Kem A Rogers[1], John A Ronald[1], and Brian K Rutt[3]

[1]Western University, London, ON, Canada, [2]Lawson Health Research Institute, London, ON, Canada, [3]Stanford University, Stanford, CA, United States

Hypercholesterolemia is a risk factor for AD and promotes increased production of beta-amyloid protein. Our lab has developed a rabbit model of AD by enriching the diets of rabbits with low amounts of cholesterol. In this study, we combined this cholesterol-fed rabbit model of AD with iron-sensitive, high-resolution MRI and demonstrated non-invasive in vivo visualization of AD plaques throughout the brains of these animals. The imaging techniques have been developed and optimized using a clinical field strength scanner (3T), which is an important step towards clinical application in human AD patients.

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153 15:27

magna cum laude

Latent Atrophy Factors in Alzheimer's Disease

Xiuming Zhang[1], Elizabeth C. Mormino[2], Reisa A. Sperling[2], Mert R. Sabuncu[3,4], and B.T. Thomas Yeo[1,3,5]

[1]ASTAR-NUS Clinical Imaging Research Centre, Department of Electrical and Computer Engineering, Singapore Institute for Neurotechnology and Memory Networks Program, National University of Singapore, Singapore, Singapore, [2]Department of Neurology, Massachusetts General Hospital/Harvard Medical School, Charlestown, MA, United States, [3]Martinos Center for Biomedical Imaging, Massachusetts General Hospital/Harvard Medical School, Charlestown, MA, United States, [4]Computer Science and Artificial Intelligence Laboratory, Massachusetts Institute of Technology, Cambridge, MA, United States, [5]Centre for Cognitive Neuroscience, Duke-NUS Graduate Medical School, Singapore, Singapore

Alzheimer's disease (AD) is the most common form of dementia and greatly heterogeneous. Here we develop a model of the heterogeneity of AD-related atrophy, demonstrating that most AD dementia patients and at-risk nondemented participants express multiple latent atrophy factors to varying degrees. Our study also demonstrates that these atrophy factors are associated with distinct cognitive decline trajectories across the preclinical and clinical stages. Our results provide a framework by which biomarker readouts could potentially predict disease progression at the individual level. Our analytic strategy is general and might be utilized to discover subtypes within and across other heterogeneous brain disorders.

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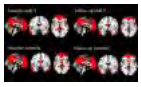

Association of Alzheimer’s disease GWAS loci with default mode network

fan su[1]

[1]southeast university, nanjing, China, People's Republic of

To investigate the altered pattern of DMN in amnestic mild cognitive impairment (aMCI) subjects and the genetic factors that lead to the DMN dysfunctions, 87 individuals with aMCI and 131 matched healthy controls were recruited and an average 3-year follow-up study was performed. We studied the differences of DMN between aMCI subjects and healthy controls at baseline and how the DMN changed over time. Regression analyses were performed to explore whether the GRS influence the DMN dysfunctions. We observed that DMN disengage in the early stage of AD and the combined effect of AD-related loci influence the DMN pattern.

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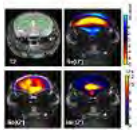

The effect of Alzheimer's disease on the viscoelasticity of the mouse brain under the influence of enriched environment.

Jing Guo[1], Tonia Munder[2], Charlotte Klein[2], Anna Pfeffer[2], Jürgen Braun[3], Barbara Steiner[2], and Ingolf Sack[1]

[1]Department of Radiology, Charité - University Medicine Berlin, Berlin, Germany, [2]Department of Neurology, Charité - University Medicine Berlin, Berlin, Germany, [3]Institute of Medical Informatics, Charité - University Medicine Berlin, Berlin, Germany

MRE was used to study environmental influences on viscoelasticity of the murine hippocampus in Alzheimer's disease (AD). In wild type control mice, hippocampal viscosity was significantly increased within 6 months while elasticity remained unchanged. This suggests that environment-stimulated neuronal proliferation adds mobile elements to the mechanical matrix of the brain which increases mechanical attenuation properties. Within 6 months, AD caused a decline of hippocampal viscosity only in the enriched environment while standard mouse remained unaffected suggesting that AD in an early phase primarily affects new neurons in the murine hippocampus.

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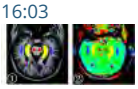


A preliminary study on MR amide proton imaging in patients with Alzheimer’s disease and mild cognitive impairment

Rui Wang[1], Chunmei Li[1], Yongming Dai[2], Dantao Peng[3], Xuna Zhao[4], and Min Chen[1]

[1]Radiology, Beijing Hospital, Beijing, China, People's Republic of, [2]Philips Heathcare, Shanghai, China, People's Republic of, [3]China-Japan Friendship Hospital, Beijing, China, People's Republic of, [4]Philips Heathcare, Beijing, China, People's Republic of

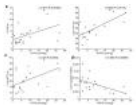
The aim of this study is to evaluate the feasibility of MR amide proton transfer (APT) imaging for the detection of cerebral abnormalities in patients with Alzheimer’s disease (AD) and amnestic mild cognitive impairment (aMCI), and to explore its clinical utility. Twenty-one AD patients, 11 aMCI patients and 19 normal controls (NC) underwent APT MR imaging. The magnetic resonance ratio asymmetry (MTRasym) values at 3.5ppm of bilateral hippocampi, temporal white matter regions, occipital white matter regions and cerebral peduncles were measured on the oblique APT images. We found that MTRasym(3.5ppm)asym in bilateral hippocampi showed a consistently increasing trend from NC to MCI, to AD. MTRasym(3.5ppm) values of bilateral hippocampi were significantly negatively correlated with MMSE. Our results suggested that APT imaging is a useful tool to diagnose early AD and monitor the disease.

Oral

Hepatobiliary 1: Liver Perfusion/Flow & Function

Summit 1 | 14:15 - 16:15 | *Moderators:*Scott Reeder & Alejandro Roldán-Alzate

157 | 14:15



MR elastography and DCE-MRI of the liver and spleen for non-invasive prediction of portal pressure

Stefanie Hectors[1], Mathilde Wagner[1], Octavia Bane[1], Aaron Fischman[2], Thomas Schiano[3], and Bachir Taouli[1,4]

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

The goal of this study was to assess whether DCE-MRI parameters and MR elastography-derived stiffness in liver and spleen can predict portal pressure. Liver time-to-peak (TTP), mean transit time (MTT), upslope and stiffness (LS) all significantly correlated with hepatic venous pressure gradient (HVPG) measurement. Sensitivity-specificity of LS for detection of HVPG≥5mmHg and HVPG≥10mmHg were 64%-91% and 71%-89% respectively, while combined LS and spleen TTP yielded the highest sensitivity-specificity (92%-86% for HVPG≥5mmHg, 100%-92% for HVPG≥10mmHg). These results indicate that combination of liver and spleen perfusion and stiffness metrics into a multiparametric analysis maximizes diagnostic performance for the prediction of portal pressure.

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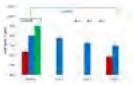

Longitudinal assessment of structural and haemodynamic parameters in compensated cirrhosis using Quantitative Magnetic Resonance Imaging

Chris Bradley[1], Eleanor F Cox[1], David Harman[2], Martin W James[2], Guru P Aithal[2], I Neil Guha[2], and Susan T Francis[1]

[1]Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom, [2]NIHR Biomedical Research Unit in Gastrointestinal and Liver Diseases, University of Nottingham, Nottingham, United Kingdom

We perform a longitudinal 3 year study to assess progression of disease in compensated cirrhosis (CC) using annual haemodynamic and structural MR measures, and compare with a healthy volunteer group. Longitudinal relaxation time (T_1) correlates with liver disease severity, and shows a small variance across years in stable, compensated cirrhosis. In contrast a large variance is shown for liver stiffness measures using Fibroscan®. MR measures correlate well with Enhanced Liver Fibrosis (ELF) scores. This study suggests that MR provides a sensitive technique to assess changes in pathophysiology of CC.

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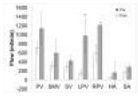

Hemodynamic Changes in the Portal Circulation in Living Related Liver Donors, Assessed by 4D flow MRI

Alejandro Roldán-Alzate[1,2], Luis A Fernandez[3], Oliver Wieben[2,4], and Scott B Reeder[2,4]

[1]Mechanical Engineering, University of Wisconsin - Madison, Madison, WI, United States, [2]Radiology, University of Wisconsin - Madison, Madison, WI, United States, [3]Surgery, University of Wisconsin - Madison, Madison, WI, United States, [4]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States

The purpose of this study was to evaluate hemodynamic changes in the mesenteric and portal circulation of LDLT donors in response to surgical liver resection. Four living related liver donors were studied. Subjects were imaged using 4D Flow MRI before and after liver resection surgery. Highly patient-specific responses to each surgical procedure were found. The ability to quantify hemodynamic changes in the portal and mesenteric circulation non-invasively demonstrates that 4D flow MRI may be a suitable tool for both surgical planning of LDLT, and for improved understanding of the hemodynamic changes that occur in the liver remnant of the donor.

160 | 14:51

Free-Breathing 3D Liver Perfusion Quantification Using a Dual-Input Two-Compartment Model

Satyam Ghodasara[1], Vikas Gulani[2], and Yong Chen[2]

[1]Case Western Reserve University School of Medicine, Cleveland, OH, United States, [2]Radiology, Case Western Reserve University, Cleveland, OH, United States

The dual-input two-compartment model was applied to liver perfusion data, and significant differences in perfusion parameters were found between normal hepatic parenchyma and focal lesions, and also between HCC and metastatic lesions. These findings support the possibility of using a two-compartment model with 3D free-breathing acquisitions, for lesion characterization.

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Acceleration of Image Analysis for Liver Perfusion Quantification Using Parallel Computational Techniques

Satyam Ghodasara[1], Yong Chen[2], Mark Griswold[2], Nicole Seiberlich[3], and Vikas Gulani[2]

[1]Case Western Reserve University School of Medicine, Cleveland, OH, United States, [2]Radiology, Case Western Reserve University, Cleveland, OH, United States, [3]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

To make free-breathing liver perfusion quantification feasible for a clinical timescale, acceleration of both non-Cartesian parallel imaging reconstruction and non-rigid image registration was performed with parallel computing techniques. Our results show massively increased speed (12 minutes compared to >22.5 hours for standard computations) with extremely minor differences in both image

quality and perfusion quantification.

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magna cum laude

15:15

Measurement of bulk liver perfusion: Assessment of agreement between ASL and caval subtraction phase-contrast MRI at 9.4T
Manil Chouhan[1], Rajiv Ramasawmy[2], Alan Bainbridge[3], Adrienne Campbell-Washburn[2], Jack Wells[2], Shonit Punwani[1], Rajeshwar Mookerjee[4], Simon Walker-Samuel[2], Mark Lythgoe[2], and Stuart Taylor[1]

[1]UCL Centre for Medical Imaging, University College London, London, United Kingdom, [2]UCL Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom, [3]Department of Medical Physics, University College London Hospitals NHS Trust, London, United Kingdom, [4]UCL Institute for Liver and Digestive Health, University College London, London, United Kingdom

Non-invasive preclinical liver perfusion measurements could be used to develop biomarkers and assess new treatments for liver disease and primary/secondary malignant liver lesions. ASL can provide regional hepatic perfusion maps, and in this study we compare FAIR ASL tissue perfusion measurements with caval subtraction phase-contrast MRI, a validated method for measuring total liver blood flow, to demonstrate ASL overestimation but encouraging agreement between both methods.

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15:27

Quantitative Liver Function Analysis using Volumetric T1 Mapping with Fast Multi-Slice B1 Correction on Hepatocyte-specific Contrast Enhanced Liver Magnetic Resonance Imaging
Jeong Hee Yoon[1], Jeong Min Lee[1], Eun Ju Kim[2], Tomoyuki Okuaki[3], and Joon Koo Han[1]

[1]Radiology, Seoul National University Hospital, Seoul, Korea, Republic of, [2]Philips Healthcare, Seoul, Korea, Republic of, [3]Philips Healthcare, Tokyo, Japan

Liver signal intensity on hepatobiliary phase at gadoxetic acid-enhanced liver MRI has been reported to be useful to estimate global and regional liver function quantitatively. However, simple MR signal measurement is often suffering from its sensitivity of MR field inhomogeneity and non-linear relationship with contrast medium concentration. Herein, we investigated of B1 correction effect on T1 map and compared its diagnostic performance to assess liver function according to Child-Pugh classification. In addition, we attempted to investigate risk assessment capability of B1 corrected T1 map for long-term clinical outcome in patients with cirrhosis.

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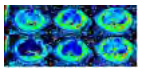
15:39



Gd-EOB-DTPA-enhanced MRI: evaluation of liver function by multiple hepatocyte-phase images and T1 mapping in rats
Jia Xu[1], Xuan Wang[1], Yan You[2], Qin Wang[1], Hui Liu[3], Jing Lei[1], Huadan Xue[1], and Zhengyu Jin[1]

[1]Department of Radiology, Peking Union Medical College Hospital, Beijing, China, People's Republic of, [2]Department of Pathology, Peking Union Medical College Hospital, Beijing, China, People's Republic of, [3]Siemens Ltd. China, Shanghai, China, People's Republic of

To evaluate regional liver function preoperatively is of great value in planning surgical management. Our Aim is to investigate the potential of Gd-EOB-DTPA enhanced MRI in evaluating hepatic function in rats with liver fibrosis. Parameters calculated from Gd-EOB-DTPA enhanced MRI exhibited moderate to high correlation with plasma indocyanine green retention rate at 15 minutes after intravenous injection of ICG (ICG R15) in rats with liver fibrosis, indicating its potential in liver function evaluation.

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15:51

Comparison of the Hepatocyte Fraction and Conventional Image Based Methods for the Estimation of Liver Function
Tomoyuki Okuaki[1], Kosuke Morita[2], Tomohiro Namimoto[3], Morikatsu Yoshida[3], Shinya Shiraishi[3], Masanori Komi[2], Yasuyuki Yamashita[3], and Marc Van Cauteren[1]

[1]Philips Healthcare, Tokyo, Japan, [2]Department of Central Radiology, Kumamoto University Hospital, Kumamoto, Japan, [3]Department of Diagnostic Radiology, Faculty of Life Sciences, Kumamoto University, Kumamoto, Japan

The hepatocyte fraction (HeF) is based on simple pharmacokinetics, and can quantitatively estimate the fraction of hepatocytes. In this study, the HeF, liver-spleen contrast ratio and delta T1 value were compared to the results of ^{99m}Tc-GSA scintigraphy using the blood clearance index (HH15) and receptor index (LHL15). The correlation coefficients of the HH15 were 0.602, 0.544 and 0.773, respectively, and of the LHL15 were 0.612, 0.670 and 0.762, respectively. The HeF quantification showed the highest correlation with the ^{99m}Tc-GSA, proving it to be useful for a robust evaluation of liver function, compared to conventional imaging based quantitative methods.

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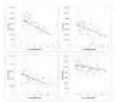
16:03



The change and interrelation of quantitative hepatic MR imaging biomarkers in the course of chronic hepatitis.
Akira Yamada[1], Yasunari Fujinaga[1], Yoshihiro Kitoh[2], Takeshi Suzuki[1], Daisuke Komatsu[1], Aya Shiobara[2], Yasuo Adachi[2], Atsushi Nozaki[3], Yuji Iwadate[3], Kazuhiko Ueda[1], and Masumi Kadoya[1]

[1]Department of Radiology, Shinshu University School of Medicine, Matsumoto, Japan, [2]Division of Radiology, Shinshu University Hospital, Matsumoto, Japan, [3]GE Healthcare Japan, Hino, Japan

Variable quantitative hepatic imaging biomarkers including pharmacokinetic parameters of hemodynamics and hepatocellular uptake function, R2* and fat fraction, apparent diffusion coefficient (ADC), liver stiffness were obtained from the patients with chronic hepatitis using MR imaging. The change and interrelation of these imaging biomarkers in the course of chronic hepatitis were evaluated quantitatively. Portal venous inflow and hepatocellular uptake function correlated well with liver stiffness, meanwhile, ADC showed weak correlation. Arterial compensation, decreased blood flow speed and volume were observed in the patients with decreased portal venous inflow. No significant correlation was observed between liver stiffness and R2* or fat fraction.

Oral

RF Coil Arrays

Summit 2 | 14:15 - 16:15 | *Moderators:*Randy Duensing & Fraser Robb

167 | 14:15

A 32-channel integrated body coil for 7 Tesla whole-body imaging

Stephan Orzada[1], Andreas K. Bitz[2], Oliver Kraff[1], Mark Oehmigen[1,3], Marcel Gratz[1,3], Sören Johst[1], Maximilian N. Völker[1], Stefan H. G. Rietsch[1,3], Martina Flöser[2], Thomas Fiedler[2], Samaneh Shooshtary[4], Klaus Solbach[4], Harald H. Quick[1,3], and Mark E. Ladd[1,2]

[1]Erwin L. Hahn Institute for MRI, Essen, Germany, [2]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [3]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany, [4]High Frequency Technology, University of Duisburg-Essen, Duisburg, Germany

Due to the severe problems with B1 inhomogeneity, volume resonators are not a good choice for body applications at ultra-high fields, and local multi-channel arrays are commonly used for transmission. In this work we present an integrated 32ch transmit/receive body array for 7 Tesla whole-body imaging. First in vivo images show a human volunteer imaged completely in 4 stations.

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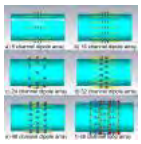
168 | 14:27

summa cum laude



Approaching the Ultimate Intrinsic SNR with Dense Arrays of Electric Dipole Antennas

Gang Chen[1,2,3], Riccardo Lattanzi[1,2], Daniel Sodickson[1,2], and Graham Wiggins[1,2]

[1]The Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]The Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [3]The Sackler Institute of Graduate Biomedical Science, New York University School of Medicine, New York, NY, United States

Coil designs motivated by the ideal current patterns corresponding to the Ultimate Intrinsic SNR (UISNR) have been used to boost central SNR at 3T and 7T. For a cylindrical phantom and a current distribution defined on a concentric cylindrical surface, the ideal current pattern for optimal central SNR includes both divergence-free and curl-free components. While loops are exclusively divergence-free, recent work has shown that electric dipole antennae include both divergence-free and curl-free current components. Here we explore in simulation whether arrays with an increasing number of electric dipole antennas can approach UISNR in the center of a head-sized phantom at 7T, and investigate selected practical design considerations.

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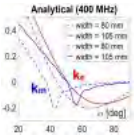
169 | 14:39



Optimization of the Transceiver Phased Array for Human Brain Imaging at 9.4 T: Loop Overlapping Rediscovered.

Nikolai I Avdievich[1], Ioannis Giapitzakis[1], Andreas Pfrommer[1], and Anke Henning[1,2]

[1]High-field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Ultra-high field (UHF) (≥7T) transmit (Tx) and transceiver surface loop phased arrays improve Tx-efficiency and homogeneity for human brain imaging. Overlapping the loops enhances Tx-efficiency and SNR by increasing the penetration depth. However, overlapping can compromise decoupling and SNR by generating a substantial mutual resistance. Therefore, UHF Tx-arrays are commonly constructed using gapped loops. Based on analytical optimization we constructed a 9.4T 8-loop head transceiver array. Both the magnetic and electric coupling were compensated at the same time by overlapping and excellent decoupling was obtained. Tx- and Rx-performance of the array was compared favorably to that of a gaped array.

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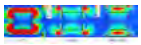
170 | 14:51



Comparison of 3T whole body parallel transmit arrays based on measured data from full scale models

Eddy B Boskamp[1], Saikat Saha[1], Ricardo Becerra[1], and Michael Edwards[1]

[1]Engineering, GE Healthcare, Waukesha, WI, United States

In this study we are comparing 16 channel TEM, 8 channel TEM and 8 loop array pTx body coils based on experimental data obtained from full scale whole body prototypes as opposed to only simulation. Besides SAR, efficiency and uniformity, there are additional criteria to include when selecting a body coil for parallel transmit. Examples are star intensity artifact, E fields that heat up cables and baluns, VSWR, and perturbation sensitivity, which may make it impossible to build a certain design given obtainable tolerances.

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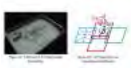
171 | 15:03



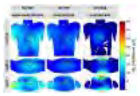
A 3D Loop-Loopole Receive Array for Spine Imaging at 3.0 T.

Karthik Lakshmanan[1,2], Ryan Brown[1,2], and Graham C Wiggins[1,2]

[1]Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, Newyork, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), NYU School of Medicine, Newyork, NY, United States

High channel count RF receive coil arrays have become commonplace due to the advent of parallel imaging techniques and due to technical advances in receive chain technology. Using these general purpose coil arrays SNR can be maximized over wide depths by covering the imaging region with an array of planar loops. This is usually achieved by reducing the coil dimensions while still maintaining sufficiently high unloaded-to-loaded Q ratio. In this work we aim to improve upon the SNR of a high element count array by adding concentric orthogonal "Loopole" elements. The asymmetric behavior of the loopoles combined with its orthogonal location provided SNR improvements both at shallow and deep regions in an imaging plane.

172 15:15



Detailing Local Multi-Channel RF Surface Coil versus Body RF Coil Transmission for Cardiac MRI at 3 Tesla: Which Configuration is Winning the Game?

Oliver Weinberger[1,2], Lukas Winter[1], Matthias A Dieringer[1], Antje Els[1], Celal Oezerdem[1], Antonino Cassara[3], Harald Pfeiffer[3], and Thoralf Niendorf[1,2]

[1]Berlin Ultrahigh Field Facility (BUFF), Max Delbrueck Center for Molecular Medicine (MDC), Berlin, Germany, [2]Experimental and Clinical Research Center (ECRC), Charité Medical Faculty, Berlin, Germany, [3]Physikalisch Technische Bundesanstalt (PTB), Berlin, Germany

In this work a local four-channel transmit/receive RF coil dedicated for cardiac MR at 3T is compared to a conventional built-in body RF coil in conjunction with a four-channel receive-only RF coil. SAR and B_1^+ simulations of both configurations are shown. The invivo efficiency performance of both coils in respect to B_1^+/sqrt(SAR) is demonstrated in 12 healthy subjects. The efficiency surplus of the local RF coil was used to increase the applicable flip angle FA_{SSFP} of a standard high resolution 2D SSFP protocol or to shorten the used repetition time TR_{SSFP} by 54%.

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173 15:27

Design of a 8-channel transceive dipole array with up to 64 receive-only loop coils

Ingmar Voogt[1], Dennis W.J. Klomp[1], Hans Hoogduin[1], Peter R. Luijten[1], Cornelis A.T. van den Berg[1], and Alexander J.E. Raaijmakers[1]

[1]UMC Utrecht, Utrecht, Netherlands

We have developed an array combination consisting of eight fractionated dipole antennas combined with 64 receive loops. Loops are combined in 16 linear groups of four. Eight are equipped with a transmit dipole antenna, eight are not. The coupling between all elements is below -15 dB. The transmit efficiency is not influenced by the presence of the receive loops. Phantom MRI measurements show strong enhancement of the SNR. Finally, preliminary human scans (T2w images) have been acquired.

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174 15:39

magna cum laude

Parallel Transmit (pTx) Capability of Various RF Transmit Elements and Arrays at 7T UHF MRI

Stefan HG Rietsch[1,2], Stephan Orzada[1], and Harald H Quick[1,2]

[1]Erwin L. Hahn Institute for MR Imaging, University of Duisburg-Essen, Essen, Germany, [2]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany

First steps towards whole body imaging with remote arrays at 7T UHF MRI are currently undertaken. Parallel transmit (pTx) capabilities of transmit arrays can be evaluated by the number of degrees of freedom which characterize the shim capabilities. In this work, 16 different pTx arrays with different transmit elements and combinations of transmit elements are simulated to examine inter element coupling behavior, singular values to determine the degrees of freedom and shim capabilities. Combining dipoles and loops seems to be the most promising approach among the investigated pTx arrays.

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175 15:51

About the Ultimate SNR for Cylindrical and Spherical RF Arrays in a Realistic Human Head Model

Andreas Pfrommer[1] and Anke Henning[1,2]

[1]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Institute for Biomedical Engineering, UZH and ETH Zurich, Zurich, Switzerland

In this work we investigated differences in the ultimate SNR in a realistic human head model for two configurations with the RF array elements distributed on either a cylindrical or a spherical holder. The basis set of solutions in our approach was created by vector cylindrical and spherical harmonics, which are known to form a complete set of eigenfunctions to Maxwell's equations in free-space. Assuming both surfaces have the same radius, the spherical geometry yielded higher SNR in grey and white matter compared to the cylindrical one. Moreover it allowed higher acceleration factors with the same g-factors.

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176 16:03

High-quality flexible printed MRI receive coils towards garment integration

Pierre Balthazar Lechene[1], Joe Corea[1], Anita Flynn[1], Michael Lustig[1], and Ana Arias[1]

[1]EECS, UC Berkeley, Berkeley, CA, United States

Close proximity of MRI receive coils to the patient can allow an increase of signal-to-noise ratio (SNR). Integrating the coils into garments that tightly conform to the body can provide such proximity. This work develops flexible printed MRI coils on a mesh with the potential to be integrated into garments. The dielectric used in the coil's capacitors is optimized to provide SNR within 91% of conventional coils. Encapsulation enhances the coils mechanical robustness, allowing bending below 1mm of radius of curvature. It is shown that, by cutting and sewing, the coils can be tailored to intimately fit a brassiere cup.

Oral

MR-Guided Interventions

Room 300-302 16:30 - 18:30 *Moderators:*Joshua de Bever & Axel Krafft

197 16:30 Rapid Device Localization for Prospective Stereotaxy: Using Computation Instead of Imaging

Miles E. Olsen[1], Ethan K. Brodsky[1], Jonathan A. Oler[2], Marissa K. Riedel[2], Eva M. Fekete[2], Ned H. Kalin[2], and Walter F. Block[1]

[1]Medical Physics, University of Wisconsin - Madison, Madison, WI, United States, [2]Psychiatry, University of Wisconsin - Madison, Madison, WI, United States

We present a technique for rapidly aiming interventional devices during prospective stereotaxy procedures. Our approach enables accurate computational determination of trajectory guide orientation and the true physical pivot point of frameless stereotaxy guides that mount on the skull.

Historically, these neurosurgical tasks require minutes per iterative cycle consisting of: scan, interpret image, adjust aim, repeat – or no intraoperative imaging at all, relying on preoperative images registered to stereotactic frame coordinates. Our rapid technique (~5 FPS) is closer to the clinician's preferred responsiveness of optical tracking of devices in the OR (~30 FPS).

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198 16:42

Evaluation of Infection Risk for MR Guided DBS Implantations in a Radiology Suite

Alastair Martin[1], Paul Larson[2], Nadja Levesque[2], Jill Ostrem[3], and Philip Starr[2]

[1]Radiology and Biomedical Imaging, UCSF, San Francisco, CA, United States, [2]Neurological Surgery, UCSF, San Francisco, CA, United States, [3]Neurology, UCSF, San Francisco, CA, United States

Hardware infection incidence for DBS implantations performed in a diagnostic MR suite is reported. A total of 164 DBS procedures were performed in movement disorder patients resulting in six (3.7%) hardware related infections. Two infections occurred within the first 10 cases and led to a change in sterile practice. Over the last 154 cases four (2.6%) infections have been reported and all were associated with implantation of the IPG controller, which is done in a separate surgical procedure 1-3 weeks after DBS implantation. Infection risk when implanting DBS electrodes in a diagnostic MR suite is comparable to conventional OR procedures.

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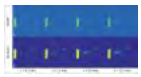
199 16:54



Time-resolved 23-Na Imaging for Monitoring of Thermochemical Ablation Injections

Nicolas G.R. Behl[1], Armin M. Nagel[1,2], Erik N.K. Cressman[3], Reiner Umathum[1], David Fuentes[4], R. Jason Stafford[4], Peter Bachert[1], Mark E. Ladd[1], and Florian Maier[1]

[1]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany, [2]Diagnostic and Interventional Radiology, University Medical Center Ulm, Ulm, Germany, [3]Interventional Radiology, M. D. Anderson Cancer Center, Houston, TX, United States, [4]Imaging Physics, M. D. Anderson Cancer Center, Houston, TX, United States

Thermochemical ablation (TCA) is a novel minimally invasive ablation approach. Acetic acid and sodium hydroxide are injected simultaneously and mix and react directly before entering the tissue. The exothermal reaction releases heat that is used for thermal ablation. For a detailed characterization of TCA injection, 4D ^{23}Na-data with reasonable temporal resolution are required. In this work, a compressed sensing approach was applied to acquire 4D ^{23}Na-data of injections with high spatial and good temporal resolution.

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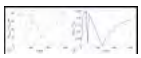
200 17:06

magna cum laude



Intrinsic MR visualization of RF lesions using IR-SSFP after MR-guided ablation

Philippa Krahn[1,2], Venkat Ramanan[2], Labonny Biswas[2], Nicolas Yak[2], Kevan Anderson[2], Jennifer Barry[2], Sheldon Singh[3], Mihaela Pop[1,2], and Graham A Wright[1,2]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Cardiology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

Here we explored an efficient imaging protocol for visualizing both the edema (reversible) and necrosis (irreversible) regions of myocardial injury in RF lesions. Using an MR-guided catheter system, we performed ablation in swine, immediately followed by T_1-based imaging (IR-SSFP) and T_2 mapping (T_2-prepared SSFP) for lesion characterization. The areas of edema segmented from IR-SSFP images and T_2 maps were visually similar and showed good correlation. IR-SSFP is known to visualize lesion cores at a specific TI--selecting an additional TI which emphasizes edema, we successfully demonstrated that both regions could be visualized by a single IR-SSFP acquisition.

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201 17:18

summa cum laude

In-vivo echo-navigated MR thermometry for real-time monitoring of cardiac radiofrequency ablation

Solenn Toupin[1,2], Matthieu Lepetit-Coiffe[2], Pierre Bour[1], Valery Ozenne[1], Baudouin Denis de Senneville[3], Rainer Schneider[4], Kimble Jenkins[5], Arnaud Chaumeil[1], Pierre Jais[1], and Bruno Quesson[1]

[1]IHU-LIRYC, Bordeaux, France, [2]Siemens Healthcare, Saint Denis, France, [3]Mathematical Institute of Bordeaux, Bordeaux, France, [4]Siemens Healthcare, Erlangen, Germany, [5]MRI Interventions, Irvine, CA, United States

The visualization of lesion formation in real time is one potential benefit of carrying out radiofrequency ablation (RFA) under magnetic resonance (MR) guidance in the treatment of ventricular arrhythmia. In this study, we propose a real-time MR thermometry method to visualize online the temperature distribution in the myocardium during catheter-based RFA. An echo-navigated sequence is used with slice tracking to compensate respiratory-induced through-plane motion and allow all image orientation. The method was evaluated during free breathing in 5 healthy volunteers and during RF delivery on the left ventricle (LV) of a sheep in vivo.

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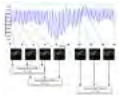
202 17:30 GPU Accelerated Dynamic Respiratory Motion Model Correction for MRI-Guided Cardiac Interventions



Robert Xu[1,2] and Graham Wright[1,2]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Schulich Heart Research Program, Sunnybrook Research Institute, Toronto, ON, Canada

The objective of this study is to explore the use of a rapidly updated dynamic motion model to correct for respiratory motion induced errors during MRI-guided cardiac interventions. The motivation for the proposed technique is to improve the accuracy of MRI guidance by taking advantage of the anatomical context provided by the high-resolution prior images and the respiratory motion information present in a series of real-time MR images. To achieve this goal, the proposed dynamic motion model is updated continuously, and is used to predict the motion estimate for realigning the prior volume with the real-time images during an intervention.

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203 17:42

An MR-compatible Assistance System for MR-guided Needle Interventions: Initial Phantom Evaluation

Axel Joachim Krafft[1,2,3], Simon Reiss[2], Andreas Reichert[2], Michael Vogele[4], and Michael Bock[2]

[1]German Cancer Consortium (DKTK), Heidelberg, Germany, [2]Radiology – Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [3]German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]iSYS Medizintechnik GmbH, Kitzbuehel, Austria

Minimally invasive interventions highly benefit from imaging guidance during instrument positioning and monitoring of therapeutic progress. MRI with its unique soft tissue contrast and ability for functional imaging is ideally suited for interventional guidance. To enable and facilitate minimally invasive interventions in closed-bore high-field MR systems with small bore diameters that severely limit patient access, we propose a novel, versatile assistance system in combination with passive instrument tracking. The system was studied in a systematic phantom experiment during needle procedures, and a mean targeting accuracy of less than 2 mm was achieved (mean procedure time: 6.5 min).

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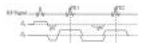
204 17:54

magna cum laude



Dual echo z-shimmed sequence for PRF-shift MR thermometry near metallic ablation probes

Yuxin Zhang[1] and William A Grissom[2]

[1]Biomedical Engineering, Tsinghua University, Beijing, China, People's Republic of, [2]Biomedical Engineering, Vanderbilt University Institute of Imaging Science, Nashville, TN, United States

Signal loss induced by ablation probe prevents accurate temperature monitoring where the thermal dose is highest. To address this problem, a dual echo sequence with z-shimming is proposed to recover the signal and an associated penalized likelihood approach is applied to estimate a single temperature map from both echoes. Phantom experiments were conducted to validate the effect of the proposed sequence. Evident signal recovery is shown in the magnitude images and temperature maps with heating. Standard deviation maps with no heating are presented to reflect the large reduction in uncertainty over time with dual-echo z-shimmed thermometry.

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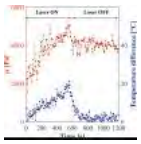
205 18:06

summa cum laude



In vivo monitoring of percutaneous thermal ablation by simultaneous MR Elastography and Thermometry

Nadège Corbin[1], Jonathan Vappou[1], Pramod Rao[1], Benoit Wach[1], Laurent Barbé[1], Pierre Renaud[1], Michel de Mathelin[1], and Elodie Breton[1]

[1]ICube-University of Strasbourg, Strasbourg, France

MR-guided percutaneous thermal ablations are currently monitored by MR thermometry. However, no information related to intrinsic property changes of the tissue is available during the procedure. The feasibility of monitoring in vivo thermal ablations by simultaneous Magnetic Resonance Elastography (MRE) and MR-thermometry is demonstrated in this work. The interventional MRE system includes a needle MRE driver, a respiratory triggered gradient-echo sequence with motion encoding and an online reconstruction method that provides elasticity and temperature measurements in real-time. Changes in elasticity and temperature occurring during laser thermal ablation are successfully measured in vivo over 20 minutes thanks to this interventional MRE system.

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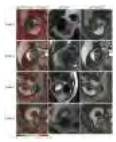
206 18:18



Preliminary evaluation of R2*-based temperature mapping for predicting the kill zone in MRI-guided renal cryoablation

Junichi Tokuda[1], Kemal Tuncali[1], Lisanne Kok[1,2], Vincent M Levesque [1], Ravi T Seethamraju [3], Clare M Tempany[1], and Ehud J Schmidt[1]

[1]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [2]Eindhoven University of Technology, Eindhoven, Netherlands, [3]Siemens Healthcare, Boston, MA, United States

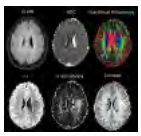
We tested the feasibility of R2*-based temperature mapping using a PETRA UTE sequence to determine the “kill zone” within an ice ball in the kidney during MRI-guided renal cryoablation. R2*-maps were calculated from dual-echo PETRA images acquired during six renal cryoablation cases, and converted to temperature maps using R2*-temperature calibrations performed in swine kidneys. We compared ablation volumes estimated from (a) the -20°C boundary on the temperature maps; (b) the signal void on intra-procedural T2-weighted images; and (c) post-ablation contrast-enhanced MRI as the “gold standard”. Results show that R2*-based temperature maps provided a reliable lower limit of the kill-zone volume.

Oral

Diffusion Acquisition

Room 324-326 16:30 - 18:30 *Moderators:*Kawin Setsompop

207 16:30



Optimal data acquisition for application to the continuous time random walk diffusion model

Thomas Richard Barrick[1], Andrew Mott[1], Diggory North[1], and Franklyn Arron Howe[1]

[1]*Neuroscience Research Centre, St George's, University of London, London, United Kingdom*

This study aims to optimise diffusion-weighted MRI (DW-MRI) acquisition for applications involving the continuous time random walk (CTRW) diffusion model. Minimum acquisition time and effects of inversion recovery are considered. Optimisation indicates a 6 minute 4 b-value DW-MRI acquisition is sufficient for diffusion tensor data. Inversion recovery significantly reduces the variability in calculated α, β and ADC due to effects of CSF in grey matter and periventricular white matter. Analysis of water diffusion in brain with the CTRW model may reveal more subtle effects of neuronal damage than conventional DWI.

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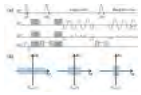
208 16:42



The Effects of Navigator Distortion Level on Interleaved EPI DWI Reconstruction: A Comparison between Image and K-space Based Method

Erpeng Dai[1], Xiaodong Ma[1], Zhe Zhang[1], Chun Yuan[1,2], and Hua Guo[1]

[1]*Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of,* [2]*Vascular Imaging Laboratory, Department of Radiology, University of Washington, Seattle, WA, United States*

One of the challenges for interleaved EPI (iEPI) DWI is the phase inconsistency among different shots. Several methods, performed either in the image or k-space domain, have been proposed to solve this problem with extra acquired navigator data. However, the navigator is usually acquired with a lower bandwidth in the phase encoding direction than the image echo, which can cause different distortion levels. In this study, the effects of such distortion for the image or k-space based reconstruction are investigated. It has been shown that the k-space based method is more tolerant to the navigator distortion.

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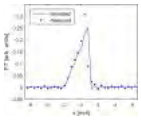
209 16:54



Experimental detection of imaginary signals in diffusion pore imaging using double diffusion encoding

Kerstin Demberg[1], Frederik Bernd Laun[1], Johannes Windschuh[1], Reiner Umathum[1], Peter Bachert[1], and Tristan Anselm Kuder[1]

[1]*Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany*

By diffusion pore imaging, the average shape of arbitrary closed pores in an imaging volume element can be detected employing a long-narrow gradient profile. Alternative approaches use short gradient pulses only. Until now, however, diffusion pore imaging of non-point-symmetrically shaped pores has not been demonstrated using short gradient pulses only. In this abstract, we present a first experimental verification using double diffusion encoded experiments. Non-point-symmetric pores result in non-vanishing imaginary parts in the double diffusion encoded signal. Thus the phase of the form factor can be estimated with an iterative approach. This allows for unambiguous pore image reconstruction.

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210 17:06

Virtual Coil Reconstruction for 3D Diffusion-Weighted Multi-Shot MRI using a Single Reference Shot.

Eric Y. Pierre[1], Jacques-Donald Tournier[1,2], and Alan Connelly[1]

[1]*Florey Institute of Neuroscience and Mental Health, Melbourne, Australia,* [2]*Centre for the Developing Brain, King's College London, London, United Kingdom*

We introduce an efficient Mult-Shot Diffusion-Weighted (DW) 3D-GRASE acquisition and reconstruction technique to produce DW image volumes free of motion-induced phase artifacts, without relying on explicit measurement or inference of the phase information. The method replaces navigators measurements by a single reference scan for the whole acquisition. Virtual Coil concepts for Parallel Imaging techniques are used to map the multi-shot data onto a k-space signal with consistent phase information.

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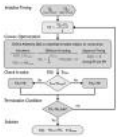
211 17:18

magna cum laude



Convex Optimized Diffusion Encoding (CODE) Gradient Waveforms for Minimum TE and Bulk Motion Compensated Diffusion Weighted MRI

Eric Aliotta[1,2], Holden H Wu[1,2], and Daniel B Ennis[1,2]

[1]*Radiological Sciences, UCLA, Los Angeles, CA, United States,* [2]*Biomedical Physics IDP, UCLA, Los Angeles, CA, United States*

Spin-Echo EPI Diffusion Weighted MRI (SE-EPI DWI) typically uses a diffusion encoding gradient waveform with two identical gradients on either side of the 180° pulse which, in combination with the temporal footprint of the EPI readout results in sequence dead time. This dead time can be used for additional diffusion encoding which can, in turn, reduce TE and/or be used to null gradient moments for bulk motion compensated diffusion encoding. Convex Optimized Diffusion Encoding (CODE) was developed to minimize TE for DWI with and without motion compensation, implemented on a clinical scanner and tested in volunteers.

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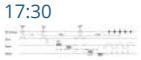
212 17:30



Detection of Microscopic Diffusion Anisotropy in Human Brain Cortical Gray Matter in Vivo with Double Diffusion Encoding

Marco Lawrenz[1] and Juergen Finsterbusch[1]

[1]*Systems Neuroscience, University Medical Center Hamburg-Eppendorf, Hamburg, Germany*

Double diffusion encoding experiments with two weighting periods applied successively in the same acquisition offer access to microscopic tissue properties. Rotationally invariant measures of the so-called microscopic diffusion anisotropy as a marker for cell or compartment shape have reliably been determined in brain white matter. In this study, it is demonstrated that microscopic diffusion

anisotropy can also be detected in cortical gray matter in vivo and measures of it can be determined extending first evidences presented recently. However, an inversion recovery pulse is required to null white matter signals and avoid partial volume effects.

213 17:42

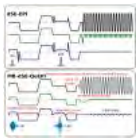
High-resolution diffusion imaging at 7T using 3D multi-slab EPI

Wenchuan Wu[1], Peter J Koopmans[1], Robert Frost[1], Myung-Ho In[2], Oliver Speck[3], and Karla L Miller[1]

[1]FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Department of Neurologic Surgery, Mayo Clinic, Rochester, MN, United States, [3]Department of Biomedical Magnetic Resonance, Otto-von-Guericke University, Magdeburg, Germany

In this work, we combined 3D multi-slab imaging (optimal SNR efficiency for spin-echo sequence) and 7T (higher SNR) to enhance diffusion imaging. With the newly developed Slice-FLEET technique and NPEN correction, we successfully achieved robust high resolution diffusion MRI at 7T with high SNR.

214 17:54



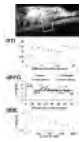
Efficient quiet multiband accelerated HARDI fetal Diffusion

Jana Maria Hutter[1], J-Donald Tournier[1], Anthony N Price[1], Lucilio Cordero Grande[1], Emer Judith Hughes[1], Kelly Pegoretti[1], Laura McCabe[1], Mary Rutherford[1], and Joseph V Hajnal[1]

[1]Centre for the developing brain, King's College London, London, United Kingdom

Fetal diffusion MRI analysis is often limited by the ability of the conventional ssEPI to allow an efficient, high-resolution acquisition, able to produce multi-shell high angular resolution dMRI data as required by advanced analysis tools. This abstract presents a novel, multiband accelerated, sinusoidal, quiet and efficient ssEPI acquisition. The first results on 3 fetuses with 54 directions show promising data quality and significantly decreased scan time.

215 18:06



Microscopic Anisotropy of the Rat Spinal Cord In vivo with DW PRESS

Matthew Budde[1] and Nathan Skinner[1]

[1]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States

Diffusion weighted imaging of the spinal cord has seen promising applications to diagnosis and prognosis, yet it is limited by technical challenges. This work presents the implementation of diffusion weighted spectroscopy of the water signal in the rat spinal cord in vivo with the goal of reducing acquisition times and post processing requirements to promote wider clinical feasibility.

216 18:18

Diffusion-weighted MRI using undersampled radial STEAM with iterative image reconstruction

Andreas Merrem[1], Jakob Klosowski[1], Sabine Hofer[1], Klaus-Dietmar Merboldt[1], and Jens Frahm[1]

[1]Biomedizinische NMR Forschungs GmbH, Max-Planck-Institut für Biophysikalische Chemie, Göttingen, Germany

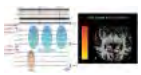
Single-shot STEAM MRI is a method for black-blood diffusion-weighted imaging where the use of radiofrequency-refocussed echoes leads to no image distortions, no susceptibility artifacts, and no violations of the Carr-Purcell-Meiboom-Gill condition. Despite these favorable properties, clinical applications have been limited by a low signal-to-noise ratio. Here, we demonstrate the development of highly undersampled radial diffusion-weighted single-shot STEAM MRI with iterative reconstruction to achieve acceptable signal-to-noise for studies of the human brain.

Oral

fMRI in Disease

Room 331-332 16:30 - 18:30 *Moderators:*Qiyong Gong & Jie Tian

217 16:30



Presurgical brain mapping in epilepsy using simultaneous EEG and functional MRI at ultra-high field: feasibility and first results

Frédéric Grouiller[1], Joao Jorge[2,3], Francesca Pittau[4], Wietske van der Zwaag [5,6], Christoph M Michel[7], Serge Vulliémoz [4], Rolf Gruetter[2], Maria I Vargas[8], and François Lazeyras[1]

[1]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [2]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Institute for Systems and Robotics, Department of Bioengineering, Instituto Superior Técnico, University of Lisbon, Lisbon, Portugal, [4]EEG and Epilepsy Unit, Department of Neurology, Geneva University Hospital, Geneva, Switzerland, [5]Biomedical Imaging Research Center (CIBM), Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [6]Spinoza Centre for Neuroimaging, Amsterdam, Netherlands, [7]Functional Brain Mapping Laboratory, Department of Fundamental Neurosciences, University of Geneva, Geneva, Switzerland, [8]Division of Neuroradiology, Geneva University Hospital, Geneva, Switzerland

The aim of this study was to demonstrate that EEG can be used safely at ultra-high field to locate epileptic focus and functional eloquent cortex in patients. We recorded simultaneous EEG-fMRI at 7T in 9 patients. Despite large artifacts in intra-MRI EEG recordings, it was possible to detect interictal epileptiform discharges and to perform noise-sensitive topography-related analyses. Using an optimized setup and appropriate artifact removal algorithms, localization of epileptic networks and of functional eloquent cortex is possible at ultra-high field. Therefore, the increased fMRI sensitivity offered by this technology may be beneficial to improve presurgical evaluations of patients with epilepsy.

218 16:42

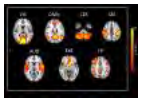
High-Frequency and Other Pathological Network Hemodynamics Observed in Epilepsy Patients Imaged With Multi-Band Multi-Echo BOLD Functional MRI at 7T

Prantik Kundu[1,2], Lara V. Marcuse[3], Bradley Delman[1], Rebecca Feldman[1], Madeline C. Fields[3], and Priti Balchandani[1]

[1]Department of Radiology, Icahn School of Medicine at Mt. Sinai, New York, NY, United States, [2]Department of Psychiatry, Icahn School of Medicine at Mt. Sinai, New York, NY, United States, [3]Department of Neurology, Icahn School of Medicine at Mt. Sinai, New York, NY, United States

Clinical assessment of epilepsy based on extra-cranial EEG electrophysiology has moderate diagnostic sensitivity (40%), poor spatial specificity (1-5 cm), and no prognostic value. We seek to utilize MRI for more effective non-invasive characterization of epilepsy than currently established. We implemented multi-echo multi-band (MEMB) BOLD fMRI at 7T to map the hemodynamic signatures of seizure zones and networks in spontaneous brain activity of focal epilepsy patients versus matched controls. We mapped seizure networks in patients at millimeter-resolution, and observed epileptiform BOLD to have significantly amplified infra-slow and high-frequency temporal oscillations, analogous to characteristic epileptiform activity from EEG.

219 16:54



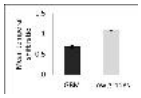
Mapping resting state networks in epilepsy with Arterial Spin Labeling connectivity analysis

Ilaria Boscolo Galazzo[1,2], Silvia Francesca Storti[3], Anna Barnes[1], Enrico De Vita[4], Francesca Benedetta Pizzini[2], John Duncan[5], Ashley Groves[1], Gloria Menegaz[3], and Francesco Fraioli[1]

[1]Institute of Nuclear Medicine, University College London, London, United Kingdom, [2]Department of Neuroradiology, University Hospital Verona, Verona, Italy, [3]Department of Computer Science, University of Verona, Verona, Italy, [4]Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom, [5]Department of Clinical and Experimental Epilepsy, UCL Institute of Neurology, London, United Kingdom

In this study, we propose the assessment of resting-state brain networks (RSNs) using Arterial Spin Labeling perfusion MRI as an alternative to the gold-standard sequence represented by the Blood-oxygenation-level-dependent (BOLD) contrast. RSNs have been derived by means of independent component analysis (ICA) and spatially compared to literature networks. In addition, functional connectivity changes in epileptic patients have been quantified in comparison to healthy controls. The results demonstrated ASL suitability in identifying RSNs, with a strong agreement with BOLD, and in detecting functional alterations in pathological conditions.

220 17:06



BOLD Hemodynamic alteration in Brain Tumors

Lalit Gupta[1], Rakesh K Gupta[2], Prativa Sahoo[1], Pradeep K Gupta[2], Rana Patir[3], Sandeep Vaishya[3], Indrajit Saha[4], and Walter Backes[5]

[1]Philips India Ltd., Bangalore, India, [2]Department of Radiology, Fortis Memorial Research Institute, Gurgaon, India, [3]Department of Neurosurgery, Fortis Memorial Research Institute, Gurgaon, India, [4]Philips India Ltd., Gurgaon, India, [5]Department of Radiology, Maastricht University Medical Center, Maastricht, Netherlands

The objective of the study is to determine the temporal delay in cerebral hemodynamic flow in brain tumors relative to normal brain tissue using rsfMRI and compare this with DCE derived cerebral blood volume(CBV) maps. Time series from all the voxels were cross-correlated with the mean time series from the normal hemisphere. The time point with maximum correlation was used to generate temporal shift map(TSM) for each voxel. We observed early hemodynamic changes in high grade glioma and found significant difference in the mean TSM ratio between Glioblastoma(GBM) and low grade tumors. TSM also appeared similar to rCBV perfusion maps.

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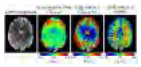


Investigating the impact of temporal signal fluctuations and local effective echo times on indices of BOLD sensitivity in healthy subjects and tumor patients at 7T.

Barbara Dymerska[1], Pedro Cardoso[1], Nina Mahr[2], Eva Matt[2], Florian Fischmeister[2], Roland Beisteiner[2], Siegfried Trattnig[1], and Simon Daniel Robinson[1]

[1]High Field MR Centre, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [2]High Field MR Centre, Department of Neurology, Medical University of Vienna, Vienna, Austria

Temporal signal fluctuations (tSNR) and local effective echo time (TE_{local}) are explored and their influence on BOLD sensitivity is investigated at 7T for healthy subjects and tumor patients, where prominent spatial variations in those two measures are expected. We show that tSNR may indicate sufficient sensitivity to detect activation but that BOLD sensitivity may be dramatically reduced by changes in TE_{local} close to pathologies and vital brain functions (motor, speech, auditory). Neglecting local TE variations can thus lead to false negative results in clinical fMRI. We thus suggest a new BOLD sensitivity metric based on TE_{local}·tSNR.

222 17:30

Hemodynamic Alterations in Posttraumatic Stress Disorder and Mild Traumatic Brain Injury

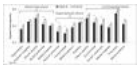
Gopikrishna Deshpande[1,2,3], D Rangaprakash[1], Wenjing Yan[1], Jeffrey S Katz[1,2,3], Thomas S Denney[1,2,3], and Michael N Dretsch[4,5]

[1]AU MRI Research Center, Department of Electrical and Computer Engineering, Auburn University, Auburn, AL, United States, [2]Department of Psychology, Auburn University, Auburn, AL, United States, [3]Alabama Advanced Imaging Consortium, Auburn University and University of Alabama Birmingham, Birmingham, AL, United States, [4]U.S. Army Aeromedical Research Laboratory, Fort Rucker, AL, United States, [5]Human Dimension Division, HQ TRADOC, Fort Eustis, VA, United States

Functional MRI is an indirect measure of neural activity, as it is the convolution of the hemodynamic-response function (HRF) and a latent neural response. Recent studies show variance in HRF across brain regions and subjects. This raises the question of reliability of fMRI results if, for example, a canonical HRF is used in analysis. Using whole-brain resting-state fMRI, we employed blind hemodynamic deconvolution to estimate HRF parameters. We uncovered hemodynamic alterations in Soldiers with PTSD and mTBI, and found that

certain subcortical and default-mode network regions showed significant alterations in HRF.

223 17:42



Assessment of brain cognitive functions in patients with vitamin B12 deficiency using resting state functional MRI

Lalit Gupta[1], Rakesh K Gupta[2], Pradeep K Gupta[2], Hardeep Singh Malhotra[3], Indrajit Saha[4], and Ravindra K Garg[3]

[1]Philips India Ltd., Bangalore, India, [2]Department of Radiology, Fortis Memorial Research Institute, Gurgaon, India, [3]Department of Neurology, King George Medical University, Lucknow, India, [4]Philips India Ltd., Gurgaon, India

The alterations in the brain cognitive functions due to vitamin B12 deficiency and reversibility of these alterations following therapy was studied using resting state fMRI. Regional Homogeneity (ReHo) was used to assess functional changes in patients with vitamin B12 deficiency. ReHo was significantly lower in patients than controls in the entire cerebrum and in the brain networks associated with cognition control i.e. default mode, cingulo-opercular and fronto-parietal network. We conclude that the brain networks associated with cognition control, in particular pre-frontal regions, are altered in patients with vitamin B12 deficiency that partially recovered following six weeks of replacement therapy.

224 17:54

Longitudinal Changes in Intrinsic Brain Activity in Cirrhotic Patients Before and One Month After Liver Transplantation

yue cheng[1], Li-xiang Huang[1], Shuang-shuang Xie[1], Tian-yi Qian[2], and Wen Shen[1]

[1]Tianjin First Central Hospital, Tianjin, China, People's Republic of, [2]Siemens Healthcare, MR Collaborations NE Asia, Beijing, China, People's Republic of

In this study, we evaluated brain activity changes in cirrhotic patients referred for liver transplantation (LT). Twenty cirrhotic patients and 25 healthy controls were included. Amplitude of low-frequency fluctuation (ALFF) values were compared between cirrhotic patients (pre- and post-LT) and healthy controls as well as patients pre- and post-LT. In cirrhotic patients, decreased ALFF in most brain regions can be reversed one month after LT, and the increased ALFF in temporal and frontal lobe may also return to normal. The reduced ALFF in the right supplementary motor area, inferior parietal lobule and calcarine persisted. One month after LT, the spontaneous brain activity partially renormalized, but complete cognitive function restoration may need a longer time.

225 18:06

magna cum laude

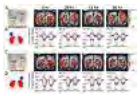
Perils in the Use of Cross-validation for Performance Estimation in Neuroimaging-based Diagnostic Classification

Pradyumna Lanka[1], D Rangaprakash[1], and Gopikrishna Deshpande[1,2,3]

[1]AU MRI Research Center, Department of Electrical and Computer Engineering, Auburn University, Auburn, AL, United States, [2]Department of Psychology, Auburn University, Auburn, AL, United States, [3]Alabama Advanced Imaging Consortium, Auburn University and University of Alabama, Birmingham, AL, United States

In this study, we highlight the fact that cross-validation accuracy might not be a good measure of performance estimation in neuroimaging-based diagnostic classification, especially with smaller sample sizes typically encountered in neuroimaging. We trained an array of classifiers using resting state fMRI-based functional connectivity measures from subjects in a particular age group using cross-validation, and then tested on an independent set of subjects with the same diagnosis (mild cognitive impairment and Alzheimer's disease), but from a different age group. We demonstrate that cross-validation accuracy might give us an inflated estimate of the true performance of the classifiers.

226 18:18



fMRI indicates central TRPV1 modulation on gouty pain

Chiao-Chi Chen[1], Yi-Hua Hsu[1], Yi-Jen Peng[2], Guo-Shu Huang[3], and Chen Chang[1]

[1]Institute of Biomedical Sciences, Academia Sinica, Taipei, Taiwan, [2]Department of Pathology, Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan, [3]Department of Radiology, Tri-Service General Hospital, National Defense Medical Center, Taipei, Taiwan

Gout is one of the most painful forms of diseased conditions. Non-steroid anti-inflammatory drugs and colchicine are first-line agents for the acute attack, but these drugs are poorly tolerated or contraindicated in some patients. Elucidating the pain signaling pathway of gout may shed light on the key molecules that may be pursued as therapy targets in the future. Our neuroimaging, cellular, and molecular investigations regarding transient receptor potential vanilloid 1 (TRPV1) reveal a novel transduction pathway from the periphery to the brain during the attack of gout.

Oral

Human Brain Tumours: Diagnosis & Response to Therapy

Room 334-336 16:30 - 18:30 *Moderators:*Ravianth Balaji & Natalie Serkova

227 16:30

Multi-Center and Multi-Vendor Study of Long-TE 1H MRS at 3T for Detection of 2-Hydroxyglutarate in Brain Tumors In Vivo

Changho Choi[1], Thomas Huber[2], Anna Tietze[3], Byung Se Choi[4], Jung Hee Lee[5], Seung-Koo Lee[6], Alexander Lin[7], and Sunitha Thakur[8]

[1]UT Southwestern Medical Center, Dallas, TX, United States, [2]Technical University of Munich, Munich, Germany, [3]Aarhus University Hospital, Aarhus, Denmark, [4]Seoul National University College of Medicine, Seongnam, Korea, Republic of, [5]Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of, [6]Yonsei University College of Medicine, Seoul, Korea, Republic of, [7]Harvard Medical School, Boston, MA, United States, [8]Memorial Sloan-Kettering Cancer Center, New York, NY, United States

The non-invasive identification of elevated 2-hydroxyglutarate (2HG) in IDH-mutated gliomas by 1H MRS in vivo is a major breakthrough in brain tumor research. Studies have shown that optimized long-TE approaches may confer advantages over short-TE MRS for detecting 2HG. Here we report an evaluation of the feasibility of long-TE 2HG MRS in Philips, Siemens and GE 3T scanners. Echo times were optimized, with numerical simulations and phantom validation, for the vendor-specific RF pulses. In-vivo data from IDH-mutated glioma patients, obtained in the three vendors, are discussed.

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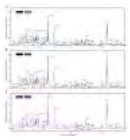
228 16:42



Metabolic Profiling of Malignant Transformation and IDH-mutation in Diffuse Infiltrating Gliomas

Llewellyn Jalbert[1], Adam Elkhaled[1], Joanna J Phillips[2], Evan Neill[3], Marram P Olson[3], Mitchel S Berger[4], John Kurhanewicz[1,3], Susan M Chang[4], and Sarah J Nelson[1,3]

[1]Department of Bioengineering & Therapeutic Sciences, University of California, San Francisco (UCSF), San Francisco, CA, United States, [2]Department of Pathology, University of California, San Francisco (UCSF), San Francisco, CA, United States, [3]Department of Radiology & Biomedical Imaging, University of California, San Francisco (UCSF), San Francisco, CA, United States, [4]Department of Neurological Surgery, University of California, San Francisco (UCSF), San Francisco, CA, United States

Patients diagnosed with infiltrating low-grade glioma have a relatively long survival, and a balance is often struck between treating the tumor and impacting quality of life. Aggressive treatments are typically reserved for lesions that have undergoing malignant transformation (MT) to a higher-grade lesion. Mutations in the isocitrate dehydrogenase 1 & 2 oncogenes and production of 2-hydroxyglutarate further characterize these tumors and are associated with improved outcome and treatment sensitivity. In this study, we found distinct metabolic profiles associated with patients' tumors that had undergone MT, as well as contained the IDH-mutated genotype, using proton HR-MAS spectroscopy.

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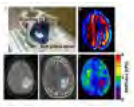

Noninvasive Assessment of IDH Mutational Status in Glioma using MR Elastography

Kay Pepin[1], Arvin Arani[1], Mona El Sheikh[1], Nikoo Fattahi[1], David Lake[1], Armando Manduca[1], Kiaran McGee[1], Ian Parney[1], Richard Ehman[1], and John Huston[1]

[1]Mayo Clinic, Rochester, MN, United States

MR elastography (MRE) has been used to characterize the mechanical properties of normal and diseased brain tissue (1-4). This study evaluated MRE for the noninvasive characterization of gliomas, specifically investigating the relationship between tumor stiffness and mutations in the IDH1 gene, an important prognostic biomarker for improved outcome. Eighteen patients were enrolled in this study. MRE examinations were performed at 3T using an EPI-MRE sequence and 60Hz vibration frequency. Tumor stiffness was quantified and compared to IDH mutation status, as determined by histology. Twelve tumors were identified as IDH1 mutation positive and were significantly stiffer than tumors with non-mutated IDH1.

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230 17:06

Amide-Proton-Transfer-Weighted (APTw) MRI as a Surrogate Biomarker to Detect Recurrent High-grade Gliomas after Treatment with Chemoradiation: Validation by Image-Guided Stereotactic Biopsy

Shanshan Jiang[1,2], Charles Eberhart[3], Jaishri Blakeley[4], Lindsay Blair[4], Huamin Qin [3], Michael Lim[5], Alfredo Quinones-Hinojosa[5], Hye-Young Heo[1], Yi Zhang[1], Dong-Hoon Lee[1], Xuna Zhao[1], Zhibo Wen[2], Peter C.M. van Zijl[1], and Jinyuan Zhou[1]

[1]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States, [2]Department of Radiology, Southern Medical University Zhujiang Hospital, Guangzhou, China, People's Republic of, [3]Department of Pathology, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Neurology, Johns Hopkins University, Baltimore, MD, United States, [5]Department of Neurosurgery, Johns Hopkins University, Baltimore, MD, United States

We explored the imaging features of treatment effects and active tumor in glioma patients after surgery and chemoradiation using amide-proton-transfer-weighted (APTw) imaging at 3 Tesla. Needle biopsy samples were obtained for pathological validation. Corresponding APTw signal intensities were recorded. Results showed that APTw signal intensities had strong positive correlations with cellularity and proliferation. The active tumor had significantly higher APTw signal intensity, compared to treatment effects. The area-under-curve (AUC) for APTw intensities to differentiate treatment effects from active tumor was 0.959. APT imaging has potential for molecular image-guided biopsy for post-treatment glioma patients to distinguish pseudoprogression from tumor recurrence.

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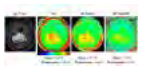
231 17:18



Amide Proton Transfer (APT) Imaging of Brain Tumors using 3D Fast Spin-Echo Dixon Method: Comparison with Separate B0 Mapping

Osamu Togao[1], Akio Hiwatashi[1], Jochen Keupp[2], Koji Yamashita[1], Kazufumi Kikuchi[1], Masami Yoneyama[3], and Hiroshi Honda[1]

[1]Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan, [2]Philips Research, Hamburg, Germany, [3]Philips Electronics Japan, Tokyo, Japan

Recently, the FSE Dixon APT acquisition protocol with intrinsic . B0 correction was developed and implemented on 3T clinical MRI scanners. This technique allows simultaneous acquisition of APT imaging and intrinsic B0 mapping without increasing scan time. In the present study, we demonstrated the quantitative performance of the 3D FSE Dixon APT imaging of brain tumors in comparison with the separate B0 mapping method.

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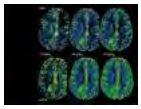
232 17:30

Introducing steady state blood volume mapping using ferumoxytol, a new MRI tool to assess the intravascular space in brain tumors and other intracranial pathologies

Csanad Varallyay[1], Daniel Schwartz[2], Joao Prola Netto[1], Prakash Ambady[2], Andrea Horvath[2], and Edward Neuwelt[2]



[1]Diagnostic Radiology and Neurology, Oregon Health and Science University, Portland, OR, United States, [2]Neurology, Oregon Health and Science University, Portland, OR, United States

Steady state blood volume (SS-CBV) mapping using the blood pool agent ferumoxytol as an MRI contrast agent is feasible in brain tumors and other intracranial pathologies. It allows high resolution, distortion free blood volume maps, which can be a useful MRI tool to improve diagnosis and assessment of response to therapy. Ferumoxytol dose and MRI sequences may be optimized for various clinical applications.

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233 17:42

Semi-quantitative MRI Assessment of anti-PD1 Immunotherapy Response in Recurrent Glioblastoma

Lei Qin[1,2], Xiang Li[2,3], Amanda Stroiney[4], David A Reardon[1,2], and Geoffrey Young[2,3]

[1]Dana-Farber Cancer Institute, boston, MA, United States, [2]Harvard Medical School, boston, MA, United States, [3]Brigham and Women's Hospital, Boston, MA, United States, [4]Northeastern University, Boston, MA, United States

The purpose of this study is to evaluate the predictive value of quantitative and semi-quantitative MRI biomarkers in determining patient benefit in anti-PD1 immunotherapy treatments. Longitudinal MRIs were performed on patients diagnosed with recurrent GBM. Volumetric analysis of abnormal tissue from contrast enhanced T1, FLAIR, and ADC revealed two distinct patterns: a) progressive increase volume in patients who derived no significant benefit, and b) a transient increase in the volume, followed by a delayed decrease in patients with >6 mo survival on trial. In this preliminary study (n=10), the data suggest that the volume of abnormal tissue on ADC seems to correlate better with patient benefit than abnormality on FLAIR and T1.

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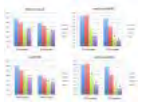
234 17:54



Serial 3D H-1 MRSI of Patients with Newly Diagnosed GBM being Treated with Radiation, Temozolomide, Erlotinib and Bevacizumab

Sarah Nelson[1], Yan Li[1], Janine Lupo[1], Marram Olson[1], Jason Crane[1], Annette Molinaro[2], Ritu Roy[3], Soonmee Cha[1], and Susan Chang[2]

[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Neurological Surgery, University of California, San Francisco, San Francisco, CA, United States, [3]Helen Diller Family Comprehensive Cancer Center, University of California, San Francisco, San Francisco, CA, United States

Patients with newly diagnosed GBM are typically treated with a combination of radiation and temozolomide in conjunction with a variety of investigational agents. Assessing the effectiveness of such therapies is complicated by differences in their mechanisms of action that lead to ambiguities in the interpretation of conventional anatomic images and difficulties in assessing the spatial extent of tumor. The results of this study demonstrate that integrating 3D lactate edited H-1 MRSI into routine MR examinations and applying quantitative analysis methods allows for the objective evaluation of changes in tumor burden and the early assessment of outcome.

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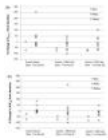
235 18:06



Differential imaging biomarker response to sunitinib across tumor histologies in a prospective trial of brain metastases

Caroline Chung[1], Brandon Driscoll[1], Warren Foltz[1], Cynthia Menard[1], David Jaffray[1], and Catherine Coolens[1]

[1]Princess Margaret Cancer Centre, Toronto, ON, Canada

Our preclinical study of sunitinib (SU) in combination with conformal large single fraction radiation in an orthotopic murine brain tumor model, discovered that changes in apparent diffusion coefficient (ADC), AUC and Ktrans were promising imaging biomarkers that could predict response to SU as well as combined SU and radiation. Based on our preclinical findings, we designed a prospective phase I trial of SU and radiosurgery (SRS) for brain metastases that incorporated translational investigation of these imaging biomarkers. Here we summarize our discovery of differential ADC and AUC responses to sunitinib between renal cell cancer and other histology brain metastases.

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236 18:18

magna cum laude

Optimal time-window and perfusion protocol for MRI in early assessment of high grade glioma treatment response

Christopher Larsson[1,2], Jonas Vardal[1], Inge Rasmus Groote[3], Magne Mørk Kleppestø[1,2], Petter Brandal[4], and Atle Bjørnerud[1,5]

[1]The Intervention Centre, Oslo University Hospital, Oslo, Norway, [2]Faculty of Medicine, University of Oslo, Oslo, Norway, [3]Department of Psychology, University of Oslo, Oslo, Norway, [4]Department of Cancer Medicine, Surgery & Transplantation, Oslo University Hospital, Oslo, Norway, [5]Faculty of Physics, University of Oslo, Oslo, Norway

Due to limitations in structural MRI in assessment of overall survival (OS) in high grade glioma interest in more advanced functional MRI methods has risen. A prospective longitudinal high grade glioma study including structural imaging and T1/T2* perfusion was performed in 27 patients to investigate the optimal time-window and most sensitive MRI perfusion method for early OS analysis.

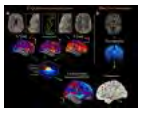
No structural imaging, DSC or absolute perfusion parameter was found significant for early OS assessment. Change in median Ktrans and CBF from baseline to eight weeks was found significant and CBF change >15% most accurate predictor for poor OS.

Oral

Multiple Sclerosis: Novel Techniques & Studies

237 16:30

summa cum laude



Association between cortical demyelination and structural connectomics in early multiple sclerosis

Gabriel Mangeat[1,2], Russell Ouellette[2,3], Constantina Andrada Treaba[2,3], Tobias Granberg[2,3], Elena Herranz[2,3], Celine Louapre[2,3], Nikola Stikov[1,4], Jacob A. Sloane[3,5], Eric C. Klawiter[2,3,6], Caterina Mainero[2,3], and Julien Cohen-Adad[1,7]

[1]Polytechnique Montreal, Montreal, QC, Canada, [2]Athinoula A. Martinos Center for Biomedical Imaging, MGH, Charlestown, MA, United States, [3]Harvard Medical School, Boston, MA, United States, [4]Montreal Health Institute, Montreal, QC, Canada, [5]Beth Israel Deaconess Medical Center, Boston, MA, United States, [6]Department of Neurology, MGH, Boston, MA, United States, [7]CRIUGM, Functional Neuroimaging Unit, Université de Montréal, Montreal, QC, United States

Multiple sclerosis (MS) is a chronic disorder of the central nervous system characterized by diffuse abnormalities along white matter tracts and demyelination, including cortical lesions. In this study, we explored the interplay between cortical and brain structural networks integrity in a cohort of early MS subjects by combining quantitative mapping of T_2^* and T_1 relaxation rates from 7T MRI acquisitions to measure cortical demyelination with diffusion imaging and graph theory to assess the structural brain architecture. Results suggest that motor, premotor and anterior cingulate cortices are affected simultaneously by cortical demyelination and connectomics alterations, at a very early stage of MS.

238 16:42

magna cum laude

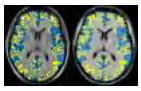
Cerebellar-cerebral connections with the default mode network influence working memory performance in MS

Giovanni Savini[1,2], Matteo Pardini[3], Alessandro Lascialfari[1,4], Declan Chard[5], David Miller[5], Egidio D'Angelo[2,6], and Claudia Angela Michela Gandini Wheeler-Kingshott[2,5]

[1]Department of Physics, University of Milan, Milan, Italy, [2]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy, [3]Department of Neurosciences, Rehabilitation, Ophthalmology, Genetics and Maternal and Child Health, University of Genoa, Genoa, Italy, [4]Department of Physics, University of Pavia, Pavia, Italy, [5]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL, Institute of Neurology, University College London, London, United Kingdom, [6]Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy

The cerebellum is linked to the default mode network (DMN) and its contribution to non-motor functions is now increasingly recognized. In Multiple Sclerosis (MS) motor and cognitive functions are both impaired. Here we aimed at assessing a possible link between cognition and cerebellar-cerebral fibers disruption in MS. Probabilistic tractography and graph theory derived metrics were compared to Symbol Digit Modalities Test (SDMT) scores in MS. We found that accounting for cerebellar-cerebral connections when calculating DMN graph metrics yielded a stronger correlation between network efficiency and SDMT scores, suggesting that disruption of the cerebellar-cerebral connections has significant cognitive consequences in MS.

239 16:54



Outer and inner cortical MTR abnormalities observed in clinically isolated syndromes

Rebecca Sara Samson[1], Manuel Jorge Cardoso[2,3], Wallace J Brownlee[1], J William Brown[1,4], Matteo Pardini[5], Sebastian Ourselin[2,3], Claudia Angela Michela Gandini Wheeler-Kingshott[1,6], David H Miller[1,7], and Declan T Chard[1,7]

[1]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, University College London, London, United Kingdom, [2]Translational Imaging Group, Centre for Medical Image Computing, Department of Medical Physics and Bioengineering, University College London, London, United Kingdom, [3]Dementia Research Centre, Department of Neurodegenerative Diseases, UCL Institute of Neurology, London, United Kingdom, [4]Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [5]Department of Neuroscience, Rehabilitation, Ophthalmology, Genetics, Maternal and Child Health, University of Genoa, Genoa, Italy, [6]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy, [7]National Institute for Health Research (NIHR) University College London Hospitals (UCLH) Biomedical Research Centre, London, United Kingdom

Cortical magnetization transfer ratio (cMTR) is potentially a sensitive measure of pathology linked with disease progression in relapse-onset multiple sclerosis (MS). We investigated outer cMTR changes in people following a clinically isolated syndrome (CIS), and compared those who later developed MS with those who did not. Compared with controls, the outer-to-inner cMTR ratio was significantly lower in patients who developed MS after 15 years but not in those who remained CIS. This suggests that the pathological processes underlying preferential reductions in outer cMTR start early in the clinical course of MS, and may be relevant to conversion to MS.

240 17:06

Variable Density Magnetization Transfer (vdMT) imaging for 7 T MR Imaging

Se-Hong Oh[1], Wanyong Shin[1], Jongho Lee[2], and Mark J. Lowe[1]

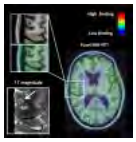
[1]Imaging Institute, Cleveland Clinic Foundation, Cleveland, OH, United States, [2]Laboratory for Imaging Science and Technology, Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of

Because of the much higher SAR and longer acquisition time, in-vivo studies using MT at UHF have not been clinically feasible. In this work, we demonstrated a new approach (variable density MT [vdMT])for acquiring whole brain covered 7T MT data in a clinically reasonable time. vdMT provides similar image quality to that obtained with conventional MT imaging, and shortens the scan time by avoiding from SAR limitation. The proposed method generates high-resolution MT data in reasonable scan time and it exhibits high similarity with the conventional method. Moreover, it maintains sensitivity to MS lesions.

241 17:18

The neuroinflammatory component of gray matter pathology in multiple sclerosis by in vivo combined 11C-PBR28 MR-PET and 7T imaging

Elena Herranz[1,2], Costanza Gianni[1,2], Céline Louapre[1,2], Constantina Andrada Treaba[1,2], Sindhuja T Govindarajan[1], Gabriel Mangeat[1,3],



Russell Ouellette[1], Marco L Loggia[1,2], Noreen Ward[1], Eric C Klawiter[1,2,4], Ciprian Catana[1,2], Jacob A Sloane[2,5], Jacob M Hooker[1,2], Revere P. Kinkel[6], and Caterina Mainero[1,2]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Institute of Biomedical Engineering, Polytechnique Montreal, Montreal, QC, Canada, [4]Department of Neurology, Massachusetts General Hospital, Boston, MA, United States, [5]Beth Israel Deaconess Medical Center, Boston, MA, United States, [6]University of California, San Diego, CA, United States

In multiple sclerosis (MS) histopathological investigations implicated neuroinflammation through microglia and/or macrophages activation in the pathogenesis of cortical and subcortical diffuse damage. By combining 11C-PBR28 positron emission tomography (PET) imaging with anatomical 7T and 3T MRI, we investigated the presence and correlates of neuroinflammation in cortex and gray matter of subjects with MS. We found that neuroinflammation was present in thalamus, hippocampus, basal ganglia as well as cortex, particularly cortical lesions, and associated with structural damage, increased neurological disability and impaired information processing speed. Our data indicate that neuroinflammation is closely associated with neurodegeneration.

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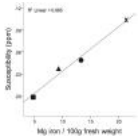
242 17:30



Quantitative Susceptibility Mapping (QSM) in patients with clinically isolated syndrome (CIS) and multiple sclerosis (MS) - a large cohort study

Ferdinand Schweser[1,2], Jesper Hagemeier[1], Paul Polak[1], Michael G Dwyer[1], Niels P Bergsland[1,3], Nicola Bertolino[1], Bianca Weinstock-Guttman[4], Andreas Deistung[5], Jürgen R Reichenbach[5,6], and Robert Zivadinov[1,2]

[1]Buffalo Neuroimaging Analysis Center, Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, The State University of New York at Buffalo, Buffalo, NY, United States, [2]MRI Molecular and Translational Research Center, Jacobs School of Medicine and Biomedical Sciences, The State University of New York at Buffalo, Buffalo, NY, United States, [3]MR Research Laboratory, IRCCS Don Gnocchi Foundation ONLUS, Milan, Italy, [4]Department of Neurology, Jacobs School of Medicine and Biomedical Sciences, The State University of New York at Buffalo, Buffalo, NY, United States, [5]Medical Physics Group, Department of Diagnostic and Interventional Radiology, Jena University Hospital - Friedrich Schiller University Jena, Jena, Germany, [6]Michael Stifel Center for Data-driven and Simulation Science Jena, Friedrich Schiller University Jena, Jena, Germany

Quantitative susceptibility mapping (QSM) is the most sensitive technique available for studying tissue iron *in vivo*. In this work, we applied QSM to more than 1000 patients with multiple sclerosis (MS) and almost 250 patients with clinically isolated syndrome (CIS). Our results provide strong support for changed deep gray matter iron concentrations in MS and CIS.

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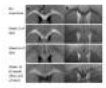
243 17:42



Dissociated longitudinal patterns of neural activation, functional connectivity and structural connectivity in a mouse model of de- and re-myelination

Yi-Ching Lynn Ho[1,2], Fiftarina Puspitasari[1], Way-Cherng Chen[1], and Kai-Hsiang Chuang[1]

*[1]Singapore Bioimaging Consortium, Agency for Science, Technology & Research (A*STAR), Singapore, Singapore, [2]Interdisciplinary Institute of Neuroscience & Technology (ZIINT), Zhejiang University, Hangzhou, China, People's Republic of*

We hypothesized that structure and functional responses do not demonstrate the same pattern of impairment across time. Using the cuprizone mouse model of reversible demyelination, we show different longitudinal patterns of neural activation and functional connectivity, compared to healthy mice and also to the extent of cuprizone demyelination.

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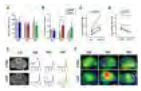
244 17:54



Hyperpolarized 13C MRSI can detect neuroinflammation in vivo in a Multiple Sclerosis murine model

Caroline Guglielmetti[1,2], Chloe Najac[1], Annemie Van der Linden[2], Sabrina M Ronen[1], and Myriam M Chaumeil[1]

[1]University of California San Francisco, San Francisco, CA, United States, [2]University of Antwerp, Antwerp, Belgium

This study demonstrates that ^{13}C MRS of hyperpolarized pyruvate can be used to detect increased lactate production from pro-inflammatory macrophages, mechanism mediated by pyruvate dehydrogenase kinase-1 upregulation and pyruvate dehydrogenase inhibition, in a preclinical model of multiple sclerosis, hence providing a novel tool for in-vivo detection of neuroinflammation.

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245 18:06

Axon Loss as an Outcome Measure for Assessing Therapeutic Efficacy

Tsen-Hsuan Lin[1], Mitchell Hallman[1,2], Mattew F. Cusick[3], Jane E. Libbey[3], Peng Sun[1], Yong Wang[1,4,5,6], Robert S. Fujinami[3], and Sheng-Kwei Song[1,5,6]

[1]Radiology, Washington University School of Medicine, St. Louis, MO, United States, [2]Perelman School of Medicine at the University of Pennsylvania, Philadelphia, PA, United States, [3]Pathology, University of Utah School of Medicine, Salt Lake City, UT, United States, [4]Obstertic and Gynecology, Washington University School of Medicine, St. Louis, MO, United States, [5]The Hope Center for Neurological Disorders, Washington University School of Medicine, St. Louis, MO, United States, [6]Biomedical Engineering, Washington University in St. Louis, St. Louis, MO, United States

Diffusion basis spectrum imaging (DBSI) has successfully distinguished co-existing pathologies in CNS, such as MS. The utility of DBSI derived “axon volume” has not been explored previously. In this study, we demonstrated the use of axon loss, reflecting irreversible tissue damage, as an outcome measure for assessing therapeutic efficacy in a mouse model of multiple sclerosis.

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246 18:18

In vivo 7T Quantitative Susceptibility Mapping of Cortical Lesions in Multiple Sclerosis

magna cum laude

Wei Bian[1], Eric Tranvinh[1], Thomas Tourdias[2], May Han[3], Tian Liu[4], Yi Wang[4], Brian Rutt[1], and Michael Zeineh[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]Service de NeuroImagerie Diagnostique et Thérapeutique, CHU de Bordeaux, Bordeaux, France, [3]Department of Neurology, Stanford University, Stanford, CA, United States, [4]Department of Radiology, Weill Medical College of Cornell University, New York, NY, United States

Magnetic susceptibility measured with quantitative susceptibility mapping (QSM) has been proposed as a biomarker for inflammation in multiple sclerosis (MS) white matter (WM) lesions. However, a detailed in vivo characterization of cortical lesions has not been performed. In this study, the susceptibility in both cortical and WM lesions relative to adjacent normal-appearing parenchyma was measured and compared for 14 MS patients using QSM at 7T. Our results showed that relative susceptibility was negative for cortical lesions but positive for WM lesions. The opposite pattern of relative susceptibility suggests that iron loss dominates the susceptibility contrast in cortical lesions.

Oral

Automating & Speeding Algorithms

Summit 1 16:30 - 18:30 *Moderators:*James Pekar

247 16:30

Fully Automated Data Management and Quality Assurance in Very Large Prospective Cohort MR Imaging Studies – the MR Imaging Study within the German National Cohort

Jochen G. Hirsch[1], Alexander Köhn[1], Daniel C. Hoinkiss[1], Jonas Peter[1], Andreas Thomsen[1], Matthias Günther[1,2], and the German National Cohort MRI Study Investigators[3]

[1]Fraunhofer MEVIS, Bremen, Germany, [2]University Bremen, Bremen, Germany, [3]NAKO MR Imaging Core, Munich, Germany

We present a fully automated data management workflow and quality assurance, which is set up for large, multicentric cohort studies including whole-body MR imaging. The workflow includes a modality worklist, exam-synchronous DICOM transfer to centralized storage, quality control of MR acquisition, various image-based quality measures, web-based radiological image review for incidental findings, visual quality scores, as well as long-term archiving. This workflow, implemented in the MRI Study of the German National Cohort, enables to acquire and process more than 30 whole-body MRI scans per day, available for IF reading within 4 hours. Deviations, outliers, technical failures are pointed out on-the-fly.

248 16:42

Automated slice positioning for 2D MRA in bolus tracking of DCE-MRI

Takao Goto[1] and Mirai Araki[1]

[1]MR Engineering, GE Healthcare, Hino-shi, Japan

Accurate placement of a 2D plane across the aorta while examining scout images is a complex task and makes the operator's workflow difficult in bolus tracking of DCE-MRI. We present a new method for automated slice positioning for 2D MRA used to monitor bolus arrival. The 2D plane was planned by aorta detection using both Hough Forests and AdaBoost classifiers following the classification of axial images. A dataset with 40 patients was tested, and 35 cases depicted the cross section of the aorta clearly. This automation will help the operator and decrease the total study time.

249 16:54

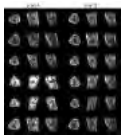
Automatic Pipeline for Regional Brain Analyses in Demyelinated Mice

Emilie Poirion[1], Daniel Garcia Lorenzo[1], Isaac Adanyeguh[1], Marie-Stéphane Aigrot[1], Alexandra Petiet[2], and Bruno Stankoff[1,3]

[1]Brain and Spine Institute, INSERM U1127/CNRS UMR 7225, Sorbonnes Universités, UPMC, CHU Pitié-Salpêtrière, 47 Bd de l'hôpital, 75013 Paris, Paris, France, [2]Brain and Spine Institute, Center for Neuroimaging Research (CENIR), CHU Pitié-Salpêtrière, 47 Bd de l'hôpital, 75013 Paris, Paris, France, [3]AP-HP, Saint Antoine Hospital, Department of Neurology, 184 Bd du Faubourg Saint Antoine, 75012 Paris, Paris, France

Experimental studies in mouse models offer the opportunity to combine ***in-vivo*** longitudinal high-field MRI and histological analyses. However, automatic MRI tools for processing rodent data to avoid manual processing are lacking. We proposed an automatic pipeline to perform systematic analyses on large murine cohorts with longitudinal data. We first applied artifacts correction as bias correction to optimize the subsequent steps. We then registered masks of regions of interest (ROIs) for our analyses onto each subject from which we extracted the quantitative data. This pipeline provides a way of quickly analyzing ROI regardless of disease models or the MRI sequence.

250 17:06



Improving robustness in automated slice positioning for knee MR by combining landmark detection and image processing

Takamasa Sugiura[1], Shuhei Nitta[1], Taichiro Shiodera[1], Yuko Hara[1], Yasunori Taguchi[1], Tomoyuki Takeguchi[1], Takuya Fujimaki[2], Kensuke Shinoda[2], Hiroshi Takai[2], and Ayako Ninomiya[2]

[1]TOSHIBA CORPORATION, Kawasaki, Japan, [2]TOSHIBA MEDICAL SYSTEMS CORPORATION, Otawara, Japan

We propose an improved automatic slice positioning algorithm for knee MR which combines conventional machine-learning based landmark detection with advanced image processing techniques. Conventional slice positioning methods determine the diagnostic slice center and orientation by detecting anatomical landmarks in the scout image. However, computing slice positions from landmarks can be inadequate since landmarks vary across patients and can be cut-off from scout images. Here, we use not only landmark detection but also image processing based contour detection of the femoral condyle and angle estimation of the femur and tibia to enable slice

positioning for a wider range of scout images.

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251 magna cum laude

17:18 

3D magnetic resonance fingerprinting with a clustered spatiotemporal dictionary

Pedro A. Gómez[1,2], Guido Buonincontri[3], Miguel Molina-Romero[1,2], Cagdas Ulas[1,2], Jonatahn I. Sperl[2], Marion I. Menzel[2], and Bjoern H. Menze[1]

[1]Technische Universität München, Garching, Germany, [2]GE Global Research, Garching, Germany, [3]Istituto Nazionale di Fisica Nucleare, Pisa, Italy

We present a method for creating a spatiotemporal dictionary for magnetic resonance fingerprinting (MRF). Our technique is based on the clustering of multi-parametric spatial kernels from training data and the posterior simulation of a temporal fingerprint for each voxel in every cluster. We show that the parametric maps estimated with a clustered dictionary agree with maps estimated with a full dictionary, and are also robust to undersampling and shorter sequences, leading to increased efficiency in parameter mapping with MRF.

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252 17:30 

Multi-dimensional phase unwrapping: a new and efficient linear algebraic formulation using weighted least-squares

Laurent Lamalle[1,2], Georgios Gousios[3], and Matthieu Urvoy[3]

[1]Inserm US 17 & CNRS UMS 3552, Grenoble, France, [2]Université Joseph Fourier & CHU de Grenoble, UMS IRMaGe, Grenoble, France, [3]SFR RMN Biomédicale et Neurosciences, Université Joseph Fourier, Grenoble, France

Phase information of MR images can provide quantitative access to various physical properties of the examined sample, such as local $$$B_0$$$ values, magnetic susceptibility or flow. Phase is a continuous information whose estimation typically requires unwrapping. In this study, we propose a novel phase estimation algorithm which: (1) relies on a numeric scheme that is robust to phase jumps, and (2) is optimized for execution on modern parallel processors.

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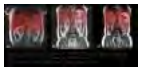
253 17:42 

Fast liver FOV localization for improved liver-MRI workflow

Arathi Sreekumari[1], K S Shriram[1], Uday Patil[1], Ersin Bayram[2], Dattesh Shanbhag[1], and Rakesh Mullick[1]

[1]GE Global Research, Bangalore, India, [2]GE Healthcare, Houston, TX, United States

In this work we are focusing on automating the scan coverage and FOV for liver MRI acquisitions. We demonstrate that using fast scout images, we can achieve very good localization of liver FOV, irrespective of anatomy differences and hand-up / hands-down positioning.

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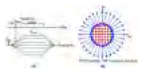
254 magna cum laude

17:54 

Simultaneous measurement of short and long T2* components using hybrid encoding

Hyungseok Jang[1,2], Curtis N Wiens[1], and Alan B McMillan[1]

[1]Department of Radiology, University of Wisconsin, Madison, WI, United States, [2]Department of Electrical and Computer Engineering, University of Wisconsin, Madison, WI, United States

In this study, we propose a highly time efficient quantitative imaging scheme where short and long T2* components can be simultaneously estimated. This method is based on a multi-echo UTE hybrid encoding scheme, where the central SPI region is oversampled to allow measurement of short T2* across a wide range of TEs. The UTE acquisition is immediately followed by a gradient echo train to measure long T2*. We show the proposed method can obtain an extensive number of images (e.g., approximately 750 images) within a single acquisition and reasonable scan time.

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255 18:06 

Automatic Classification of Brain Connectivity Matrices - a toolbox for supporting neuropsychiatric diagnosis

Ricardo Jorge Maximiano[1], Tiago Constantino[1,2,3], André Santos-Ribeiro[1,4], and Hugo Alexandre Ferreira[1]

[1]Institute of Biophysics and Biomedical Engineering, Faculty of Sciences of the University of Lisbon, Lisbon, Portugal, [2]Spitalzentrum Biel, Bienne, Switzerland, [3]Lisbon School of Health Technology - ESTeSL, Lisbon, Portugal, [4]Centre for Neuropsychopharmacology, Imperial College London, London, United Kingdom

In this work, a user-friendly toolbox that aims to classify automatically brain connectivity matrices is described. To test this tool, we used the Parkinson's Progression Markers Initiative (PPMI) data which includes structural and functional Magnetic Resonance Imaging data of healthy subjects, patients with "scans without evidence for dopaminergic deficit" (SWEDD) and patients diagnosed with Parkinson's Disease (PD). Using default parameters, this tool was able to achieve a maximum accuracy of 85.4% in classifying the 3 groups of subjects by selecting features that were related to the rostral middle frontal gyrus and splenium, which are in agreement with PD literature.

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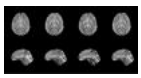
256 magna cum laude

18:18 

Rapid Two-Step QSM Without A Priori Information

Christian Kames[1,2], Vanessa Wiggermann[1,3,4], and Alexander Rauscher[1,4]

[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [2]Department of Engineering Physics, University of British Columbia, Vancouver, BC, Canada, [3]Department of Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [4]Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada

Current state-of-the-art QSM reconstruction algorithms are plagued by the trade-off between reconstruction speed and quality. We propose a novel two-step dipole inversion algorithm 20x faster than MEDI and HEIDI, while producing qualitatively appealing images with a root-mean-square error less than MEDI's and HEIDI's when compared to COSMOS. The proposed method works by first reconstructing the well-conditioned k-space region through the use of a Krylov subspace solver, followed by a total variation minimization to fill in the ill-conditioned k-space region.

Oral

Quantitative MSK Imaging

Summit 2 | 16:30 - 18:30 | *Moderators:* Delphine Perie & Yongxian Qian

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257 | 16:30

Measurement and Compensation of Respiration-Induced B0 Variations for Bone Marrow Fat Quantification in Lumbar Spine

Yoonho Nam[1], Joon-Yong Jung[1], Hyun Seok Choi[1], Eojin Hwang[1], Hongpyo Lee[2], and Dong-Hyun Kim[2]

[1]Department of Radiology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of, [2]Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of

Fat fraction of the bone marrow has been suggested as an important quantitative parameter in the assessment of treatment response and determination of the benignity in oncologic imaging. Therefore, accurate fat quantification is a prerequisite for the fat fraction to be established as a reliable imaging biomarker. For this purpose, spoiled gradient echo sequences have been commonly used. However, gradient echo imaging is susceptible to B_0 variations from various sources such as respiration, cardiac pulsation. In this study, we investigate and compensate the effects of respiration-induced B_0 variations on fat quantification of the bone marrow in the lumbar spine.

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258 | 16:42

Quantitative Muscle Perfusion with DCE-MRI Shows Distinct Load-Dependent Exercise-Stimulated Muscle Perfusion Patterns

Jeff L. Zhang[1], Christopher Hanrahan[1], Christopher C. Conlin[1], Corey Hart[2], Gwenael Layec[2], Kristi Carlston[1], Daniel Kim[1], Michelle Mueller[3], and Vivian S. Lee[1]

[1]Radiology, University of Utah, Salt Lake City, UT, United States, [2]Internal Medicine, University of Utah, Salt Lake City, UT, United States, [3]Vascular surgery, University of Utah, Salt Lake City, UT, United States

Noninvasive mapping of calf muscle perfusion with high spatial resolution has potential for assessing the severity of peripheral artery disease (PAD) and studying associated capillary density abnormality. We tested our novel DCE-MRI method to measure calf muscle hyperemia stimulated by plantar flexion at three different workloads. Increases in exercise load caused increased total perfusion in gastrocnemius, with a heterogeneous pattern at medium load and homogeneous at higher load. Perfusion in soleus did not increase until very heavy load of 16 lbs. DCE-MRI provides high spatial resolution measurement of post-exercise muscle perfusion.

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259 | 16:54

Gender Differences in Sodium Deposition in Muscle and Skin

Ping Wang[1,2], Muge Serpil Deger[3], Hakmook Kang[4], T. Alp Ikizler[3], Jens M. Titze[5], and John C. Gore[1,2]

[1]Institute of Imaging Science, Vanderbilt University Medical Center, Nashville, TN, United States, [2]Department of Radiology and Radiological Sciences, Vanderbilt University Medical Center, Nashville, TN, United States, [3]Division of Nephrology and Hypertension, Department of Medicine, Vanderbilt University Medical Center, Nashville, TN, United States, [4]Department of Biostatistics, Vanderbilt University Medical Center, Nashville, TN, United States, [5]Division of Clinical Pharmacology, Department of Medicine, Vanderbilt University Medical Center, Nashville, TN, United States

Sodium ions play a vital role in cellular homeostasis and electrochemical activity throughout the human body. Previous studies have measured muscle and skin sodium contents in vivo in humans using MRI and have shown characteristic changes with age and as a result of pathological changes. In this study, we found significant gender differences in sodium deposition between muscle and skin, with male has higher sodium content in skin than in muscle, while female has higher muscle sodium than skin sodium. This observation seems to be more reliable with the increase of age.

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260 | 17:06

Correlation of Mono-exponential and Bi-exponential UTE-T2* Analyses and Biomechanics in Human Achilles Tendons

Eric Y Chang[1,2], Robert M Healey[3], Reni Biswas[2], Sheronda Statum[2], Betty Tran[2], Kenyu Iwasaki[4], Jiang Du[2], Won C Bae[2], and Christine B Chung[1,2]

[1]Radiology Service, VA San Diego Healthcare System, San Diego, CA, United States, [2]Department of Radiology, University of California, San Diego Medical Center, San Diego, CA, United States, [3]Department of Orthopaedic Surgery, University of California, San Diego Medical Center, San Diego, CA, United States, [4]Department of Orthopaedic Surgery, Kyushu University, Fukuoka, Japan

In this pilot study, we sought to determine if mono-exponential T2, mono-exponential UTE-T2*, or bi-exponential UTE-T2* correlated with biomechanical properties in human Achilles tendons. We found very high and significant correlation coefficients between mono-exponential T2* (rho = 0.90, p = 0.002) and bi-exponential T2* fractions (rho = -0.97, p < 0.001) obtained using the UTE-Cones sequence and ultimate tensile strain. Ultimate tensile strain represents the percentage change in tendon length prior to failure and high strains have been previously associated with tendon degeneration. Our results suggest that non-invasive MRI of the Achilles tendon may serve as a surrogate measure.

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261 17:18

A comparison of denoising methods in dynamic MRS

Benjamin C Rowland[1] and Alexander P Lin[1]

[1]*Centre for Clinical Spectroscopy, Brigham and Women's Hospital, Boston, MA, United States*

MR spectroscopy is often used to study dynamic systems, such as muscle energetics using ^{31}P. The need to perform temporal averaging to improve signal to noise ratios can compromise the temporal resolution of the measurements. Indirect time domain denoising can help to resolve this issue. In this study we evaluate six potential denoising approaches for dynamic MRS.

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262 17:30

Extracting Quantitative Information From MRI Bound- and Pore-Water Maps of Cortical Bone

Mary Kate Manhard[1], Sasidhar Uppuganti[2], Mathilde C Granke[2], Daniel F Gochberg[3], Jeffry S Nyman[2], and Mark D Does[1]

[1]*Biomedical Engineering, Vanderbilt University, Nashville, TN, United States,* [2]*Department of Orthopaedics & Rehabilitation, Vanderbilt University, Nashville, TN, United States,* [3]*Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States*

Bound and pore water concentration measures of cortical bone found from MRI have been shown to correlate with material properties of bone, but the ideal way to analyze and draw information from 3D quantitative maps remains unclear. Material properties of cadaver radii found from a 3-point bend test were correlated with characteristics of the distribution of bound and pore water concentrations (e.g. mean, skewness) in ROIs found from different segmentations. Results highlighted the importance of segmentation method as well as quantitative measures drawn from the maps.

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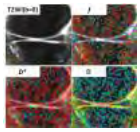
263 17:42



Detection of the meniscal blood supply changes in meniscal problems with Intravoxel incoherent motion MR imaging

Tan Guo[1], Dandan Zheng[2], Bing Wu[2], and Min Chen[1]

[1]*Radiology, Beijing Hospital, Beijing, China, People's Republic of,* [2]*GE Healthcare, MR Research China, Beijing, Beijing, China, People's Republic of*

The blood supply of meniscus is an essential indicator for the prognosis of meniscal problems. With a favorable blood supply of the teared meniscus, it's tend to preserve the meniscus as much as possible at partial meniscetomy and meniscal repair. Intravoxel incoherent motion (IVIM) theory provide information about microcirculation of blood in addition to the pure molecular diffusion. The perfusion information detected with IVIM is emphasized on microvascular bed, which is the typical blood supply pattern of meniscus. In this study, IVIM model were used to estimate the change of vasculature in normal, degenerated and teared meniscus.

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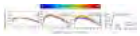
264 17:54



Orientation anisotropy of quantitative rotating and laboratory frame relaxation parameters in articular cartilage

Jari Rautiainen[1], Lassi Rieppo[2,3], Simo Saarakkala[2,3,4], and Mikko Johannes Nissi[1,5]

[1]*Department of Applied Physics, University of Eastern Finland, Kuopio, Finland,* [2]*Research Unit of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland,* [3]*Medical Research Center Oulu, Oulu University Hospital and University of Oulu, Oulu, Finland,* [4]*Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland,* [5]*Diagnostic Imaging Center, Kuopio University Hospital, Kuopio, Finland*

Classical ($$$T_1$$$, $$$T_2$$$) and several rotating frame quantitative MR parameters have been used for evaluation of composition and structure of articular cartilage, and demonstrated to have variable sensitivity to tissue orientation. The orientation dependence of $$$T_1$$$, $$$T_2$$$, $$$T_2^*$$$, CW-$$$T_{1\rho}$$$ with four spin-lock amplitudes, adiabatic $$$T_{1\rho}$$$ with three different pulse modulations, adiabatic $$$T_{2\rho}$$$ and $$$T_{\rm RAFF}$$$ relaxation times were further investigated at 9.4T at different orientations of articular cartilage relative to B0 and compared with polarized light microscopy of the same tissue. $$$T_1$$$, adiabatic $$$T_{1\rho}$$$ with HS1-pulse and CW-$$$T_{1\rho}$$$ at 2 kHz spin-lock demonstrated the least orientation dependence.

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265 18:06

The value of DWI with ADC mapping for assessing synovitis and bone erosion in early stage of RA

Xinwei Lei[1], Jin QU[1], Ying ZHAN[1], Huixia Li[1], and Yu Zhang[2]

[1]*Tianjin First Center Hospital, Tianjin, China, People's Republic of,* [2]*Philips Healthcare, Beijin, China, People's Republic of*

The aim of study was to explore whether synovitis and bone erosion judged by ADC values correspond exactly or not to those judged by CE-MRI. 25 patients were examined by 3.0T MR including DWI and CE-MRI. ADC value of synovitis and bone erosion was significantly lower than that of joint effusion and cysts. ADC values of 2.0 was found distinguishing joint effusion from synovitis, and bone erosion from cysts. Therefore, MR diffusion provides additional information to the routine MRI sequences rendering it an effective non-invasive tool in differentiating between synovitis and joint effusion, as well as bone erosion and cysts.

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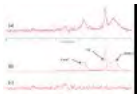
266 18:18



Measurement of proteoglycan concentration in intervertebral discs assessed by 1HMRS at 1.5T

Lisa Maria Harris[1,2], Ella Hodder[2,3], Mara Cercignani[2], Jan Bush[2], Derek Convill[3], Paul Colley[1], and Nicholas Dowell[2]

[1]*Radiological Sciences, Brighton and Sussex University Hospitals NHS Trust, Brighton, United Kingdom,* [2]*Clinical Imaging Sciences Centre, Brighton and Sussex Medical School, Brighton, United Kingdom,* [3]*Computing, Engineering and Mathematics, University of Brighton, Brighton, United Kingdom*

An assessment was made to determine whether proteoglycan concentration could accurately be quantified at 1.5T using 1HMRS in a group of 13 healthy volunteers. A peak from the N-acetyl resonance associated with proteoglycan was seen in all thirteen spectra, and reliably measured (308.8±59.9). This compares favourably with studies performed at higher field strengths, thus showing that is it possible even at 1.5T to measure proteoglycans in intervertebral discs.

Combined Educational & Scientific Session

Ultrastructural & Functional Bone & Muscle Imaging

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 | 14:15 - 16:15 | *Moderators:*Mark Does & Jiang Du

14:15
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Muscle Quality and Function
John Thornton[1]

[1]MRC Centre for Neuromuscular Diseases, University College London, London, United Kingdom

Target audience: This presentation is intended to inform those interested in the application of quantitative MRI to probe structure, function or pathology in skeletal muscle. Objectives: To outline the properties of skeletal muscle pertinent to quantitative MRI, the various MRI-accessible quantities that reflect muscle quality, and how MRI measurements correlate with disease severity and functional assessment

14:45
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Clinical Applications
Thomas M Link[1]

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

Over the past decade advanced quantitative MRI techniques have evolved which allow to characterize bone and muscle structure and function. Clinically applicable techniques analyzing bone quality and strength are high resolution, morphological MRI, UTE and MRS. These techniques have shown promise in clinical studies, providing information beyond bone mineral density, the current standard measurement. Novel technologies focusing on the assessment of muscle structure and function are chemical shift-based fat quantification techniques, MRS, T2 relaxation time measurements and BOLD MRI, all of which are also clinically applicable and were used in investigating pain syndromes and disorders of muscle function.

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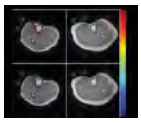
magna cum laude

15:15



Bound- and Pore-Water MRI of Cortical Bone in Osteoporotic Patients
Mary Kate Manhard[1], S Bobo Tanner[2], Daniel F Gochberg[3], Jeffry S Nyman[4], and Mark D Does[1]

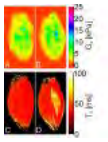
[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Department of Medicine, Vanderbilt University, Nashville, TN, United States, [3]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [4]Department of Orthopaedics & Rehabilitation, Vanderbilt University, Nashville, TN, United States

Osteoporotic fractures are a growing problem, and X-ray based methods do not always identify individuals at risk of a fracture. MRI based methods of bound and pore water in cortical bone have the potential to offer new information about fracture resistance. These methods were implemented on both osteoporotic volunteers and healthy controls in the tibia. Osteoporotic subjects had significant decreases in bound water concentration and slight increases in pore water concentration compared to healthy subjects. These promising results will allow for further investigation of changes of bound and pore water concentrations across diseases and with response to various treatment methods.

178

magna cum laude

15:27



Magnetic resonance elastography characterization of skeletal muscle stiffness changes resulting from pressure ulcers
Jules Laurent Nelissen[1,2], Willeke Traa[3], Larry de Graaf[1], Kevin Moerman[4], Cees Oomens[3], Aart Nederveen[5], Ralph Sinkus[6], Klaas Nicolay[1], and Gustav Strijkers[2]

[1]Biomedical NMR, Eindhoven University of Technology, Eindhoven, Netherlands, [2]Preclinical and Translational MRI, Academic Medical Center, Amsterdam, Netherlands, [3]Biomechanics of Soft Tissues, Eindhoven University of Technology, Eindhoven, Netherlands, [4]MIT media lab, Massachusetts Institute of Technology, Cambridge, MA, United States, [5]Radiology, Academic Medical Center, Amsterdam, Netherlands, [6]Imaging Sciences & Biomedical Engineering, King's College London, London, United Kingdom

We have investigated the feasibility of using Magnetic Resonance Elastography (MRE) to quantify muscle-tissue mechanical properties and changes therein related to the development of deep tissue injury type of pressure ulcers. MRE measurements were performed before and after damage-inducing indentation of the tibialis-anterior muscle of Sprague Dawley rats. Current study demonstrates that changes in muscle-tissue mechanical properties associated with deep tissue injury can be quantified by MRE. We expect that better knowledge of changes in soft tissue mechanical properties due to damage, measured with MRE, will provide new insights in the aetiology of deep tissue injury and other muscle pathologies.

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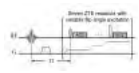
magna cum laude

15:39



Selective in Vivo Bone Imaging with Long-T2 suppressed PETRA MRI
Cheng Li[1], Jeremy F. Magland[1], Xia Zhao[1], Alan C. Seifert[2], and Felix W. Wehrli[1]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States

An IR-based long-T2 suppressed PETRA sequence was designed and optimized to image sub-millisecond-T2 tissue components, e.g.

collagen-bound bone water. To minimize scan time signal was sampled repeatedly after each inversion with individual excitation flip-angle designed to yield constant short-T2 signal amplitude. A fast non-iterative reconstruction algorithm combined with phase-modulated excitation pulse was applied to minimize image artifacts due to non-uniform excitation profile, allowing for increased flip-angle and higher SNR. Optimized long-T2 suppressed PETRA allows imaging of bone matrix water, opening up new possibilities for anatomic bone imaging at isotropic resolution and quantification in clinically practical scan times.

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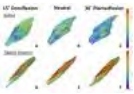
180 15:51



In vivo skeletal muscle fiber length measurements using a novel MRI diffusion tensor imaging approach: reproducibility and sensitivity to passive stretch.

Jos Oudeman[1], Valentina Mazzoli[1,2,3], Marco A Marra[2], Klaas Nicolay[3], Mario Maas[1], Nico Verdonschot[2], Andre M Sprengers[2], Aart J Nederveen[1], Gustav J Strijkers[4], and Martijn Froeling[5]

[1]Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Orthopedic Research Lab, Radboud UMC, Nijmegen, Netherlands, [3]Biomedical NMR, Eindhoven University of Technology, Eindhoven, Netherlands, [4]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands, [5]Radiology, University Medical Center, Utrecht, Utrecht, Netherlands

Diffusion Tensor Imaging in combination with tractography facilitates 3D visualizations of the muscle architecture, which is described by fiber length and pennation angle. In order to get accurate fiber length estimation, tendinous structures need to be separated from muscles. In this work we propose a new method for semiautomatic tendon segmentation. The fiber length obtained after tendon segmentation is seen to be reproducible. Furthermore the sensitivity of the method allows for detection of change in fiber length whit muscle stretch. The observed behavior is in agreement with the known antagonistic function of muscles.

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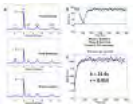
181 16:03

magna cum laude



31P-MRS and MRI of lower leg muscle oxidative metabolism in heart failure patients

Ding Xia[1], Stuart D. Katz[2], and Ravinder R. Regatte[1]

[1]Center for Biomedical Imaging, Department of Radiology, New York University Langone Medical Center, New York, NY, United States, [2]Division of Cardiology, Department of Medicine, New York University Langone Medical Center, New York, NY, United States

We measured the lower leg muscle oxidative metabolism in healthy volunteers (n=5) and heart failure patients (n=6) with quantitative ^{31}P-MRS and MRI at 3T clinical scanner. The post-exercise rate of phosphocreatine (PCr) resynthesis was decreased in heart failure subjects (i.e. delayed PCr recovery time) compared to healthy volunteers in global calf muscle, as well as in predominantly fast twitch (type II) gastrocnemius muscle (medial and lateral, GM and GL) and predominantly slow twitch (type I) soleus (SOL) muscle.

16:15 Adjournment & Meet the Teachers

Educational Course

Updates From Big Data Initiatives

*Organizers:*Jonathan Gillard, M.D., FRCR, MBA & Jennifer A McNab, Ph.D.

Nicoll 2 14:15 - 16:15 *Moderators:*James Gee & Jennifer McNab

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14:15

Big Data: The Rhineland Study

Tony Stöcker[1]

[1]1German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany

This lecture briefly introduces the Rhineland Study and summarizes the concepts of its MR protocol. The Rhineland Study investigates aging, in particular of the human brain and related neurological disorders, across the adult lifespan. The Rhineland Study will include up to 30,000 subjects, aged 30 years or over at first visit, and reexamination every three years. The emphasis is on quantitative measures, including one-hour MRI examination of brain structure and function.

14:45

Big Data: UK Biobank

Stephen Smith

I will give an overview of the UK Biobank brain imaging component, which will carry out multimodal brain imaging on 100,000 subjects as part of the UK Biobank long-term prospective epidemiological study. UK Biobank data is open access.

15:15

Big Data: Human Connectome Project

Bruce R. Rosen[1]

[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States

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15:45

The Baseline Study of Human Health and the Transition to Illness

Sanjiv Gambhir[1]

[1]*Radiology, Stanford University, Stanford, CA, United States*

16:15 Adjournment & Meet the Teachers

Educational Course

ISMRM/SMRT Joint Forum: Update on MRI Contrast Agents - Recent Controversies

*Organizers:*Chris Kokkinos, B.App.Sc., Pg.Cert.(MRI) & Scott B. Reeder, M.D., Ph.D.

Nicoll 3 14:15 - 16:15 *Moderators:*Jeffrey Weinreb

14:15 Update on Nephrogenic Systemic Fibrosis: Should We Stop Screening?
Sadhana Nandwana

This presentation will provide a current update on nephrogenic systemic fibrosis (NSF) and where we stand with exposure of selected gadolinium based contrast agents (GBCAs) in renally impaired patients and risk of NSF. Risk stratification based on safety profiles of GBCAs and current national and international guidelines and recommendations will be examined. Evaluation of whether these guidelines should be modified in light of recent publications demonstrating a lack of NSF occurrence in patients exposed to specific GBCAs will be discussed.

14:45 Panel Discussion

15:15 Gadolinium Deposition: Imaging Phenomenon or Should We Change Our Practice?
Greg C. Brown[1]

[1]*Centre for Advanced Imaging, The University of Queensland, St Lucia, Australia*

Reports of gadolinium accumulation in the brain have surprised many practitioners, and raised questions of potential harm to patients. The FDA & NIH recommend reconsideration of GBCA use while investigations continues. The accumulation calls into doubt a common assumption that existing renal function mediated guidelines are sufficient to avoid significant biological interaction.

This presentation reviews the recent reports and presents literature concerning gadolinium chelate stability, transmetalation, gadolinium interactions in biochemistry, observations of bone and skin accumulation (beyond NSF definitions), and environmental build up to provide a context for a reconsideration by clinical and research practitioners of our current GBCA usage.

15:45 Panel Discussion

16:15 Ferumoxytol: Should We Be Using It in Clinical Practice?
Mustafa Bashir[1]

[1]*Duke University Medical Center*

Ferumoxytol has seen increasing use as a contrast agent in both clinical and research MRI. This talk will describe some of the potential uses and risks associated with the agent.

16:45 Panel Discussion

17:15 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

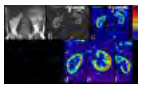
Quantitative Biomarkers in Renal MRI: Adding Physiologic Information to the Morphologic Assessment

*Organizers:*Lorenzo Mannelli, M.D., Ivan Pedrosa, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 1 16:30 - 18:30 *Moderators:*Sooah Kim & S. Sendhil Velan

16:30 Introduction by Moderator

16:33



Arterial Spin Labeled Measurement of Renal Perfusion

Ananth J Madhuranthakam[1]

[1]*Radiology, UT Southwestern Medical Center, Dallas, TX, United States*

ASL has become a mainstream application for brain perfusion, but still has challenges for renal perfusion. Various improvements including pseudo-continuous labeling combined with background suppression and timed-breathing approaches have enabled robust renal perfusion imaging. This presentation will discuss different types of arterial spin labeling technique along with the acquisition methods and strategies for robust renal perfusion imaging without the administration of exogeneous contrast agent.

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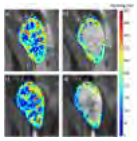
16:48



Assessing longitudinal renal blood flow changes in children following renal replacement therapy using Arterial Spin Labelling MRI

Fábio Nery[1], Enrico De Vita[2,3], Chris A. Clark[1], Isky Gordon[1], and David L. Thomas[3]

[1]*UCL Institute of Child Health, Developmental Imaging and Biophysics Section, LONDON, United Kingdom,* [2]*National Hospital for Neurology and Neurosurgery, Lysholm Department of Neuroradiology, LONDON, United Kingdom,* [3]*UCL Institute of Neurology, Department of Brain Repair and Rehabilitation, LONDON, United Kingdom*

Arterial spin labelling (ASL) is a contrast-free MRI technique that allows for the quantitative measurement of organ perfusion. In this study, we non-invasively evaluated renal perfusion changes in sixteen children within the first year following renal replacement therapy using ASL. Each child was scanned in three occasions : (A) immediately post-transplant; (B) “1 month” post-transplant and (C) “1 year” post-transplant. The highest renal cortical blood flow was seen on the first scan in the majority of children while in later scans equilibrium between child and kidney was reached.

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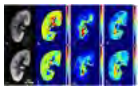
17:00



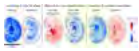
Noninvasive Measurement of Single Renal Oxygen Extraction Fraction using Focused Asymmetric Spin Echo Approach - a feasibility study

CY Wang[1], R Zhang[2], L Jiang[3], R Wang[4], XD Zhang[4], H Wang[3], K Zhao[4], LX Jin[3], J Zhang[1,2], XY Wang[1,4], and J Fang[1,2]

[1]*Academy for Advanced Interdisciplinary Studies, Peking University, Beijing, China, People's Republic of,* [2]*College of Engineering, Peking University, Beijing, China, People's Republic of,* [3]*Philips Healthcare, Suzhou, China, People's Republic of,* [4]*Department of Radiology, Peking University First Hospital, Beijing, China, People's Republic of*

This study demonstrates the feasibility of combining 2D-RF excitation pulse and ASE sequence (focused ASE sequence, FASE) for single renal OEF measurement. Comparison between images acquired with full-FOV ASE and focused ASE was conducted to confirm the advantages of the focused ASE sequence for single renal imaging. The new technique could reduce artifacts and distortion caused by susceptibility differences, and limit spatial blurring due to T2-decay, which is promising for diagnosis of some renal diseases.

17:12



How Bold is BOLD MRI of the Kidney: Detailing Renal Hypoxia with MRI, Electrochemical Physiological Methods and Optical Imaging

Thoralf Niendorf[1]

[1]*Berlin Ultrahigh Field Facility (B.U.F.F.), Max-Delbrück Center for Molecular Medicine, Berlin*

This presentation is designed to inspire the preclinical and clinical imaging, renal physiology, and nephrology communities to foster explorations into the assessment of renal oxygenation and haemodynamics by exploiting the powers of MRI. For this purpose the merits and limitations of renal BOLD-MRI are surveyed together with their implications. Explorations into detailing the relation between renal T_2* and renal tissue partial pressure of oxygen (pO_2) are discussed. Multi-modality in vivo approaches suitable for detailing the role of the confounding factors that govern T_2* are considered. Future directions of MRI assessment of renal oxygenation and perfusion are explored.

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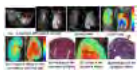
17:27



Quantitative MRI of Renal Function in a Mouse Model of Unilateral Ureteral Obstruction

Haiying Tang[1], Matthew Fronheiser[1], Guoqiang Zhang[2], Adrienne Pena[1], Daniel Kukral[1], Cindy Cai[2], Rachel Zebo[2], Jeff L L Zhang[3], Bradley Zinker[2], Anthony Azzara[2], Patrick Chow[1], Feng Luo[4], and Wendy Hayes[1]

[1]*Bristol Myers Squibb, Princeton, NJ, United States,* [2]*Bristol Myers Squibb, Hopewell, NJ, United States,* [3]*Radiology, University of Utah, Salt Lake City, UT, United States,* [4]*Bristol Myers Squibb, Wallingford, CT, United States*

Recent advances in magnetic resonance imaging (MRI) allow the development of non-invasive and quantitative tools to assess renal function. DCE-MRI using low dose Gd-based contrast has been established as a reliable technique for measuring glomerular filtration rate (GFR) in individual kidneys. Other promising markers for renal function include R2* measured with BOLD MRI, and the longitudinal relaxation time T1. Unilateral ureteral obstruction (UUO) has been developed in rodents as a model of renal fibrosis. The purpose of the study is to evaluate the various MRI techniques in assessing kidney tissue properties and renal function in the UUO mouse model.

270

17:39

Determination of Parameters Variation in DTI, BOLD, and ASL MRI for Transplanted Kidneys

Maryam Seif[1], Laila Yasmin Mani[2], Chris Boesch[1], Bruno Vogt[2], and Peter Vermathen[1]

[1]*Depts. Radiology and Clinical Research, University of Bern, Bern, Switzerland,* [2]*Dept. Nephrology, Hypertension and Clinical Pharmacology,*

Hospital University of Bern, Bern, Switzerland

DTI, BOLD and ASL MRI techniques have gained acceptance to evaluate different physiological aspects of the renal function both in research and clinics. However, there are not yet sufficient studies available investigating the accuracy and repeatability of renal MRI techniques. The main aim of this study was therefore to evaluate the reproducibility of DTI, BOLD MRI and ASL parameters derived from two scans and to investigate whether there are significant correlations between renal parameters obtained from these MR techniques in transplanted kidneys.

17:51 Diffusion
Hersh Chandarana[1]

[1]*NYU School of Medicine*

Conventional methods of measuring renal function including estimated GFR are insensitive to early renal dysfunction and cannot assess single kidney function/dysfunction. Advance MR imaging techniques including diffusion weighted imaging (DWI) are being investigated to study renal microstructure and function in health and disease. Various flavors of diffusion weighted imaging including intra-voxel incoherent motion (IVIM) and diffusion tensor imaging (DTI) have shown considerable promise in evaluation of kidney structure and function.

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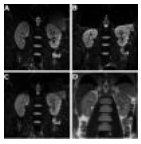
271 18:06



Diffusion Tensor Imaging (DTI) of the kidneys incorporating advanced geometric distortion correction using reversed phase encoding images.
Jose Teruel[1,2], Jeremy C. Lim[3], Eric E. Sigmund[4], Elissa Botterill[5], Jas-mine Seah[6], Shawna Farquharson[7], Elif E. Ekinci[6,8], and Ruth P. Lim[5,9]

[1]*Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway,* [2]*St. Olavs University Hospital, Trondheim, Norway,* [3]*Department of Radiology, The Royal Melbourne Hospital, Melbourne, Australia,* [4]*Department of Radiology, NYU Langone Medical Center, New York, NY, United States,* [5]*Department of Radiology, Austin Health, Melbourne, Australia,* [6]*Department of Endocrinology, Austin Health, Melbourne, Australia,* [7]*Florey Neuroscience Institute, Melbourne, Australia,* [8]*Department of Endocrinology, The University of Melbourne, Melbourne, Australia,* [9]*Departments of Radiology and Surgery, The University of Melbourne, Melbourne, Australia*

Diffusion tensor imaging is emerging as a promising technique for structural and functional evaluation of the kidneys. However, diffusion sequences employing echo planar imaging readout are prone to geometric distortions due to static field inhomogeneities arising from different magnetic susceptibilities from adjacent tissues and bowel gas. In this study, we evaluated the efficacy of distortion correction using a reversed phase encoding approach for diffusion tensor imaging of healthy controls and patients with Type 1 diabetes.

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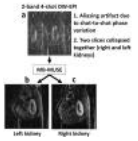
272 18:18



Kidney diffusion-weighted imaging based on multi-band multi-shot DW-EPI acquisition and multi-band multiplexed sensitivity encoding (MB-MUSE) reconstruction
Hing-Chiu Chang[1,2], Arnaud Guidon[3], Mustafa R. Bashir[4], Dan Xu[5], Lloyd Estkowski[6], Ersin Bayram[7], Allen W. Song[2], and Nan-Kuei Chen[2]

[1]*Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong,* [2]*Brain Imaging and Analysis Center, Duke University Medical Center, Durham, NC, United States,* [3]*Global MR Application and Workflow, GE Healthcare, Boston, MA, United States,* [4]*Department of Radiology, Duke University Medical Center, Durham, NC, United States,* [5]*Global MR Application and Workflow, GE Healthcare, Waukesha, WI, United States,* [6]*Global MR Application and Workflow, GE Healthcare, Menlo Park, CA, United States,* [7]*Global MR Application and Workflow, GE Healthcare, Houston, TX, United States*

DWI has been shown to be useful in characterizing renal carcinoma with quantitative measurement of ADC. However, with echo-planar imaging (EPI) based DWI protocols, the application of body DWI remains limited due to suboptimal EPI image quality. The multi-band multi-shot EPI with multiplexed sensitivity encoding (MB-MUSE) has been developed and shown to be useful in achieving high-resolution and high-quality DWI and DTI of brains, with improved scan throughput. In this study, we propose to use MB multi-shot EPI to acquire kidney DWI data with reduced geometric distortion and bilateral coverage, demonstrating the feasibility of MB multi-shot DWI of body applications.

18:30 Adjournment & Meet the Teachers

Educational Course

Cardiac MRI: Non-Ischemic Cardiomyopathies

*Organizers:*Daniel Ennis, Ph.D. & Martin Graves, Ph.D.

Nicoll 2 16:30 - 18:30 *Moderators:*Harald Kramer & Jeanette Schulz-Menger

16:30 CMR in Inflammatory Systemic Disorders
Andrew Taylor[1,2]

[1]*Department of Cardiovascular Medicine, Alfred Hospital, Melbourne, Australia,* [2]*BakerIDI Heart and Diabetes Institute, Melbourne, Australia*

Cardiac manifestations are frequently observed in many inflammatory systemic disorders. Identification of cardiac involvement is of high clinical importance, as in many instances a large proportion of the morbidity and mortality in systemic inflammatory diseases is

due to cardiac complications, which if identified early may be amenable to therapeutic intervention. In order to simplify the protean cardiac manifestations observed in inflammatory systemic disorders, these diseases can be discussed under the general headings of sarcoidosis, connective tissue diseases, and hypereosinophilic syndromes.

17:00 CMR for Identification of Secondary Left Ventricular Hypertrophy
Marianna Fontana[1]

[1]*University College London*

17:30 CMR in Metabolic Disorders
Harald Kramer[1]

[1]*University Hospital Munich*

Besides particular cardiac disease like congenital heart disease, ischemic heart disease or myocarditis the heart can be involved in numerous systemic disease entities. These include endstage kidney disease, liver cirrhosis, metabolic syndrome, amyloidosis, autoimmune disorders, hereditary metabolic defects and malignant disease. Cardiac involvement can include coronary artery disease, valvular disease, endocardial, myocardial or pericardial disorders. Detailed knowledge of the potential cardiac alterations in systemic disease is key in their accurate diagnosis and treatment.

18:00 CMR in Genetic Disorders
Bernd J. Wintersperger[1]

[1]*Department of Medical Imaging, University of Toronto, Toronto, ON, Canada*

Continuous discoveries in genome abnormities result in an ever increasing number of cardiovascular diseases being considered of genetic cause. High importance is furthermore emphasis of either heritable disease or individual mutation caused abnormality. While beyond assessment of genomics, the versatile toolbox of cardiac MRI enables detailed insight into subtle phenotypes that may be linked to changes in genotype (genotype +) and as such provides insight into a possible clinical course of a disease. Furthermore, cardiac MRI provides ongoing excellence in the important aspect of initial diagnosis, therapy monitoring and identification of possible complications in a large variety of genetic CV diseases.

18:30 Adjournment & Meet the Teachers

Educational Course

MR Physics & Techniques for Clinicians

*Organizers:*Marcus T. Alley, Ph.D., Brian Hargreaves, Ph.D., Michael Markl, Ph.D., Bernd Jung, Ph.D. & Nicole Seiberlich, Ph.D.

Nicoll 3 16:30 - 18:30 *Moderators:*Vikas Gulani & Bernd Jung

16:30 Spin Gymnastics
Walter Kucharczyk

Spin Gymnastics is both an introduction to MRI physics and a summary of its most important concepts. It is intended to "set the table" for a series of subsequent lectures in the Physics for Clinicians Course that build on the basic concepts presented in this lecture. The information is presented in a graphical, animated format to assist in the complex understanding of the spatial and temporal components of the MR imaging process.

17:00 K-Space
Rafael O'Halloran[1]

[1]*Icahn School of Medicine at Mount Sinai*

We will take a graphical approach to review key concepts of k-space as they relate to MRI image quality. Using cartoons and images we will demonstrate how resolution, field-of-view, and SNR can be understood in terms of k-space coverage and sampling. The implications on image quality will be discussed and demonstrated with example images.

17:30 Adjournment & Meet the Teachers

Corporate Symposium

Gold Corporate Symposium: GE Healthcare

Plenary Hall 13:00 - 14:00

Other

Special Session: Manuscript Reviewing for ISMRM's Scientific Journals

Room 300-302 18:45 - 19:45

Tuesday, May 10, 2016

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Sunrise Session

Multiparametric MR for Cancer

*Organizers:*Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 300-302 7:00 - 7:50 *Moderators:*Rosella Canese & Katja Pinker

Tumor Diagnosis with MR Spectroscopy.
Arend Heerschap

MRS - Response to Therapy
Tone Frost Bathen

Adjournment & Meet the Teachers

Sunrise Session

High-Throughput: The 5 Minute MR Scan

*Organizers:*Garry E. Gold, M.D. & Joshua D. Trzasko, Ph.D.

Room 324-326 7:00 - 7:50 *Moderators:*Joshua Trzasko

Cardiac MRI
Daniel Sodickson

MR Angiography
Tim Leiner

Adjournment & Meet the Teachers

Sunrise Session

Addressing Clinical Challenges in the Body with MRI: Incidental Cystic Lesions

Organizers: Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 7:00 - 7:50 *Moderators:*Mustafa Bashir

A Guideline Based Approach to the Incidental Pancreatic Cysts
Masoom Haider

Incidental Cystic Lesions: Kidney
Kartik Jhaveri

Adjournment & Meet the Teachers

Sunrise Session

Techniques for Imaging White Matter

*Organizers:*Andrew Alexander, Ph.D. & Jennifer A McNab, Ph.D.

Room 334-336 | 7:00 - 7:50 | *Moderators:*Cornelia Laule

White Matter Imaging: Established Techniques
Mara Cercignani

White Matter Imaging: Emerging Techniques
Susie Huang

Adjournment & Meet the Teachers

Sunrise Session

Interventional MRI: Technology

*Organizers:*Michael S. Hansen, Ph.D. & Viola Rieke, Ph.D.

Summit 1 | 7:00 - 7:50 | *Moderators:*Michael Hansen

Introduction

The Interventional MRI Suite
Anthony Faranesh

Real-Time Image Guidance
Adrienne Campbell-Washburn

Adjournment & Meet the Teachers

Sunrise Session

Hyperpolarisation & MR Applications

*Organizers:*Thomas K. F. Foo, Ph.D. & N. Jon Shah, Ph.D.

Summit 2 | 7:00 - 7:50 | *Moderators:*Sean Fain & Philip Lee

Hyperpolarisation - Description, Overview & Method
Rolf Schulte

Hyperpolarisation - Clinical Potential & Relevance
Ferdia Gallagher

Adjournment & Meet the Teachers

Sunrise Session

Ultra-High Field Cardiovascular MRI

*Organizers:*Harald Kramer, M.D. & Jeanette Schulz-Menger, M.D.

Nicoll 1 | 7:00 - 7:50 | *Moderators:*Harald Kramer & Jeanette Schulz-Menger

Vascular MR at 7T
Harald H. Quick

Cardiac Spectroscopy at 7T
Christopher Rodgers

Morphological Cardiac MR at 7T
Thoralf Niendorf

Adjournment & Meet the Teachers

Sunrise Session

Advanced Quantitative MSK Imaging Techniques

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 2 | 7:00 - 7:50 | *Moderators:*Eric Chang & Ashley Williams

Relaxation Mechanisms in Collagen Rich MSK Systems
Emily McWalter

Clinical Applicatons & Technical Challenges (Tendons, Ligaments, Menisci, Cartilage)
Richard Kijowski

Adjournment & Meet the Teachers

Sunrise Session

Controversies in Diffusion & Functional MRI

*Organizers:*Daniel C. Alexander, Ph.D., Jay J. Pillai, M.D. & Jonathan R. Polimeni, Ph.D.

Nicoll 3 | 7:00 - 7:50 | *Moderators:*Daniel Alexander

Microstructural Features Accessible from Diffusion MRI
Sune Jespersen

Benefits of a Multimodal Approach
Nikola Stikov

Adjournment & Meet the Teachers

Plenary Session

MRI Biomarkers: Paradigm Shift or Contradiction in Terms?

*Organizers:*Steven P. Sourbron, Ph.D., Guoying Liu, Ph.D. & Garry E. Gold, M.D.

Plenary Hall | 8:30 - 9:30 | *Moderators:*Steven Sourbron & Guoying Liu

The Quantitative Imaging Biomarkers Alliance (QIBA)
Daniel C Sullivan[1]

[1]*Radiology, Duke University Medical Center, Durham, NC, United States*
Daniel Sullivan

Reproducibility & Standardisation of MR Biomarkers
Edward F Jackson[1]

[1]*Medical Physics, University of Wisconsin School of Medicine & Public Health, Madison, WI, United States*
Edward Jackson

Integration of MRI Biomarkers into Radiology Practice
Nandita deSouza[1]

[1]*The Institute of Cancer Research, London, UK*
Nandita deSouza

Adjournment

Traditional Poster : Body

Exhibition Hall 10:00 - 12:00 *(no CME credit)*

Electronic Poster : Acquisition, Reconstruction & Analysis

Exhibition Hall 10:00 - 11:00 *(no CME credit)*

Study Groups

Musculoskeletal MR

Hall 405 E 10:00 - 12:00

Study Groups

X-Nuclei Imaging

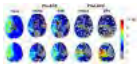
Hall 406 D 10:00 - 12:00

Power Pitch

Neuroimaging: Novel Findings & Techniques

Power Pitch Theatre, Exhibition Hall 10:00 - 11:00 *Moderators:*Peter Barker & Peter Bandettini

273 summa cum laude 10:00

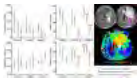


Simultaneous evaluation of hemodynamic and functional connectivity in patients with chronic steno-occlusive disease of the cerebrovascular system: A study using BOLD with acetazolamide

Junjie Wu[1], Seena Dehkharghani[1], Tyler Gleason[1], Fadi Nahab[2], and Deqiang Qiu[1]

[1]Department of Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [2]Department of Neurology, Emory University, Atlanta, GA, United States

274 10:03

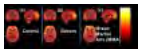


Electrical Conductivity Characteristics of Glioma: Noninvasive Assessment by MRI and Its Validity

Khin Khin Tha[1,2], Ulrich Katscher[3], Shigeru Yamaguchi[4], Shunsuke Terasaka[4], Toru Yamamoto[5], Kohsuke Kudo[2,6], and Hiroki Shirato[1,2]

[1]Department of Radiobiology and Medical Engineering, Hokkaido University Graduate School of Medicine, Sapporo, Japan, [2]Global Institution for Quantum Medical Science and Engineering, Hokkaido University, Sapporo, Japan, [3]Research Laboratories, Hamburg, Germany, [4]Department of Neurosurgery, Hokkaido University Graduate School of Medicine, Sapporo, Japan, [5]Graduate School of Health Sciences, Sapporo, Japan, [6]Hokkaido University Hospital, Sapporo, Japan

275 magna cum laude 10:06

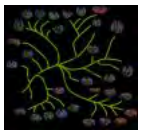


Quantifying differences in the cerebral blood flow (CBF) between controls, professional boxers and Mixed Martial Arts (MMA) fighters using arterial spin labeling (ASL) MRI

Virendra R Mishra[1], Karthik Sreenivasan[1], Xiaowei Zhuang[1], Zhengshi Yang[1], Sarah Banks[1], Dietmar Cordes[1], and Charles Bernick[1]

[1]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States

276 10:09



The Evolution of the Mammalian Connectome

Yossi Yovel[1], Omri Zomet[1], Arieli Bonzach[2], Assaf Marom[1], and Yaniv Assaf[1]

[1]Tel Aviv University, Tel Aviv, Israel, [2]Beit Dagan Veterinary institute, Beit Dagan, Israel

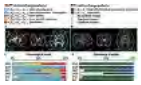
277 summa cum laude 10:12

Neurite Orientation Dispersion and Density Imaging (NODDI) in Young Onset Alzheimer's Disease and Its Syndromic Variants

Jiaying Zhang[1], Catherine F Slattery[2], Ross W Paterson[2], Alexander JM Foulkes[2], Laura Mancini[2], David L Thomas[2], Marc Modat[1], Nicolas Toussaint[2], David M Cash[2], John S Thornton[2], Daniel C Alexander[1], Sebastien Ourselin[1], Nick C Fox[2], Jonathan M Schott[2], and Hui Zhang[1]

[1]Department of Computer Science and Centre for medical image computing, University College London, London, United Kingdom, [2]Department of Neurodegenerative disease, Institute of Neurology, University College London, London, United Kingdom

278 10:15 Developmental processes on the neonatal brain revealed by white matter tract integrity metrics derived from diffusion kurtosis imaging



Xianjun Li[1,2], Jie Gao[1], Yumiao Zhang[1], Yanyan Li[1], Huan Li[1], Mingxi Wan[2], and Jian Yang[1,2]

[1]Radiology Department of the First Affiliated Hospital, Xi'an Jiaotong University, Xi'an, China, People's Republic of, [2]Department of Biomedical Engineering, the Key Laboratory of Biomedical Information Engineering of the Ministry of Education, School of Life Science and Technology, Xi'an Jiaotong University, Xi'an, China, People's Republic of

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summa cum laude

10:18

A serial microcompartment-specific T2* relaxation study of white matter lesions in multiple sclerosis at 7T

Xiaozhen Li[1,2], Peter van Gelderen[2], Pascal Sati[3], Jacco de Zwart[2], Daniel Reich[3], and Jeff Duyn[2]

[1]Dept. NVS, Karolinska Institutet, Stockholm, Sweden, [2]Advanced MRI Section, LFMI, NINDS, National Institutes of Health, Bethesda, MD, United States, [3]Translational Neuroradiology Unit, NINDS, National Institutes of Health, Bethesda, MD, United States

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10:21

Real-time fMRI Neurofeedback with Simultaneous EEG in Combat-related PTSD: Frontal EEG Asymmetry Variations as Measure of Treatment Response

Vadim Zotev[1], Raquel Phillips[1], Masaya Misaki[1], Chung Ki Wong[1], Brent Wurfel[1], Matthew Meyer[1,2], Frank Krueger[1,3], Matthew Feldner[1,4], and Jerzy Bodurka[1,5]

[1]Laureate Institute for Brain Research, Tulsa, OK, United States, [2]Laureate Psychiatric Clinic and Hospital, Tulsa, OK, United States, [3]Neuroscience Dept., George Mason University, Fairfax, VA, United States, [4]Dept. of Psychological Science, University of Arkansas, Fayetteville, AR, United States, [5]College of Engineering, University of Oklahoma, Tulsa, OK, United States

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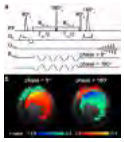
magna cum laude

10:24



In-vivo detection of neuronal current using spin-lock oscillatory excitation at 7T

Yuhui Chai[1], Guoqiang Bi[2], Liping Wang[3], Fuqiang Xu[4], Xin Zhou[4], Bensheng Qiu[2], Hao Lei[4], Bing Wu[5], Yang Fan[5], and Jia-Hong Gao[1]

[1]Center for MRI Research, Peking University, Beijing, China, People's Republic of, [2]University of Science and Technology of China, Hefei, China, People's Republic of, [3]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, People's Republic of, [4]Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, China, People's Republic of, [5]GE Healthcare, MR Research China, Beijing, China, People's Republic of

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summa cum laude

10:27

Rapid Myelin Water Imaging in Human Cervical Spinal Cord

Emil Ljungberg[1], Irene Vavasour[2], Roger Tam[2,3], Youngjin Yoo[3], Alexander Rauscher[4], David Li[2], Anthony Traboulsee[5], Alex MacKay[1,2], and Shannon Kolind[5]

[1]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]Radiology, University of British Columbia, Vancouver, BC, Canada, [3]Electrical and Computer Engineering, University of British Columbia, Vancouver, BC, Canada, [4]Pediatrics, University of British Columbia, Vancouver, BC, Canada, [5]Medicine, University of British Columbia, Vancouver, BC, Canada

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283

summa cum laude

10:30

Transcranial MRI-Guided High-Intensity Focused Ultrasound for Treatment of Essential Tremor: Initial Clinical Experience and Correlation of Clinical Outcome with Lesion Size, Localization, and Dose

Christian Federau[1], Maged Goubran[1], Jason Su[1], Jaimie Henderson[1], Veronika Santini[1], Casey Harrison Halpern[1], Brian Rutt[1], Kim Butts Pauly[1], and Pejman Ghanouni[1]

[1]Stanford University, Stanford, CA, United States

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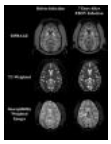
10:33



Neuroimaging of Acute Ebola Virus Disease in a Non-Human Primate Model

Margaret R. Lentz[1], Jeffery R. Solomon[2], Srikanth Yellayi[1], Richard Bennett[1], Dawn Traynor[1], David Thomasson[1], Anna Honko[1], Lisa Hensley[1], and Peter B. Jahrling[1,3]

[1]Integrated Research Facility, NIAID, National Institutes of Health, Frederick, MD, United States, [2]Clinical Research Directorate/Clinical Monitoring Research Program, Frederick National Laboratory for Cancer Research, Leidos Biomedical Research, Inc., Frederick, MD, United States, [3]Emerging Viral Pathogens Section, NIAID, National Institutes of Health, Frederick, MD, United States

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10:36

Structural variability in the human brain reflects functional architecture

Gwenaelle Douaud[1], Eugene Duff[1], Adrian Groves[1], Thomas Nichols[1,2], Saad Jbabdi[1], Christian Tamnes[3], Lars Westlye[3], Andreas Engvig[3], Kristine Walhovd[3], Anders Fjell[3], Heidi Johansen-Berg[1], and Steve Smith[1]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [2]University of Warwick, Coventry, United Kingdom, [3]University of Oslo, Oslo, Norway

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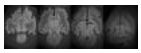
10:39

A constrained slice-dependent background suppression scheme for simultaneous multi-slice pseudo-continuous arterial spin labeling

Xingfeng Shao[1], Yi Wang[1], and Danny J.J. Wang[1]

[1]Laboratory of FMRI Technology (LOFT), Department of Neurology, University of California Los Angeles, Los Angeles, CA, United States

287 10:42



Brain Catalogue and its MRI of extinct species: the example of Thylacinus Cynocephalus

Mathieu David Santin[1,2], Marc Herbin[3], and Roberto Toro[4]

[1]Centre de NeuroImagerie de Recherche - CENIR, Paris, France, [2]Inserm U 1127, CNRS UMR 7225, Sorbonne Universités, UPMC Univ Paris 06 UMR S 1127, Institut du Cerveau et de la Moelle épinière, ICM, Paris, France, [3]Muséum National d'Histoire Naturelle, Paris, France, [4]Institut Pasteur, Paris, France

Oral

Radiogenomics & Radiomics

Room 300-302 10:00 - 12:00 *Moderators:*Seung Hong Choi & Radka Stoyanova

10:00 Introduction

288 10:12

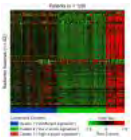
Radiogenomic analysis of glioblastoma using protein-based amide proton transfer (APT) imaging and message RNA expression: A novel correlation in molecular imaging and gene characteristics

Shanshan Jiang[1], Xianlong Wang[1], Hao Yu[1], Jiandong Xi[1], Jingwen Wu[1], Lisong Liang[1], Shilong Lu[1], Tianyu Zou[1], Jinyuan Zhou[2], and Zhibo Wen[1]

[1]Department of Radiology, Southern Medical University Zhujiang Hospital, Guangzhou, China, People's Republic of, [2]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States

The correlation between endogenous protein-based APT-weighted (APTw) imaging and gene expression in glioblastoma (GBM) was investigated. 16 patients with newly diagnosed GBM were studied. APTw/FLAIR hyperintensity area ratio (AFR), and APTw hyperintensity/gadolinium contrast-enhanced T1w enhancement area ratio (ATR) were calculated. Interoperative paired tumor and adjacent normal tissues were sampled for genomic analysis. BRCA1 and CDK4 were significantly downregulated in the high AFR group (adjusted P= 0.000953 and 0.025187), and SLAMF9 and MIA were significantly downregulated in the high ATR group (adjusted P= 1.08E-11 and 0.00997). APT imaging has great potential for unveiling some special genomic changes in GBM.

289 10:24



Large-scale radiomic profiling of glioblastoma identifies an imaging signature for predicting and stratifying antiangiogenic treatment response.

Philipp Kickingereder[1], Michael Götz[2], John Muschelli[3], Antje Wick[4], Ulf Neuberger[5], Russell T Shinohara[6], Alexander Radbruch[7], Heinz-Peter Schlemmer[7], Wolfgang Wick[4], Martin Bendszus[5], Klaus H Maier-Hein[2], and David Bonekamp[7]

[1]Department of Neuroradiology, University Hospital Heidelberg, Heidelberg, Germany, [2]Division Medical and Biological Informatics, DKFZ - German Cancer Research Center, Heidelberg, Germany, [3]Department of Biostatistics, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States, [4]Department of Neurology, University of Heidelberg Medical Center, Heidelberg, Germany, [5]Department of Neuroradiology, University of Heidelberg Medical Center, Heidelberg, Germany, [6]Department of Biostatistics and Epidemiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States, [7]Department of Radiology, DKFZ - German Cancer Research Center, Heidelberg, Germany

To analyze the potential of radiomics, an emerging field of research that aims to utilize the full potential of medical Imaging (1,2), for predicting and stratifying treatment response to antiangiogenic therapy in patients with recurrent glioblastoma.

290 10:36

Low Apparent Diffusion Coefficient Values Correlate with Enhancing Mitosis and Cell Proliferation Expression in glioblastoma using Locus-Specific Radiogenomic Map

Cheng-Yu Chen[1,2,3], Fei-Ting Hsu[1], Hua-Shan Liu[1,4], Ping-Huei Tsai[1,3], Chia-Feng Lu[2,3,5], Yu-Chieh Kao[2,3], Li-Chun Hsieh[1], and Pen-Yuan Liao[1]

[1]Department of Medical Image, Taipei Medical University Hospital, Taipei, Taiwan, [2]Translational Imaging Research Center, College of Medicine, Taipei Medical University, Taipei, Taiwan, [3]Department of Radiology, School of Medicine, Taipei Medical University, Taipei, Taiwan, [4]Graduate Institute of Clinical Medicine, Taipei Medical University, Taipei, Taiwan, [5]Department of Biomedical Imaging and Radiological Sciences, National Yang-Ming University, Taipei, Taiwan

A new approach to unravel the genomic expression of glioblastoma by advanced MR imaging technique has recently been introduced to improve the prognostic and predictive efficacies of neuroimaging. This imaging method is potentially a valuable tool to link individual differences in the human genome to structure, function and physiology into brain disease, a method referred to as radiogenomics. In this study, we established locus specific radiogenomic map based on MR imaging and Microarray RNA analysis. Our results revealed that apparent diffusion coefficient (ADC) differences were correlated with several biological processes change, including cell proliferation, T cell immunity, immune response, and mitosis. The identification of tumor genotypes by imaging phenotypes will open a new era of

therapeutic strategy in high grade gliomas.

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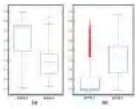
291 10:48



Radiomic features on Multi-parametric MRI can help risk categorization of Prostate Cancer patients on Active Surveillance

Ahmad Algohary[1], Satish Viswanath[1], Sadhna Verma[2], and Anant Madabhushi[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]University of Cincinnati, Cincinnati, OH, United States

Active Surveillance (AS) offers an important alternative to radical treatment as more men die with prostate cancer (PCA) than of the disease. In this study, we explore the role of radiomic texture features on a pre-biopsy screening 3 Tesla multi-parametric MRI that can predict which men with elevated PSA will have a cancer-positive or cancer-negative biopsy. The selected texture features correctly identified 14/15 biopsy-negative (compared to 10/15 cases correctly identified by PIRADS) and 23/30 biopsy-positive cases (compared to only 15/30 correctly identified by PIRADS). These features appear to enhance differentiation between biopsy-positive and biopsy-negative prostate cancer patients on Active Surveillance.

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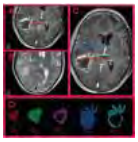
292 11:00



Association of Radiomics and Metabolic Tumor Volumes in Radiation Treatment of Glioblastoma Multiforme

christopher lopez[1], Natalya Nagornaya[2], Nestor Parra[2], Deukwoo Kwon[2], Fazilat Ishkanian[2], Arnold Markoe[2], Andrew Maudsley[2], and Radka Stoyanova[2]

[1]Radiation Oncology, University of Miami, Miami, FL, United States, [2]University of Miami, Miami, FL, United States

To investigate the importance of metabolites of N-acetyl aspartate and choline derived from MRSI and the correlation of image features from localized radiation therapy volumes determined from MRI and CT defined tumor volumes. Also to replace subjective categorical image features with calculated objective features. Results suggest that radiation therapy planning can be more accurate by adding metabolic information.

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293 11:12

Relationship of invivo MR parameters to molecular characteristics of non-enhancing lower-grade gliomas

Tracy L Luks[1], Tracy Richmond McKnight[1], Aurelia Williams[1], Evan Neill[1], Khadjia Lobo[1], Anders Persson[2], Arie Perry[3], Joanna Phillips[3], Annette Molinaro[4], Susan Chang[4], and Sarah J Nelson[1]

[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Neurology, University of California San Francisco, San Francisco, CA, United States, [3]Pathology, University of California San Francisco, San Francisco, CA, United States, [4]Neurosurgery, University of California San Francisco, San Francisco, CA, United States

Invivo MR anatomy, diffusion, perfusion, and spectroscopy profiles from non-enhancing grade 2 and grade 3 gliomas were examined by histologic and molecular characteristics associated with clinical outcome. Patients underwent a pre-surgical 3T MR exam including IRSPGR, FSE, FLAIR, DWI, MRSI and DSC. For surgical biopsies, histological sub-type, grade, cleaved caspase-3, MIB-1, Ki67, IDH1R132H, ATRX, p53, and co-deletion of 1p19q were determined. Overall, molecular characteristics associated with worse clinical outcome were associated with higher ADC and lower FA, lower nCBV and nPH, and higher Recov, and higher nLAC.

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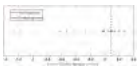
294 11:24



Radiomic features from the necrotic region on post-treatment Gadolinium T1w MRI appear to differentiate pseudo-progression from true tumor progression in primary brain tumors

Prateek Prasanna[1], Raymond Huang[2], Andrew Rose[1], Gagandeep Singh[1], Anant Madabhushi[1], and Pallavi Tiwari[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]Brigham and Women's Hospital, Boston, MA, United States

Pseudoprogression is an early-delayed inflammatory response to chemoradiotherapy typically appearing up to 3 months post-treatment in brain tumors. On routine MRI, pseudoprogression closely mimics the appearance of true progression, thereby making their visual identification challenging. Early diagnosis of pseudoprogression has implications in management of treatment effects and subsequently survival. We present initial results of using a newly developed radiomic descriptor, CoLIAGE, in distinguishing the two pathologies. We report that CoLIAGe measurements when captured from the necrotic region as opposed to just the enhancing region on MRI can reliably distinguish psuedo-progression from true progression with 100% accuracy (n=17)

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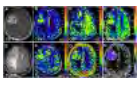
295 11:36



Combined assessment of tumor oxygen metabolism and angiogenesis in glioma patients

Andreas Stadlbauer[1], Max Zimmermann[1], Karl Rössler[1], Stefan Oberndorfer[2], Arnd Dörfler[3], Michael Buchfelder[1], and Gertraud Heinz[4]

[1]Department of Neurosurgery, University of Erlangen, Erlangen, Germany, [2]Department of Neurology, University Clinic of St. Pölten, St. Pölten, Austria, [3]Department of Neuroradiology, University of Erlangen, Erlangen, Germany, [4]Department of Radiology, University Clinic of St. Pölten, St. Pölten, Austria

Reprogramming energy metabolism and inducing angiogenesis are part of the hallmarks of cancer. Thirty-five patients with untreated or recurrent glioma were examined using vascular architecture mapping (VAM) and the multiparametric quantitative BOLD (mp-qBOLD) technique for combined exanimation of oxygen metabolism and angiogenesis in gliomas. Maps of oxygen extraction fraction (OEF) and cerebral metabolic rate of oxygen ($CMRO_2$) as well as of the vascular architecture MRI biomarkers microvessel radius (R_U), density (N_U), and type indicator (MTI) were calculated. Low-grade glioma showed increased OEF. Glioblastomas showed significantly increased $CMRO_2$ and N_U. MTI demonstrated widespread areas draining venous microvasculature in high-grade gliomas.

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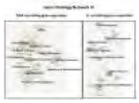
296 11:48

Radiogenomics by Proton Magnetic Resonance Spectroscopy: Integrative Analysis of Metabolites and Genome-wide Expression in



Glioblastomas

Dieter Henrik Heiland[1], Thomas Lange[2], Ralf Schwarzwald[3], Dietmar Pfeifer[4], Karl Egger[3], Horst Urbach[3], Astrid Weyerbrock[1], and Irina Mader[3]

[1]Dept. of Neurosurgery, University Medical Center Freiburg, Freiburg, Germany, [2]Dept. MR Physics, Dept. of Radiology, University Medical Center Freiburg, Freiburg, Germany, [3]Dept. of Neuroradiology, University Medical Center Freiburg, Freiburg, Germany, [4]Department of Hematology, Oncology and Stem Cell Transplantation, University Medical Center Freiburg, Freiburg, Germany

The purpose of this work was to search for a connection between metabolites observed by proton magnetic resonance spectroscopy of glioblastomas and tumor genetics. Two specific pathways could be identified, one belonging to NAA and discriminating an astroglial versus oligo/neural subgroup. Another one was related to Cr also distinguishing between two subgroups, one attributed to apoptosis and another one to the PI3K-AKT-mTOR signaling cascade.

Oral

New Techniques for CEST & MT

Room 324-326 10:00 - 12:00 *Moderators:*Julio Cardenas & Phillip Zhe Sun

297 10:00

Simultaneous Multi-Slice Spiral-CEST Encoding with Hankel Subspace Learning: ultrafast whole-brain z-spectrum acquisition

Suhyung Park[1], Sugil Kim[1,2], and Jaeseok Park[3]

[1]Center for Neuroscience Imaging Research, Institute for Basic Science (IBS), Suwon, Korea, Republic of, [2]Department of Brain and Cognitive Engineering, Korea University, Seoul, Korea, Republic of, [3]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Korea, Republic of

Chemical exchange saturation transfer (CEST) imaging has been introduced as a new contrast mechanism for molecular imaging, and typically requires long saturation preparation and multiple acquisitions of imaging data with varying saturation frequencies (called z-spectrum). Since the z-spectrum acquisition is inherently slow and takes prohibitively long imaging time, it has been very difficult to introduce CEST z-spectrum into a clinical routine. In this work, we propose a novel, simultaneous multi-slice (SMS) Spiral CEST encoding with Hankel subspace learning (HSL) for ultrafast whole-brain z-spectrum acquisition within 2-3 minutes, in which: 1) RF segmented uneven saturation is employed to reduce the duration of saturation preparation, 2) Spiral CEST encoding is employed to acquire SMS signals, and 3) SMS signals are projected onto the subspace spanned by the complementary null space, selectively reconstructing a slice of interest while nulling the other slice signals.

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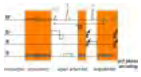
298 10:12



Superfast CEST Spectral Imaging (SCSI)

Iris Yuwen Zhou[1], Jinsuh Kim[2], Takahiro Igarashi[1], Lingyi Wen[1], and Phillip Zhe Sun[1]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital and Harvard Medical School, Charlestown, MA, United States, [2]Department of Radiology, University of Illusions at Chicago, Chicago, IL, United States

To resolve metabolites at different chemical shift offsets, complete Z-spectrum is conventionally obtained by varying saturation offset from scan to scan, which is time consuming and not suitable for studying dynamic changes. To overcome this, we innovatively combined superfast Z spectroscopy with chemical shift imaging (CSI) and developed Superfast Chemical exchange saturation transfer (CEST) Spectral Imaging (SCSI). It provides fast Z-spectral CEST information with spatial resolution. While conventional CSI measures dilute metabolites, the proposed SCSI exploits CEST mechanism to investigate the interaction between metabolites/contrast agents and tissue water, providing sensitivity enhanced measurements of metabolites and pH information.

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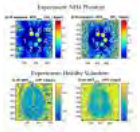
299 10:24



Clinically relevant rapid 3D CEST imaging with hexagonal spoiling gradients, optimised B1, and symmetric z-spectrum sampling

Robert C. Brand[1], Nicholas P. Blockley[1], Michael Chappell[2], and Peter Jezzard[1]

[1]FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]IBME, University of Oxford, Oxford, United Kingdom

Clinical 3D CEST has been hindered by slow acquisition times and z-spectra artefacts that affect fitting. Here, we demonstrate various sequence improvements, including: 1) hexagonal gradient spoiling that minimises ghosting, shortens TR and reduces confounding T2 sensitivity; 2) low readout flip angles combined with symmetric z-spectrum sampling that better maintains the steady state between samples and eliminates the need for T1-restoration periods; and 3) exchange-rate matched 360° CEST pulses that reduce direct water saturation to minimise T1 sensitivity and increase CNR. Together, these improvements result in high-quality whole-brain 39-offset z-spectra measurements at 3mm isotropic resolution in 2:59 minutes.

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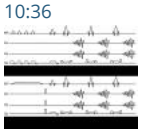
300 10:36



Conjoint measure of 3D ASL and 3D APT in the lesion proximal regions for differentiating metastasis tumor from glioblastom

Rui Li[1], Bing Wu[2], Chien-yuan Lin[3], Xin Lou[1], YuLin Wang[1], and Lin Ma[1]

[1]Department of Radiology, PLA general Hospital, Beijing, China, People's Republic of, [2]GE healthcare MR Research China, Beijing, China, People's Republic of, [3]GE heathcare Taiwan, Taipei, Taiwan

Differential diagnosis is challenging due to similar appearance using conventional imaging such as T1 contrast enhanced and DWI. In

this work, we use the measure of spatially matching 3D arterial spin labeling (ASL) and 3D amide proton transfer (APT) in the lesion proximal regions to differentiate metastasis and glioblastom, in the hypothesis that glioblastom infiltrates into sourrounding tissues whereas metastasis tumors have clear biological boundaries.

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301 magna cum laude

10:48

Blind Compressed Sensing-based Ultrafast Chemical Exchange Saturation Transfer (CEST) Imaging

Hye-Young Heo[1,2], Sampada Bhave[3], Mathews Jacob[3], and Jinyuan Zhou[1,2]

[1]The 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 Electrical and Computer Engineering, University of Iowa, Iowa City, IA, United States

CEST imaging, such as amide proton transfer (APT) imaging, is a novel, clinically valuable molecular MRI technique that can give contrast due to a change in water signal caused by chemical exchange with saturated solute protons. However, its clinical translation is still limited by its relatively long scan time because a series of RF saturation frequencies are unavoidably acquired. Here, we present a highly accelerated CEST imaging technique (up to 10-fold) using a novel blind compressed sensing framework.

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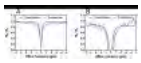
11:00



Separation of intracellular and extracellular Z-spectra by DiffusionCEST

Kevin Ray[1], Gogulan Karunanithy[2], Andrew Baldwin[2], Michael Chappell[3], and Nicola Sibson[1]

[1]Oxford Institute for Radiation Oncology, University of Oxford, Oxford, United Kingdom, [2]Physical and Theoretical Chemistry Laboratory, University of Oxford, Oxford, United Kingdom, [3]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom

CEST-MRI is an imaging technique which is sensitive to tissue pH, and has generated pH-weighted images in acute stroke patients. One key assumption regarding CEST-MRI is that the signal is predominantly intracellular. This assumption has implications in the application of CEST-MRI for pH measurement of tumours, which are generally associated with extracellular acidosis. This study developed a novel pulse sequence, combining stimulated echo acquisition mode diffusion and CEST imaging. Using this novel pulse sequence, the intracellular and extracellular contributions to the acquired Z-spectrum were isolated in a simple cell system and post-mortem mouse brain.

303

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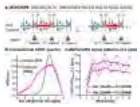


Multi-echo Parametric VARiation Saturation (MePaVARS) enabling more specific endogeneous CEST imaging

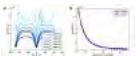
Xiaolei Song[1,2], Yan Bai[1,3], Meiyun Wang[3], and Michael T. McMahon[1,2]

[1]The 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 Radiology, Henan Provincial People's Hospital, Zhengzhou, China, People's Republic of

Existing CEST methodologies have difficulties in discriminating agents with small difference in chemical shift. As CEST signal is very sensitive to saturation power (B_1) and length (t_{sat}), indicating a second route to indentify agents by modulating the saturation conditions. We utilized the Multi-echo Parametric VARiation Saturation (MePaVARS), to separate faster and slower exchanging endogeneous CEST metabolites and molecules according to their differences response to B_1. In simulations and phantoms, MePaVARS allowed extraction of faster-exchanging Glutamate from the slower-exchanging Creatine, based on its oscillation patterns. A preliminary study for mice bearing prostate tumor further validated the feasibility of MePaVARS *in vivo*.

304

11:24



Implementing single-shot quantitative CEST/T1ρ measurements using bSSFPX

Shu Zhang[1], Robert E Lenkinski[1,2], and Elena Vinogradov[1,2]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States

Recently properties of bSSFP were explored to detect exchange processes (bSSFPX), similar to CEST or off-resonance $T_{1\rho}$ experiments. We expand the study and implement a transient bSSFPX experiment that acquires bSSFP spectra continuously as the effective saturation time increases, allowing observation of the approach of magnetization to the steady state in a single shot. The magnetization dynamic is governed by the effective field and relaxation times parallel or perpendicular to it. Work is in progress to derive an exact quantification model. The method leads to fast acquisition of time-dependent data and may speed up QUEST-like quantification of the exchange processes.

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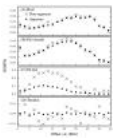
305 summa cum laude

11:36



IHMT: Is it misnamed? A simple theoretical description of "inhomogeneous" MT.

Alan P Manning[1], Kimberley L Chang[2], Alex MacKay[1,3], and Carl A Michal[1]

[1]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]Department of Neurology, University of British Columbia, Vancouver, BC, Canada, [3]UBC MRI Research Centre, Department of Radiology, University of British Columbia, Vancouver, BC, Canada

Inhomogeneous MT (IHMT) shows promise for myelin-selectivity. Images acquired with soft prepulses at positive and negative offsets simultaneously show a reduced intensity compared to images with a single positive or negative offset prepulse. The leading hypothesis is that this works due to inhomogeneous broadening of the lipid proton line. Our results contradict this. We show that IHMT can be explained by a simple spin-1 model of a coupled methylene pair, and that it occurs in ***homogeneously***-broadened systems (hair and wood). We propose the relevant timescales for IHMT are the dipolar coupling correlation time and the prepulse nutation period.

306 11:48

In vivo quantitative Magnetisation Transfer in the cervical spinal cord using reduced Field-of-View imaging: a feasibility study
Marco Battiston[1], Francesco Grussu[1], James E. M. Fairney[2,3], Ferran Prados[1,4], Sebastien Ourselin[4], Mara Cercignani[5], Claudia Angela Michela Gandini Wheeler-Kingshott[1,6], and Rebecca S Samson[1]

[1]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, University College London, London, United Kingdom, [2]UCL Department of Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [3]Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, University College London, London, United Kingdom, [4]Translational Imaging Group, Centre for Medical Image Computing, UCL Department Medical Physics and Bioengineering, University College London, London, United Kingdom, [5]CISC, Brighton & Sussex Medical School, Brighton, United Kingdom, [6]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy

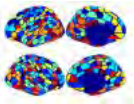
Quantitative Magnetization Transfer (qMT) Imaging techniques offer the possibility to estimate tissue macromolecular fraction, which has been shown to be specific for myelin in the brain and spinal cord. To date, applications of qMT in the spinal cord have been hampered by prohibitive protocol duration. We propose a novel approach for qMT in the spinal cord based on the combination of off-resonance saturation and small field-of-view imaging, with the potential of reducing the scan time needed to perform qMT in the spinal cord.

Oral

fMRI: The Cutting Edge in Connectivity

Room 331-332 10:00 - 12:00 *Moderators:*Kai-Hsiang Chuang & Maria Fernandez-Seara

307 10:00



Cerebral Cortex Parcellation by Fusion of Local and Global Functional Connectivity Feature
Alexander Schaefer[1], Ru Kong[1], Evan M. Gordon[2], Timothy Laumann [3], Simon B. Eickhoff[4,5], Xi-Nian Zuo[6], Avram J. Holmes[7], and B.T. Thomas Yeo[1]

[1]Department of Electrical and Computer Engineering, ASTAR-NUS Clinical Imaging Research Centre, Singapore Institute for Neurotechnology and Memory Networks Program, National University of Singapore, Singapore, Singapore, [2]VISN 17 Center of Excellence for Research on Returning War Veterans, Waco, TX, United States, [3]Department of Neurology, Washington University in St. Louis, St. Louis, MO, United States, [4]Institut for Clinical Neuroscience, Heinrich Heine University, Düsseldorf, Germany, [5]Institute for Neuroscience and Medicine, Research Center Jülich, Jülich, Germany, [6]Lab for Functional Connectome and Development, Division of Cognitive and Developmental, Chinese Academy of Sciences, Beijing, China, People's Republic of, [7]Department of Psychology, Yale University, New Haven, CT, United States

Current approaches to cerebral cortex parcellation with resting-state functional connectivity MRI (fcMRI) can be divided into local (e.g., fcMRI gradients) and global (e.g., clustering) approaches. Previous work suggests that local and global approaches capture complementary aspects of brain organization. Here we propose a novel hidden Markov Random Field model that fuses local connectivity gradients with global functional connectivity similarities. The resulting parcellation compares favorably with a state-of-the-art parcellation in terms of (1) parcel homogeneity in two different datasets and (2) agreement with cytoarchitectonic and visuotopic boundaries.

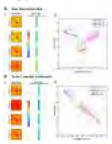
308 10:12

Track-weighted dynamic functional connectivity (TWdFC): a new method to study dynamic connectivity
Fernando Calamante[1,2], Robert Elton Smith[1], Xiaoyun Liang[1], Andrew Zalesky[3], and Alan Connelly[1,2]

[1]The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia, [2]Florey Department of Neuroscience and Mental Health, The University of Melbourne, Melbourne, Australia, [3]Melbourne Neuropsychiatry Centre and Melbourne School of Engineering, The University of Melbourne, Melbourne, Australia

There is great interest in the study of brain connectivity (structural and functional), and on the development of methods that facilitate these investigations. In functional connectivity (FC), there is also growing interest in characterising the dynamic changes (dynamic-FC, dFC). Track-weighted FC (TWFC) was proposed as a means to combine the structural and (static) functional information into a single image, by integrating a functional network with a diffusion MRI tractogram. Here we propose TW-dynamic-FC (TWdFC), by extending TWFC in two ways: first, it does not rely on an a-priori FC network; second, it allows studying dFC.

309 10:24



Beat-to-beat blood pressure fluctuations are present in time-frequency dynamics of resting-state fMRI
Joseph R Whittaker[1], Molly G Bright[1,2], Ian D Driver[1], and Kevin Murphy[1]

[1]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom

A pilot study of fMRI time-frequency dynamics, characterized using a maximal overlap discrete wavelet transform, demonstrates matched frequency correlations with beat-to-beat mean arterial blood pressure fluctuations. Voxel-wise correlations between fMRI and blood pressure wavelet coefficients, on a frequency scale centred at 0.1Hz, reveal distributed and structured spatial variance across the brain. We demonstrate that functional connectivity methods that include time-frequency representations of fMRI data are likely very sensitive to these blood pressure fluctuations.

310 10:36 A cortical and sub-cortical parcellation clustering by intrinsic functional connectivity

Ying-Chia Lin[1], Tommaso Gili[2,3], Sotirios A. Tsaftaris [1,4], Andrea Gabrielli[5], Mariangela Iorio[3], Gianfranco Spalletta[3], and Guido Caldarelli[1]

[1]IMT Institute for Advanced Studies Lucca, Lucca, Italy, [2]Enrico Fermi Centre, Rome, Italy, [3]IRCCS Fondazione Santa Lucia, Rome, Italy, [4]Institute of Digital Communications, School of Engineering, The University of Edinburgh, Edinburgh, United Kingdom, [5]ISC-CNR, UOS Sapienza, Dipartimento di Fisica, Universita Sapienza, Rome, Italy

Network analysis of resting-state fMRI (rsfMRI) has been widely utilized to investigate the functional architecture of the whole brain. Here we propose a robust parcellation method that first divides cortical and sub-cortical regions into sub-regions by clustering the rsfMRI data for each subject independently, and then merges those individual parcellations to obtain a global whole brain parcellation. To do so our method relies on majority voting (to merge parcellations of multiple subjects) and enforces spatial constraints within a hierarchical agglomerative clustering framework to define parcels that are spatially homogeneous.

311

10:48

Low Frequency Optogenetic Stimulation of Dentate Gyrus Enhances Brain Functional Connectivity Revealed by Resting-State fMRI

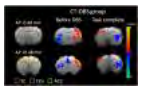
Russell W Chan[1,2], Alex TL Leong[1,2], Patrick P Gao[1,2], Y S Chan[3], W H Yung[4], Kevin K Tsia[2], and Ed X Wu[1,2]

[1]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong, China, People's Republic of, [2]Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong, China, People's Republic of, [3]School of Biomedical Sciences, The University of Hong Kong, Hong Kong, China, People's Republic of, [4]School of Biomedical Sciences, The Chinese University of Hong Kong, Hong Kong, China, People's Republic of

Low frequency coherent rsfMRI signals (<0.1Hz) do not match the bandwidth of established neuronal oscillations, highlighting a gap in our knowledge regarding the neuronal basis of rsfMRI underlying long-range brain networks. In this study, optogenetics and rsfMRI were combined to investigate the neuronal basis of rsfMRI connectivity by probing alternations of brain functional connectivity before, during and after low frequency stimulation in dorsal dentate gyrus. Our results demonstrated that low frequency optogenetic stimulation enhanced brain functional connectivity. This indicated that low frequency neuronal oscillations contribute and underlie the synchronized long-range rsfMRI brain functional networks.

312

11:00



Functional MRI reveals striatal–thalamic connectivity in cognitive neural behavior altered by central thalamic deep brain stimulation

Hsin-Yi Lai[1], Hui-Ching Lin[2,3], Yu-Chun Lo[4], Lun-De Liao[5,6], Wei-Che Wei[7], and You-Yin Chen[7]

[1]Interdisciplinary Institute of Neuroscience and Technology (ZIINT), Zhejiang University, Hangzhou City, China, People's Republic of, [2]Department and Institute of Physiology, National Yang-Ming University, Taipei, Taiwan, [3]Brain Research Center, National Yang Ming University, Taipei, Taiwan, [4]Center for Optoelectronic Biomedicine, National Taiwan University College of Medicine, Taipei, Taiwan, [5]Institute of Biomedical Engineering and Nanomedicine, National Health Research Institutes, Miaoli County, Taiwan, [6]Singapore Institute for Neurotechnology, National University of Singapore, Singapore, Singapore, [7]Department of Biomedical Engineering, National Yang-Ming University, Taipei, Taiwan

This study demonstrates neuronal striatal–thalamic connectivity modulated by direct stimulating the central thalamus in rats. Our results indicate that the CT-DBS modulate the neuronal activity in bilateral anterior cingulate cortex, caudate-putamen and somatosensory cortex and increases in functional connectivity between the striatum and parafascicular thalamic nucleus, hippocampus and primary motor cortex to shorten the cognitive related behavior task. CT-DBS fMRI has potential to explore functional connectivity in the brain and monitor functional plasticity changes in a specific neuroanatomical pathway *in vivo*.

313

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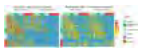


The structural basis for supporting functional connectivity in mice

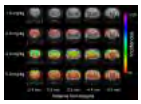
Joanes Grandjean[1], Valerio Zerbi[2], Nicole Wenderoth[2], and Markus Rudin[1]

[1]University and ETH Zurich, Zurich, Switzerland, [2]ETH Zurich, Zurich, Switzerland

Connectomics holds promise to foster our understanding of the healthy and disordered brain. MRI has been the method of choice for such analysis, combining diffusion weighted with functional imaging to resolve structural and functional connectivity, respectively. However, both methods are indirect measures prone to bias and artifacts. In mice, structural connectivity has been reconstructed with high spatial resolution by mapping the distribution of viral tracers following local injections at multiple sites offering a unique opportunity to compare functional connectivity with detailed mono-synaptic projections. Such comparisons should help bridging functional and structural connectivity in rodents with implications for human studies.

314

11:24



Characterization of acute phencyclidine-induced dose-dependent schizophrenic symptoms in rat: relationship between functional connectivity, hemodynamic response, behavior, and neurotransmitter levels

Jaakko Paasonen[1], Raimo A Salo[1], Jouni Ihalainen[2], Juuso Leikas[2], Katja Savolainen[2], Markus M Forsberg[2], and Olli Gröhn[1]

[1]Department of Neurobiology, University of Eastern Finland, Kuopio, Finland, [2]School of Pharmacy, University of Eastern Finland, Kuopio, Finland

Schizophrenia is a disorder that lack effective medication. In order to improve treatments, better disease models are required. Here, phencyclidine (PCP)-induced schizophrenic symptoms were investigated in rats with fMRI. Results were compared with microdialysis measurements and behavioral tests. At PCP doses ≥ 3 mg/kg, characteristics for psychotic symptoms were detected in functional connectivity (FC), having good correspondence with locomotor and dopamine activity. With PCP doses ≤ 2 mg/kg, markers for psychotic symptoms were absent. The FC of mesolimbic pathway was still affected, and social and cognitive deficits were confirmed in behavioral tests. Thus, PCP ≤ 2 mg/kg induces specifically the social and cognitive schizophrenic deficits.

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315 11:36

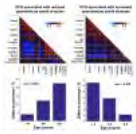
ACC GABA levels predict activity and connectivity in the fronto-striatal network during interference inhibition in borderline personality disorder

Guoying Wang[1], Julia van Eijk[1], Traute Demirakca[1], Markus Sack[1], Sylvia Cackowski[2], Annegret Krause-Utz[2], Christian Schmahl[2], and Gabriele Ende [1]

[1]Neuroimaging, Central Institute of Mental Health, Mannheim, Germany, [2]Psychosomatic Medicine and Psychotherapy, Central Institute of Mental Health, Mannheim, Germany

By combining the MRS and fMRI technique, we tested whether ACC GABA levels would predict the activity and connectivity in fronto-striatal networks during interference inhibition (Simon task) in BPD patients. BPD patients showed a significant positive correlation between ACC GABA levels and BOLD responses in fronto-striatal regions during interference inhibition. Additionally, ACC GABA levels in BPD patients were positively related to ACC-caudate functional connectivity during the incongruent condition. Our findings highlight that the GABAergic system in the ACC plays an important role in the modulation of impulsivity via regulating the local neural activity and remote connectivity between key regions.

316 11:48



Fluctuations in Functional Connectivity Predict Shifts in Arousal State

Chenhao Wang[1], Ju Lynn Ong[1], Amiya Patanaik[1], Juan Zhou[1,2], and Michael W. L. Chee[1]

[1]Neuroscience and Behavioral Disorders Program, Duke-NUS Graduate Medical School Singapore, Singapore, Singapore, [2]Clinical Imaging Research Center, Agency for Science, Technology and Research, Singapore, Singapore

To elucidate relationship between fluctuation in functional connectivity and behavior we estimated dynamic connectivity states (DCS) from task-free fMRI obtained from sleep-deprived healthy young adults. Using spontaneous eye closures as a proxy for vigilance, we identified two DCS that were associated with high and low arousal respectively. DCS exhibiting similar connectivity patterns were also observed when individuals were performing an auditory vigilance task. Dwell time in high or low arousal DCS predicted task performance. Additionally, fluctuations in DCS and task response time were correlated. Fluctuations in functional connectivity appear to be related to spontaneous changes in arousal that affect vigilance.

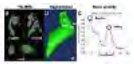
Oral

Velocity & Flow Quantification

Room 334-336 10:00 - 12:00 *Moderators:*Jeremy Collins & Oliver Wieben

317 10:00

magna cum laude



4D flow MRI-Derived Hemodynamic Atlases of the Left Ventricle with Hypertrophic Cardiomyopathy Demonstrate Abnormally Elevated Blood Flow Velocities

Pim van Ooij[1], Alex J Barker[2], Henk A Marquering[3], Gustav J Strijkers[3], James C Carr[2], Michael Markl[2,4], and Aart J Nederveen[5]

[1]Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Radiology, Northwestern University, Chicago, IL, United States, [3]Biomedical Engineering & Physics, Academic Medical Center, Amsterdam, Netherlands, [4]Biomedical Engineering, Northwestern University, Chicago, IL, United States, [5]Academic Medical Center, Amsterdam, Netherlands

Altered hemodynamics in the left ventricle (LV) may contribute to heart failure in hypertrophic cardiomyopathy (HCM). The aim of this was study was to employ 4D flow MRI to identify regions with altered velocity in HCM patients based on the concept of 'LV flow heat maps' comparing velocity fields in HCM patients with an atlas derived from healthy controls. In the ejection phase, abnormally elevated velocity was found in the LV outflow tract, whereas the filling phase showed elevated velocity in the LV apex.

318 10:12

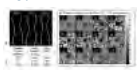
Characterization of aortic blood flow after aortic valve replacement by 4D flow MRI

Alex S Hong[1], Emilie Bollache[1], Pim van Ooij[1], James C Carr[1], Alex J Barker[1], Jeremy D Collins[1], and Michael Markl[2]

[1]Department of Radiology, Northwestern University, Chicago, IL, United States, [2]Department of Radiology, Department of Biomedical Engineering, Northwestern University, Chicago, IL, United States

Aortic valve replacement (AVR) is an effective surgical approach to treating aortic valvular disease, but it is unclear if and what type of prosthesis can fully reproduce physiologically normal flow characteristic of a native aortic valve. We utilized 4D flow MRI to systematically compare blood flow in the thoracic aorta in post-AVR (bioprosthetic vs. mechanical) patients and healthy controls. Both bioprosthetic and mechanical valves were found to produce higher peak systolic flow velocities and peak wall shear stress in the ascending aorta than native valves, demonstrating the presence of significant changes in aortic blood flow in AVR patients.

319 10:24



Pressure Gradient Measurement in the Coronary Artery Using Phase Contrast (PC)-MRI: Initial Patient Results Towards Noninvasive Quantification of Fractional Flow Reserve

Zixin Deng[1,2], Sangeun Lee[3], Zhaoyang Fan[1], Christopher Nguyen[1], Iksung Cho[3], Qi Yang[1], Xiaoming Bi[4], Byoung-Wook Choi[5], Jung-Sun Kim[3], Daniel Berman[1], Hyuk-Jae Chang[3], and Debiao Li[1]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [3]Cardiology, Severance Hospital, Yonsei Univeristy College of Medicine, Seoul, Korea, Republic of, [4]R&D, Siemens Healthcare, Los Angeles, CA, United States, [5]Radiology, Severance Hospital, Yonsei Univeristy College of Medicine, Seoul, Korea, Republic of

Fractional flow reserve is an invasive diagnostic tool to evaluate the functional significance of a coronary stenosis by quantifying the pressure gradient (ΔP) across the stenosis. We proposed a non-invasive technique to derive ΔP using Phase-contrast (PC)-MRI in conjunction with the Navier-Stokes equations (ΔP_{MR}). Excellent correlation was observed between derived ΔP_{MR} and measure ΔP from a pressure transducer in a small caliber phantom model. A significant increase in ΔP_{MR} was seen in the patient group vs. healthy controls. Preliminary results suggested that noninvasive quantification of ΔP_{MR} in coronary arteries is feasible.

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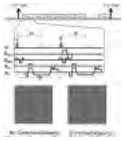

Cine Phase Contrast Simultaneous Multi-Slice imaging of blood flow and CSF motion.

David A Feinberg[1,2], Alexander Beckett[1], An T Vu[1,2], and Liyong Chen[2]

[1]Helen Wills Neuroscience Institute, University of California, Berkeley, CA, United States, [2]Advanced MRI Technologies, Sebastopol, CA, United States

The purpose was to develop and evaluate a novel approach to MR phase imaging of blood flow and CSF flow by combining cine phase contrast (cine-PC) with simultaneous multi-slice (SMS) technique to measure velocity in several slice planes simultaneously. Comparisons were made between SMS 2-4 and conventional single-slice 2D cine-PC GE imaging. The velocity curves measured in internal carotid (ICA) and vertebral arteries and jugular veins and aqueductal CSF were similar between SMS and conventional single-slice cine-PC. In ICA correlations (R=0.92-0.98) in 6 subjects. This new ability for simultaneous cross-sectional hemodynamic quantification may be useful for medical diagnoses.

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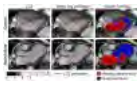
321 10:48



Vortex-ring mixing as a measure of diastolic function of the human heart: phantom validation and initial observations in healthy volunteers and patients with heart failure

Johannes Töger[1,2], Mikael Kanski[1], Per M Arvidsson[1], Marcus Carlsson[1], Sándor J Kovács[3], Rasmus Borgquist[4], Johan Revstedt[5], Gustaf Söderlind[2], Håkan Arheden[1], and Einar Heiberg[1,2,6]

[1]Department of Clinical Physiology, Lund University Hospital, Lund University, Lund, Sweden, [2]Department of Numerical Analysis, Centre for Mathematical Sciences, Lund University, Lund, Sweden, [3]Department of Internal Medicine, Washington University School of Medicine, St Louis, MO, United States, [4]Department of Arrhythmias, Lund University Hospital, Lund University, Lund, Sweden, [5]Department of Energy Sciences, Lund University, Faculty of Engineering, Lund, Sweden, [6]Department of Biomedical Engineering, Lund University, Faculty of Engineering, Lund, Sweden

Diastolic dysfunction of the left ventricle (LV) of the heart is a severe condition associated with poor prognosis. However, objective and reproducible assessment of diastolic function remains a challenge. We propose a new method using 4D flow MR by quantification of blood mixing within the LV diastolic vortex-ring. Phantom validation showed fair agreement between 4D flow MR and planar laser-induced fluorescence (PLIF). Quantitative vortex-ring mixing differs between healthy controls and patients with heart failure, which demonstrates its potential as a marker of diastolic dysfunction.

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322 11:00

Dynamic assessment of atrioventricular junction (AVJ) based on radial long-axis cine cardiac MR imaging

Shuang Leng[1], Shuo Zhang[2], Xiaodan Zhao[1], Baoru Leong[1], Yiying Han[1], Yasutomo Katsumata[3], Stuart Cook[1,4], Ru San Tan[1,4], and Liang Zhong[1,4]

[1]National Heart Centre Singapore, Singapore, Singapore, [2]Philips Healthcare Singapore, Singapore, Singapore, [3]Philips Healthcare Japan, Tokyo, Japan, [4]Duke-NUS Graduate Medical School Singapore, Singapore, Singapore

We have developed a semi-automatic tracking system of atrioventricular junction (AVJ) deformation with two-, three-, and four-chamber cardiovascular magnetic resonance (CMR) long-axis images [1]. In this study, we applied the feature-tracking technique in 18 radial rotational long-axis cine CMR planes and evaluated the motion of 36 evenly located AVJ points. Results have shown that 1) the obtained average AVJ velocities (Sm, Em and Am) and maximal displacements are independent of the number of AVJ points selected, and 2) the routinely acquired CMR imaging generated in clinical practice are sufficient enough for dynamic assessment of AVJ deformation.

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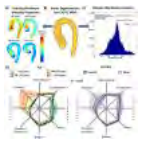
323 11:12



3D Blood Flow Velocity Distribution in the Normal Aorta: Effect of Age and Gender Across 101 Subjects

Julio Garcia[1], Roel L.F. van der Palen[2], Alex J. Barker[1], Jeremy D. Collins[1], James C. Carr[1], Joshua Robinson[3], Cynthia Rigsby[3], and Michael Markl[1,4]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Pediatric Cardiology, Leiden University Medical Center, Leiden, Netherlands, [3]Department of Medical Imaging, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL, United States, [4]Biomedical Engineering, Northwestern University, Evanston, IL, United States

The systematic characterization of effects in aortic disease patients and healthy controls is important to improve disease diagnosis. 4D flow MRI can be applied for the analysis of altered hemodynamics in cardiovascular disease. However, data analysis can be time consuming and often data are not fully utilized by analysis based on 2D planes. This study aimed to systematically apply flow distribution analysis in the entire volume of the aorta to establish normative reference values across a wide age range from pediatric to adult subjects.

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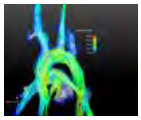
324 11:24

High Quality Preclinical 4D-Flow Phase Contrast Imaging

Moritz Braig[1], Jochen Leupold[1], Ko Cheng-Wen[2], Marius Menza[1], Juergen Hennig[1], Jan Korvink[3], and Dominik von Elverfeldt[1]

[1]University Medical Center Freiburg, Freiburg, Germany, [2]Dept. Computer Science and Engineering, National Sun Yat-sen University, Kaohsiung, Taiwan, [3]Institute of Microstructure Technology, Karlsruhe Institute of Technology, Karlsruhe, Germany



So far preclinical 4D-Flow MRI has not been able to deliver an analysis of complex flow due to low resolution. The presented framework and improvements allow high quality data acquisitions with a reduced measurement time and the possibility to visualize regional flow abnormalities. An automatic magnitude segmentation in every timeframe combines anatomic information with the underlying blood flow showing even small vessels. It will draw new conclusions in mouse models of cardiovascular diseases as a valuable tool for preclinical researchers.

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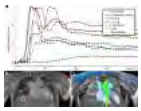
325 11:36

Ultra-High-Dimensional Flow Imaging (N-D Flow)



Joseph Y. Cheng[1], Tao Zhang[1], Marcus T. Alley[1], Michael Lustig[2], John M. Pauly[3], and Shreyas S. Vasanawala[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Electrical Engineering & Computer Sciences, University of California, Berkeley, CA, United States, [3]Electrical Engineering, Stanford University, Stanford, CA, United States

Volumetric cardiac-resolved flow imaging (4D flow) can enable the assessment of flow, function, and anatomy from a single sequence. Here, 4D flow is extended to higher dimensional space as N-D flow. By resolving different dynamics such as respiration or contrast enhancement, more diagnostic information can be extracted for a single-sequence protocol. Furthermore, this potentially improves image quality and quantification accuracy. N-D flow is enabled by a compressed-sensing and parallel imaging based acquisition and reconstruction. The feasibility of this approach is demonstrated for pediatric imaging.

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326 11:48

In vitro validation of Cartesian 4D flow mapping using patient-specific 3D printed total cavo-pulmonary connection models

Zachary Borden[1], Peng Lai[2], Ann Shimakawa[2], Alejandro Roldan-Alzate[1,3], and Christopher J Francois[1]

[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]GE Healthcare, Menlo Park, CA, United States, [3]Department of Mechanical Engineering, University of Wisconsin-Madison, Madison, WI, United States

Congenital heart disease is a common disease process which benefits from MRI 4D flow analysis. In a total cavo-pulmonary connection model, Cartesion 4D Flow mapping using k-t acceleration and variable density signal averaging correlates well with US flow probe data and 2D PC measurements. The improved post processing efficiency of Cartesian acquisition may allow more widespread adoption of 4D flow technology for analyzing congenital heart disease.

Oral

Normal Brain: Measurement & Characterisation

Hall 606 10:00 - 12:00 *Moderators:*Jalal Andre & Christopher G Filippi

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327 10:00

UK Biobank: Brain imaging protocols and first data release

Karla L Miller[1], Neal K Bangerter[2], Fidel Alfaro Almagro[1], David L Thomas[3], Essa Yacoub[4], Junqian Xu[5], Andreas J Bartsch[1,6], Saad Jbabdi[1], Stamatios N Sotiropoulos[1], Mark Jenkinson[1], Jesper Andersson[1], Ludovica Griffanti[1], Peter Weale[7], Iulius Dragonu[7], Steve Garratt[8], Sarah Hudson[8], Rory Collins[8,9], Paul M Matthews[10], and Stephen M Smith[1]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [2]Electrical and Computer Engineering, Brigham Young University, Provo, UT, United States, [3]Department of Brain Repair and Rehabilitation, UCL Institute of Neurology, University College London, London, United Kingdom, [4]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [5]Icahn School of Medicine at Mount Sinai, New York, NY, United States, [6]Department of Neuroradiology, University of Heidelberg, Heidelberg, Germany, [7]Siemens Healthcare (UK), London, United Kingdom, [8]UK Biobank Ltd, Stockport, United Kingdom, [9]Nuffield Department of Population Health, University of Oxford, Oxford, United Kingdom, [10]Department of Medicine, Imperial College London, London, United Kingdom

UK Biobank is a prospective epidemiological study of 500,000 participants consisting of extensive questionnaires, physical measures and biological samples, linking to long-term health outcomes. The imaging extension for the UK Biobank ultimately aims to image 100,000 subjects from this cohort, including brain, cardiac and body MRI, bone scans and carotid ultrasound. We overview the brain imaging component, which includes structural, functional and diffusion MRI. The value of this open resource arises not only from multi-modal/multi-organ imaging, but also from the depth of other demographic, phenotypic and exposure data, and will increase over time as clinical outcomes are realized in the population.

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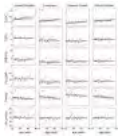
328 10:12

On the Relationship between Cellular and Hemodynamic Properties of the Human Brain Cortex over Adult Lifespan



Yue Zhao[1], Jie Wen[2], Anne Cross[3], and Dmitriy Yablonskiy[2]

[1]Chemistry, Washington University in St. Louis, St. Louis, MO, United States, [2]Radiology, Washington University in St. Louis, St. Louis, MO, United States, [3]Neurology, Washington University in St. Louis, St. Louis, MO, United States

Establishing baseline MRI biomarkers for normal brain aging is significant and valuable. In this study, we use previously developed approach to measure tissue-specific transverse relaxation rate constant ($R2^*_t$) and BOLD contributions to GRE signal, thus providing information on tissue cellular and hemodynamic properties. The VSF approach is applied for background gradient correction together with navigator echo to minimize artifacts from physiological fluctuations. Our results show age-related $R2^*_t$ increases in most cortical regions and age-independent behavior of most hemodynamic parameters. We hypothesize that $R2^*_t$ could serve as a biomarker of the cortical “cellular packing density”, which mostly reflects the neuronal density.

329 10:24

Venous metrics in a large cohort of healthy elderly individuals from susceptibility-weighted images and quantitative susceptibility maps
Phillip G. D. Ward[1,2], Parnesh Raniga[1], Nicholas J. Ferris[1,3], David G. Barnes[2,4], David L. Dowe[2], Elsdon Storey[5], Robyn L. Woods[6], and Gary F. Egan[1,7]

[1]Monash Biomedical Imaging, Monash University, Clayton, Australia, [2]Faculty of Information Technology, Monash University, Clayton, Australia, [3]Monash Imaging, Monash Health, Clayton, Australia, [4]Monash eResearch Centre, Monash University, Clayton, Australia, [5]Department of Neurology, Monash University, Clayton, Australia, [6]Department of Epidemiology & Preventative Medicine, Monash University, Melbourne, Australia, [7]ARC Centre of Excellence for Integrative Brain Function, Melbourne, Australia

In this study we examine venous characteristics of elderly individuals in a large healthy population. Venograms were generated from susceptibility-weighted images and quantitative susceptibility maps using state-of-the-art automated venography. Venous density and oxygen extraction fraction were calculated in different brain regions. The pattern of metabolic demand (oxygen extraction fraction) is found to be consistent with rest and passive observation. Additionally, our results suggest that venous density may be a potential biomarker.

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330 10:36

In Vivo Characterization of Brain Ultrashort-T2 Components
Tanguy Boucneau[1,2], Shuyu Tang[1,3], Misung Han[1], Roland G Henry[1,4], Duan Xu[1,3], and Peder Eric Zufall Larson[1,3]

[1]Radiology and Biomedical Imaging, University of California - San Francisco, San Francisco, CA, United States, [2]Physics, Ecole Normale Supérieure de Cachan, Cachan, France, [3]UC Berkeley-UCSF Graduate Program in Bioengineering, University of California, Berkeley and University of California, San Francisco, San Francisco, CA, United States, [4]Neurology, University of California - San Francisco, San Francisco, CA, United States

It has recently been shown that myelin contains ultrashort T2 components with sub-millisecond relaxation times that are not observed with conventional pulse sequences and maybe associated with bound protons in the myelin phospholipid membranes.We performed ultrashort T2* relaxometry in vivo to characterize these components with a 3D ultrashort echo time (UTE) pulse sequence at 7T.We observed an ultrashort T2 component (T2* $$$\approx 100 \mu s$$$) as well as a short T2 component (T2* $$$\approx 1.5 ms$$$) that had a distinct frequency shift corresponding to the methylene proton chemical shift, which to our knowledge has never been observed in vivo.These components were validated in an ex vivo post-mortem brain specimen, and may provide valuable new biomarkers of myelin density, structure, and integrity.

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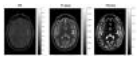

Multi-parameter mapping, fat/water separation and functional imaging with a two-sequence brain morphometry protocol
Andre Jan Willem van der Kouwe[1], Fikret Isik Karahanoglu[1], Matthew Dylan Tisdall[1], Paul Wighton[1], Himanshu Bhat[2], Thomas Benner[3], and Jonathan R Polimeni[1]

[1]Athinoula A. Martinos Center, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Siemens Healthcare, Charlestown, MA, United States, [3]Siemens Healthcare, Erlangen, Germany

We present an efficient two-sequence protocol for quantifying multiple parameters in a 1 mm isotropic brain morphometry examination. The protocol comprises a multiple gradient echo (TE), multiple inversion (TI) time MPRAGE (MEMPxRAGE) and a two-flip-angle balanced SSFP (TrueFISP) sequence. Proton density and T_1 maps are estimated from the MEMPxRAGE data using the multi-TI data and a Bloch simulation. With the T_1 map and TrueFISP data, the T_2 map is estimated using DESPOT2. Fat, water and B0 maps are obtained from the multi-TE data using the IDEAL algorithm. The MEMPxRAGE scan includes embedded 3D EPI-based navigators encoding low resolution functional information.

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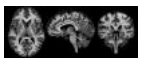
332 11:00



Reproducibility of fast three-dimensional macromolecular proton fraction mapping of the human brain: global tissue characterization and volume measurements
Vasily L. Yarnykh[1,2]

[1]Radiology, University of Washington, Seattle, WA, United States, [2]Research Institute of Biology and Biophysics, Tomsk State University, Tomsk, Russian Federation

A new method for fast high-resolution whole-brain three-dimensional (3D) mapping of the macromolecular proton fraction (MPF) based on three source images has been recently proposed. In this study, reproducibility of repeated MPF measurements in white and gray matter with simultaneous estimation of tissue volumes using automated segmentation of 3D MPF maps obtained with isotropic resolution of 1.25 mm was assessed. MPF measurements in brain tissues are highly reproducible with coefficients of variation <1.5%. 3D MPF mapping provides “all-in-one” solution for simultaneous characterization of myelination and volumetric changes in brain tissues.

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333 11:12

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Automated Measurements of Brain Morphometry Derived from T1-weighted Magnetic Resonance Imaging Fluctuate from Morning to Afternoon
Aaron Trefler[1], Neda Sadeghi[2], Adam Thomas[1], Carlo Pierpaoli[2], Chris Baker[1], and Cibu Thomas[3]

[1]National Institute of Mental Health, Bethesda, MD, United States, [2]National Institute of Child Health and Human Development, Bethesda, MD, United States, [3]Center for Neuroscience and Regenerative Medicine, Bethesda, MD, United States

Automated measures of brain morphometry derived from T1-weighted (T1W) images are typically used as proxy measures to investigate the relation between brain structure and behavior. However, the computation of T1W morphometric measures can be influenced by subject-related factors such as head motion[1] and level of hydration[2]. Here, we provide a comprehensive assessment of

the impact of time-of-day (TOD) on widely used measures of brain morphometry in healthy young adults. Our results show that the apparent volume of all major tissue compartments as well as measures of brain morphometry such as cortical thickness and gray matter density are significantly influenced by TOD.

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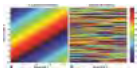
334 magna cum laude

11:24 

Optimized Inversion-Time Schedules For High-Resolution Multi-Inversion EPI Quantitative Measurements of T1
Ouri Cohen[1,2], Ville Renvall[3], and Jonathan Polimeni[1,2]

[1]Athinoula A. Martinos Center, Charlestown, MA, United States, [2]Radiology, Massachusetts General Hospital, Boston, MA, United States, [3]Department of Neuroscience and Biomedical Engineering, Aalto University School of Science, Espoo, Finland

A novel optimized method for high-resolution quantitative EPI measurements of T_1 is introduced and validated on a 3T clinical scanner in a phantom and a healthy volunteer. The method offers a 5-fold acceleration in scan time over previous techniques allowing fully quantitative 1.2 mm^3 isotropic T1 maps in less than 30 seconds.

335

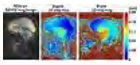
11:36 

Cerebral gray matter volume changes caused by exposure to hypobaric environment: a preliminary study
Dandan Zheng[1], Wenjia Liu[2], Li Zheng[3], and Lin Ma[2]

[1]MR Research China, GE Healthcare, Beijing, China, People's Republic of, [2]Radiology Department, Beijing Military General Hospital, Beijing, China, People's Republic of, [3]Department of Biomedical Engineering, College of Engineering, Peking University, Beijing, China, People's Republic of

Acute mountain sickness is a series of pathologic reactions during rapid exposing to low pressure hypoxic high altitude environment, which is a widespread illness among un-acclimatized individuals in plateau. Human always stay in plain will display some common physiological and pathological changes of brain, such as change of cerebral blood flow, cerebral pressure and brain volume. The aim of the present study was to investigate whether there was different change of gray matter volume in some brain regions related to AMS development before, during and after exposing to the real high altitude environment.

336

11:48 

Regional Brain Motion Varies with Subject Positioning: A Study Using Displacement Encoding with Stimulated Echoes (DENSE)
Xiaodong Zhong[1], Zihan Ye[2], Tucker Lancaster[3], Deqiang Qiu[3], Brian M. Dale[4], Amit Saindane[3], and John N. Oshinski[2,3]

[1]MR R&D Collaborations, Siemens Healthcare, Atlanta, GA, United States, [2]Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA, United States, [3]Department of Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States, [4]MR R&D Collaborations, Siemens Healthcare, Cary, NC, United States

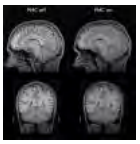
Displacement encoding with stimulated echoes (DENSE) with high motion sensitivity was used to investigate the influence of subject position (prone versus supine) on regional brain motion. Preliminary results in 9 volunteers demonstrated that there is a significant difference in displacement with a change in position. Displacements were significantly increased in the frontal lobe going from the prone to the supine position and significantly increased in the occipital lobe going from the supine to the prone position.

Oral

Brain Motion Correction

Summit 1 10:00 - 12:00 *Moderators:*Rita Nunes & Oliver Speck

337 magna cum laude

10:00 

Advances in Prospective Motion Correction with Gradient Tones
Maximilian Haeberlin[1], Alexander Aranovitch[1], Bertram Wilm[1], David Otto Brunner[1], Benjamin Dietrich[1], Barmet Christoph[2], and Klaas Paul Pruessmann[1]

[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland, [2]Skope Magnetic Resonance Technologies, Zurich, Switzerland

A system for prospective motion correction using field probes and gradient tones is presented that is independent of sequence parameters and thus compatible with clinically relevant scans. An examples of a successfully corrected MPRAGE sequence is shown and the bandwidth and the amount of unintentional head motion is measured during a 32 min. scan.

338

10:12 

High frequency orientation estimates for fast real-time motion correction using vector observations of gravity and the static magnetic field (B0).
Adam M.J. van Niekerk[1], Paul Wighton[2,3], Ali Alhamud[1], Matthew D. Tisdall[2,3], Andre J.W. van der Kouwe[2,3], and Ernesta M. Meintjes[1]

[1]Human Biology, MRC/UCT Medical Imaging Research Unit, University of Cape Town, Cape Town, South Africa, [2]Athinoula A. Martinos Center, Massachusetts General Hospital, Boston, MA, United States, [3]Radiology, Harvard Medical School, Boston, MA, United States

In this study we propose a novel approach to motion correction in MRI that separates the challenges of tracking orientation and translation. We developed an external hardware device capable of high frequency orientation estimates independent of the pulse sequence. The device takes vector observations of gravity and the MRI scanner's static magnetic field (B0) and is therefore free from many constraints of some existing external motion tracking techniques. Most notably, no scanner specific calibration is required and the

device can be miniaturised. Translation estimates are achieved through the use of 3 high-speed orthogonal navigators. Line by line rigid body motion correction is implemented in a spoiled gradient echo pulse sequence.

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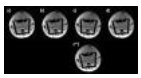
339 10:24



Prospective Motion Correction Using External Tracking and Intrinsic Motion Information

Michael Herbst[1,2], Aditya Singh[1], Benjamin Knowles[2], Maxim Zaitsev[2], and Thomas Ernst[1]

[1]JABSOM, University of Hawaii, Honolulu, HI, United States, [2]Medical Physics, University Medical Center Freiburg, Freiburg, Germany

Prospective motion correction with external tracking was applied to high resolution diffusion weighted imaging, using a phase-segmented EPI readout strategy. To detect and correct for residual errors during prospective motion correction, real-time volumetric registration provides continuous feedback to the acquisition.

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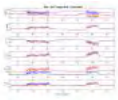
340 10:36



A Comparison of 19F NMR Field Probes and an Optical Camera System for Motion Tracking

Martin Eschelbach[1], Alexander Loktyushin[1], Paul Chang[1,2], Jonas Handwerker[3], Jens Anders[3], Anke Henning[1,4], Axel Thielscher[1,5,6], and Klaus Scheffler[1,7]

[1]High Field MR Center, Max Planck Institute for biol. Cybernetics, Tuebingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience University of Tuebingen, Tuebingen, Germany, [3]Institute of Microelectronics, University of Ulm, Ulm, Germany, [4]Institute for Biomedical Engineering, ETH Zürich, Zurich, Switzerland, [5]Univ Copenhagen, Hvidovre Hosp, Danish Res Ctr Magnet Resonance, Hvidovre, Denmark, [6]Tech Univ Denmark, Biomed Engn Sect, Lyngby, Denmark, [7]Department of Biomedical Magnetic Resonance, University Tuebingen, Tuebingen, Germany

The goal of this study is to evaluate and compare motion tracking with two different modalities: NMR field probes and an optical MPT (Moiré Phase Tracking) camera system. This was done by simultaneously measuring the manually induced motion of a spherical phantom with both systems. Our experimental results indicate that the motion patterns measured with both methods are in good agreement. However, the accuracy of the motion estimates from the field probe measurements are of an order of magnitude worse than the camera's tracking results.

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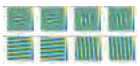

Fast calculation of phase accumulation due to pulsed gradients for arbitrary rigid body motion

Patrick Hucker[1], Michael Dacko[1], Michael Herbst[2], Ben Knowles[1], and Maxim Zaitsev[1]

[1]Dept. of Radiology · Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]John A. Burns School of Medicine, University of Hawaii, Honolulu, HI, United States

A compact solution for phase calculation due to arbitrary rigid body motion based on screw theory is presented. The proposed approach allows for rapid and quantitatively accurate calculations of the phase induced by the switching magnetic field gradients using motion tracking information e.g. from a motion tracking camera. The ability of predicting phase accumulation due to motion in presence of gradients is instrumental for achieving better correction of the motion-induced data inconsistencies for MR pulse sequences with extended signal preparation or readout periods.

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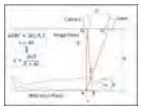
342 11:00



Motion Detection and Correction for Carotid Artery Wall Imaging using Structured Light

Jin Liu[1], Huijun Chen[2], Jinnan Wang[1], Niranjan Balu[1], Haining Liu[1], and Chun Yuan[1]

[1]University of Washington, Seattle, WA, United States, [2]Tsinghua University, Beijing, China, People's Republic of

Carotid artery wall MRI is often affected by complex neck motion. We aimed to separate different motion components and correct them for better carotid artery wall delineation using structured light system. A healthy volunteer was scanned for 2D carotid MRI. It was demonstrated that voluntary abrupt motion, unconscious bulk motion and involuntary respiration can all be detected effectively. Both abrupt motion and bulk neck shift can be corrected for better vessel wall delineation, but the duration of abrupt motion can affect motion correction effectiveness. Bulk neck shift distance optimization by maximizing sharpness can future reduce motion artifact.

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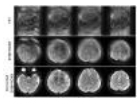
343 11:12



Motion-corrected K-space Reconstruction for High Resolution Multi-shot Diffusion Imaging

Fuyixue Wang[1], Zijing Dong[1], Xiaodong Ma[1], Erpeng Dai[1], Zhe Zhang[1], and Hua Guo[1]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of

Recently, several techniques have been developed to be capable of correcting shot-to-shot phase variations of multi-shot acquisition in order to obtain diffusion images with high spatial resolution. However, longer acquisition time of multi-shot EPI makes these methods more sensitive to bulk motion. In this work, we developed a novel k-space based motion corrected reconstruction method for 2D navigated multi-shot DWI. Motion simulations and in-vivo head motion experiments validated the effectiveness of the proposed method, which can remove the ghosting artifacts from minuscule motion and the blurring from bulk motion.

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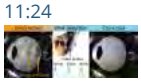


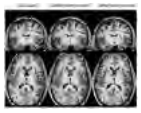
Robust MR eye scanning: blink detection and correction using field probes

Joep Wezel[1], Anders Garpebring[2], Andrew G. Webb[1], Matthias J. van Osch[1], and Jan-Willem M. Beenakker[3]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Radiation Sciences, Umeå University, Umeå, Sweden, [3]Ophthalmology, Leiden University Medical Center, Leiden, Netherlands

Eye-blinks result in significant artifacts in ocular MRI scans, often masking important clinical pathologies, such as small ocular tumors. The aim of this study is to detect and correct for these eye-blinks. We use a fluorine-based field probe to detect these eye-blinks via changes in the local magnetic field. The field probe measurements are linked to the MR-scanner which subsequently automatically reacquires the motion-corrupted part of k-space. This method effectively corrects for the main origin of image artifacts in ocular MRI, and thereby significantly improves the image quality in a clinical setting.

345 11:36



Head motion tracking and correction using discrete off-resonance markers (trackDOTS) for high-resolution anatomical imaging at 7T
João Jorge[1], Daniel Gallichan[2], and José P Marques[3]

[1]Laboratory for Functional and Metabolic Imaging, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [2]Biomedical Imaging Research Center, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Donders Institute, Radboud University, Nijmegen, Netherlands

High-resolution imaging can be significantly affected by subject head motion. Here, we demonstrate the use of discrete off-resonance MR markers ("trackDOTS") in head motion tracking and correction, for high-resolution anatomical imaging. This approach relies on fast 1D-projection acquisitions (under 50ms per measurement) which do not disturb the water signal. These measurements were incorporated in an MP2RAGE sequence, and a 0.6mm isotropic resolution image was acquired from a healthy subject. Motion timecourses estimated from the trackDOTS positions matched concomitant estimations performed with FatNavs (with deviations of 0.09±0.08mm for translations and 0.20°±0.19° for rotations); MP2RAGE image quality was visibly improved upon correction.

346 11:48

Amplified Magnetic Resonance Imaging (aMRI)
Samantha J Holdsworth[1], Wendy W Ni[1], Greg Zaharchuk[1], Michael E Moseley[1], and Mahdi S Rahimi[1]

[1]Lucas Center for Imaging, Department of Radiology, Stanford University, Palo Alto, CA, United States

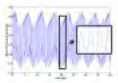
This work introduces a new visualization method called amplified Magnetic Resonance Imaging (aMRI), which uses Eulerian Video Magnification to amplify subtle spatial variations in cardiac-gated brain MRI scans and magnify brain motion. This approach reveals deformations of brain structures and displacements of arteries due to cardiac pulsatility, especially in the brainstem, cerebellum, and spinal cord. aMRI has the potential for widespread neuro- and non-neuro clinical application, because it can amplify and characterize barely perceptible motion, and allows visualization of biomechanical responses of tissues using the heartbeat as an endogenous mechanical driver.

Oral

MR Safety

Summit 2 10:00 - 12:00 *Moderators:*Andreas Bitz & Christopher Collins

347 10:00

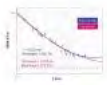


Investigating the Effects of 10.5T Static Field Exposure on Blood Pressure and Heart Rate in Anesthetized Pigs
Yigitcan Eryaman[1], Patrick Zhang[1], Lynn Utecht[1], Russell L Lagore[1], Jeramy Kulesa[1], Lance DelaBarre[1], Kivanc Kose[2], Lynn E. Eberly[3], Gregor Adriany[1], Kamil Ugurbil[1], and J. Thomas Vaughan[1]

[1]CMRR,Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Dermatology Service, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [3]Division of Biostatistics,School of Public Health, University of Minnesota, Minneapolis, MN, United States

Preliminary studies are conducted to investigate the effects of 10.5 T whole body exposure on anesthetized pigs. Blood pressure was measured invasively, recorded and analyzed to calculate the systolic/diastolic blood pressure levels as well as the heart rate.

348 10:12

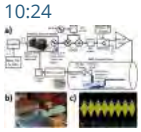


Does trans-membrane stimulation occur in peripheral nerve stimulation: why the SENN does not fit the data?
Donald McRobbie[1,2]

[1]South Australian Medical Imaging, Flinders Medical Centre, Adelaide, Australia, [2]Surgery, Imperial College, London, United Kingdom

The Spatial Extended Non-linear Node (SENN) model currently used in MR safety guidelines does not adequately predict the behaviour of magnetic stimulation in terms of its time constant and waveform dependence. This has implications for the setting of gradient limits in MRI. Stimulation of the nerve by induced electric fields perpendicular to the nerve axis may remove the inconsistencies. A better model of magnetic stimulation is required.

349 10:24



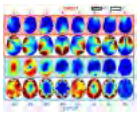
Thermo-Acoustic Ultrasound Detection of RF Tip Heating in MRI
Neerav Dixit[1], Pascal Stang[2], John Pauly[1], and Greig Scott[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Procyon Engineering, San Jose, CA, United States

Thermo-acoustic ultrasound uses pressure waves generated by thermoelastic expansion to measure heating. This technique can be used to detect excessive local SAR and RF tip heating in implanted or interventional devices. We compare the signal quality and inherent properties of several modulation schemes for thermo-acoustic ultrasound. We then interface a system for thermo-acoustic detection of

heating with an MRI scanner and demonstrate the first use of thermo-acoustic ultrasound to detect RF tip heating from an MRI scanner.

350 10:36



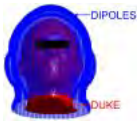
Butler matrix transmit channel compression in pTx: a SAR-aware study.

Mihir Rajendra Pendse[1], Riccardo Stara[1,2,3], Gianluigi Tiberi[4], Alessandra Retico[2], Michela Tosetti[5], and Brian Rutt[1]

[1]Stanford University, Stanford, CA, United States, [2]Istituto Nazionale di Fisica Nucleare (Pisa), Pisa, Italy, [3]Universita' di Pisa, Pisa, Italy, [4]IMAGO7, Pisa, Italy, [5]ISRCC Stella maris, Calambrone (Pisa), Italy

The use of a Butler matrix in pTx is thought to allow transmit channel compression by a factor of 2 or more compared to direct drive, while maintaining similar flip angle control. However, the SAR-related consequences of this compression strategy are relatively unexplored. Using a SAR-aware pTx design method (IMPULSE), we demonstrate that excellent flip angle uniformity is indeed possible using only 2 or 4 Butler modes compared to 8 direct drive channels; however, this comes at the expense of increased SAR. We also present a generalized strategy for selecting the optimal subset of Butler modes, i.e. the subset that provides adequate flip angle control at minimum SAR.

351 10:48



Ultimate hyperthermia: Computation of the best achievable radio-frequency hyperthermia treatments in non-uniform body models

Bastien Guerin[1,2], Jorge F. Villena[3], Athanasios G. Polimeridis[4], Elfar Adalsteinsson[5,6,7], Luca Daniel[5], Jacob K. White[5], Bruce R. Rosen[1,2,6], and Lawrence L. Wald[1,2,6]

[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Cadence Design Systems, Feldkirchen, Germany, [4]Skolkovo Institute of Science and Technology, Moscow, Russian Federation, [5]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [6]Harvard-MIT Division of Health Sciences Technology, Cambridge, MA, United States, [7]Institute for Medical Engineering and Science, Massachusetts Institute of Technology, Cambridge, MA, United States

We propose a framework for the computation of the ultimate hyperthermia, which is the best possible hyperthermia treatment for a given frequency and non-uniform body model achievable by any multi-channel hyperthermia coil. We compute the ultimate hyperthermia treatment of two shallow (close to skull) and deep (close to ventricle) brain tumors in the realistic “Duke” body model and for treatment frequencies ranging from 64 MHz to 600 MHz. We characterize the convergence to the ultimate SAR pattern as well as temperature increase associated with the ultimate SAR distribution in the presence of non-uniform perfusion effects.

352 11:00

magna cum laude

A method to approximate maximum local SAR in multi-channel transmit MR systems without transmit phase information

Stephan Orzada[1], Mark E. Ladd[1,2], and Andreas K. Bitz[2]

[1]Erwin L. Hahn Institute, Essen, Germany, [2]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

The capability of multi-channel transmit systems to drive different waveforms in the individual transmit channels results in an increased complexity for the SAR supervision In this work we propose a method based on virtual observation points (VOPs) to derive a conservative upper bound for the local SAR with a reasonable safety margin without knowledge of the transmit phases of the channels. In six different scenarios we demonstrate that the proposed method can be superior to the simple worst case method often used when only amplitude and no phase information is available.

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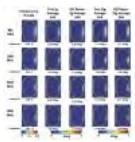


Heat Equation Inversion (HEI) Algorithm Sensitivity Assessment for Computation of SAR from MR Thermometry Acquisitions

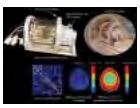
Leeor Alon[1,2,3,4], Daniel Sodickson[1,2,3], and Cem M. Deniz[1,2,3,4]

[1]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [2]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States, [3]NYU Wireless, NYU-Poly, New York, NY, United States, [4]RF Test Labs, New York, NY, United States

MR thermometry methods are often used to assess safety of RF antennas. Typically thermal mapping is conducted in phantoms, which measures the temperature change as result of exposure to RF waves. From these temperature difference maps, SAR distribution can be reconstructed using the inverse heat equation (HEI) framework . With a goal of of testing the robustness of this method, in this work, we assessed the fidelity of the algorithm with respect to different regularization parameter, different SAR distributions, excitation frequencies and heating durations.

354 11:24

summa cum laude



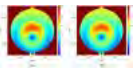
A Patient-adjustable MRI coil for implant-friendly imaging of deep brain stimulation: Design, construction, and patient-specific numerical simulations

Laleh Golestanirad[1], Boris Keil[1], Maria Ida Iacono[2], Giorgio Bonmassar[1], Leonardo M Angelone[2], Cristen LaPierre[1], and Lawrence L Wald[1]

[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Division of Biomedical Physics, Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, US Food and Drug Administration, Silver Spring, MD, United States

Recently we presented the feasibility study of using a reconfigurable DBS-friendly head coil, composed of a patient-adjustable rotating birdcage transmitter, and an integrated 32-channel receiver array to reduce SAR during imaging of patients with deep brain stimulation implants. Here we introduce the first prototype of such coil system, and present results of finite element simulations on patient-derived numerical models of realistic DBS lead trajectories, which characterize its SAR reduction performance.

355 11:36



Fast Full-Wave Calculation of Electromagnetic Fields for MRI Applications Based on Weak-Form Volume Integral Equation (VIE)
Wan Luo[1,2], Shao Ying Huang[1], Jiasheng Su[1], Zu-Hui Ma[1], and J. Thomas Vaughan[3]

[1]Singapore University of Technology and Design, Singapore, Singapore, [2]University of Electronic Science and Technology of China, Chengdu, China, People's Republic of, [3]University of Minnesota, Minneapolis, MN, United States

When B_0 in a MRI system increases, peaks and nulls are formed in the energy/field distribution inside the subject under scan, which causes safety issues and deteriorates imaging accuracy, respectively. Therefore, a quick and accurate electromagnetic simulation of the human body is crucial for predicting the temperature and specific absorption rate distribution before a scan. Here, we develop a solver based on the weak-form volume integral equation (VIE) and accelerated by the fast Fourier transform method. It requires much less CPU time and memory compared with the traditional strong-form VIE and the popular FDTD-based commercial software SEMCAD.

356 11:48

summa cum laude

Inter-laboratory study of a computational radiofrequency coil model at 64 MHz
Elena Lucano[1,2], Mikhail Kozlov[3], Eugenia Cabot[4], Sara Louie[5], Marc Horner[5], Wolfgang Kainz[1], Gonzalo G Mendoza[1], Aiping Yao[4,6], Earl Zastrow[4,6], Niels Kuster[4,6], and Leonardo M Angelone[1]

[1]Center for Devices and Radiological Health, Office of Science and Engineering Laboratories, U.S. Food and Drug Administration, Silver Spring, MD, United States, [2]Department of Information Engineering, Electronics and Telecommunications, University of Rome "Sapienza", Rome, Italy, [3]MR:comp GmbH, Gelsenkirchen, Germany, [4]IT'IS foundation, Zurich, Switzerland, [5]ANSYS, Inc., Canonsburg, PA, United States, [6]Department of Information Technology and Electrical Engineering, ETH, Zurich, Switzerland

Preliminary results of an ongoing inter-laboratory study are presented. The eventual purpose of the effort is to develop a methodology that harmonizes RF-modeling and RF-testing protocol for use in RF exposure assessment. In this phase of the study, numerical and experimental data were collected from four laboratories for unloaded and loaded coil conditions. Only information about the geometry and resonance frequency of the physical coil was provided. Qualitatively good agreement across all teams was found. Subsequent phases of the study shall include a methodology on uncertainty analysis associated with the numerical and experimental methods that can be used in practice

Combined Educational & Scientific Session

Quantitative Biomarkers of Diffuse Liver Disease

*Organizers:*Lorenzo Mannelli, M.D., Ivan Pedrosa, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 1 10:00 - 12:00 *Moderators:*Claude Sirlin & Takeshi Yokoo

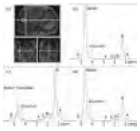
10:00 Introduction by Moderator

10:03 Fat Quantification & Composition
Mustafa Bashir[1]

[1]Duke University Medical Center

The use of MRI measures of fatty liver as well as intraabdominal fat will be discussed, particularly as pertain to Nonalcoholic Steatohepatitis and the metabolic syndrome.

357 10:18



Non-invasive quantification and characterisation of liver fat in non-alcoholic fatty liver disease (NAFLD) using automated analysis of MRS correlated with histology
Robert Flintham[1], Peter Eddowes[2], Scott Semple[3], Natasha McDonald[4], Jonathan Fallowfield[4], Tim Kendall[5], Stefan Hübscher[6], Philip Newsome[2], Gideon Hirschfield[2], and Nigel Paul Davies[1,7]

[1]Medical Physics, University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom, [2]Centre for Liver Research, NIHR Biomedical Research Unit, University of Birmingham, Birmingham, United Kingdom, [3]Clinical Research Imaging Centre, University of Edinburgh, Edinburgh, United Kingdom, [4]MRC Centre for Inflammation Research, University of Edinburgh, Edinburgh, United Kingdom, [5]MRC Human Genetics Unit, University of Edinburgh, Edinburgh, United Kingdom, [6]Pathology, University Hospitals Birmingham NHS Foundation Trust, Birmingham, United Kingdom, [7]Institute of Cancer and Genomics, University of Birmingham, Birmingham, United Kingdom

MRS is proven to accurately measure liver fat fraction (FF), but its potential to differentiate steatohepatitis from simple steatosis in non-alcohol related fatty liver disease (NAFLD) is unexplored. MRS was acquired in 60 patients with suspected NAFLD across two centres prior to biopsy. Automated analysis was developed using TARQUIN to estimate FF, lipid chain length (CL) and number of double-bonds per chain (nDB) revealing strong correlations between FF, nDB, CL and steatosis grade. nDB also negatively correlated with hepatocyte ballooning assessed by histopathology. Further investigation of the relationship between MRS-derived lipid composition measurements and disease severity in NAFLD is warranted.

358 10:30

Accuracy and optimal proton density fat fraction threshold of magnitude- and complex-based magnetic resonance imaging for diagnosis of hepatic steatosis in obese patients using histology as reference
Tydus Thai[1], William Haufe[1], Yesenia Covarrubias[1], Alexandria Schlein[1], Curtis N. Wiens[2], Alan McMillan[2], Nathan S. Artz[2,3], Rashmi Agni[4],

Michael Peterson[5], Luke Funk[6], Guilherme M. Campos[7], Jacob Greenberg[6], Santiago Horgan[8], Garth Jacobson[8], Tanya Wolfson[1], Jeffrey Schwimmer[9], Scott Reeder[2,10,11,12,13], and Claude Sirlin[1]

[1]Liver Imaging Group, Radiology, University of California-San Diego, San Diego, CA, United States, [2]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [3]Radiological Sciences, St. Jude Children's Research Hospital, Memphis, TN, United States, [4]Pathology, University of Wisconsin-Madison, Madison, WI, United States, [5]Western Washington Pathology and Multicare Health System, Tacoma, WA, United States, [6]Surgery, University of Wisconsin-Madison, Madison, WI, United States, [7]Surgery, Virginia Commonwealth University, Richmond, VA, United States, [8]Surgery, University of California-San Diego, San Diego, CA, United States, [9]Pediatrics, University of California-San Diego, San Diego, CA, United States, [10]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [11]Biomedical Engineering, Madison, WI, United States, [12]Medicine, Madison, WI, United States, [13]Emergency Medicine, Madison, WI, United States

The purpose of this prospective cross-sectional study was to determine the accuracy of optimal MRI-M- and MRI-C-determined PDFF thresholds for diagnosis of hepatic steatosis using contemporaneous histology as reference in obese adults without previously known NAFLD. The excellent performance parameters of the Youden-index PDFF thresholds for MRI-M and MRI-C (5.3% and 7.7%, respectively) further support the use of these techniques for the quantitative and non-invasive diagnosis of HS. If validated by additional prospective studies, these PDFF thresholds could be used for diagnosing HS in obese adults non-invasively.

10:42

Confounders to Iron Quantification in the Liver

Diego Hernando[1]

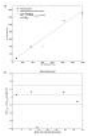
[1]University of Wisconsin-Madison, WI, United States

This presentation will provide an overview of current techniques for liver iron quantification, with a focus on relevant confounding factors which may decrease the accuracy and reproducibility of LIC estimates. The effect of these confounders, as well as recent efforts to address them, will be presented.

359

summa cum laude

10:57



Iron overload quantification using UTE Imaging at 3T

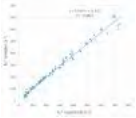
Eamon K Doyle, MS[1,2], Jonathan M Chia, MS[3], and John C Wood, MD, PhD[1,2]

[1]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Cardiology, Children's Hospital of Los Angeles, Los Angeles, CA, United States, [3]Philips Healthcare, Cleveland, OH, United States

Estimate of R2* in high-iron patients has many challenges at 3T and above. UTE imaging shows promise as method to perform iron quantitation in heavily iron-loaded tissues. We demonstrate feasibility of using a 3D radial UTE sequence at 3T to estimate R2* relaxation rates in iron-loaded human subjects and fast-decay phantoms.

360

11:09



Comparing Magnitude versus Complex Data Fitting in Liver R_2* Relaxometry

Arthur Peter Wunderlich[1,2], Stefan Andreas Schmidt[1], Meinrad Beer[1], Armin Michael Nagel[1,2], and Holger Cario[3]

[1]Clinic for Diagnsotic and Interventional Radiology, Ulm University, Medical Center, Ulm, Germany, [2]Section for Experimental Radiology, Ulm University, Medical Center, Ulm, Germany, [3]Department of Pediatrics and Adolescent Medicine, Ulm University, Medical Center, Ulm, Germany

Relaxometry of patient data was performed comparing the use of magnitude versus complex data. 94 patients suspected for liver iron overload were scanned with mulit-contrast GRE-MRI at 1.5 T, involving multiple T_E, T_R and FA. Analysis was performed as conjoined fit incorporating effects of fat/water dephasing. One fit was based on magnitude images modeling noise as free fit parameter, the other on complex data. Magnitude fit yielded similar results, but showed superior convergence and lower result uncertainty compared to the approach involving complex data.

11:21

Fibrosis: MRI vs US Elastography

Meng Yin

Liver stiffness now a well-established biomarker for assessing fibrosis in chronic liver disease, as an alternative to biopsy. MRI-based and ultrasound-based dynamic elastography methods have been introduced for clinical staging of fibrosis. Some of the methods are commercially available. However, each have their inherent strengths and weaknesses. The published literature generally indicates that MR elastography has higher diagnostic performance and fewer technical failures than ultrasound-based elastography in assessing hepatic fibrosis. There is significant potential to further develop elastography techniques to implement multiparametric methods that have promise for distinguishing between process such as inflammation, fibrosis, venous congestion, etc.

361

11:36

Discrimination of Hepatic Inflammation and Fibrosis with Magnetic Resonance Elastography

Meng Yin[1], Kevin J. Glaser[1], Harmeet Malhi[2], Amy Mauer[2], Anuradha Krishnan[2], Taofic Mounajjed[3], Jason Bakeberg[4], Christopher Ward[4], Ruisi Wang[2], Douglas Simonnetto[2], Shennen Mao[5], Jaime Glorioso[5], Faysal Elgilani[6], Vijay Shah[2], Scott Nyberg[6], Armando Manduca[1], and Richard L. Ehman[1]

[1]Radiology, Mayo Clinic, Rochester, MN, United States, [2]Gastroenterology and Hepatology, Mayo Clinic, Rochester, MN, United States, [3]Pathology, Mayo Clinic, Rochester, MN, United States, [4]Nephrology and Hypertension Research, Mayo Clinic, Rochester, MN, United States, [5]Surgery, Mayo Clinic, Rochester, MN, United States, [6]Transplant Center, Mayo Clinic, Rochester, MN, United States

To investigate the utility of MRE-derived mechanical properties in discriminating hepatic inflammation and fibrosis in early-stage of chronic liver diseases, we performed multifrequency 3D MRE on five different *in vivo* animal models with chronic liver diseases. Liver stiffness and phase angle derived from complex shear modulus were selected for evaluation. Results demonstrated distinct and potentially characteristic changes in these mechanical properties with hepatic inflammation, fibrosis and increased portal pressure. The findings offer preliminary evidence of the potential to extend MRE to distinguish and independently assess necroinflammatory and fibrotic processes in the early phase of chronic liver diseases.

362 11:48 Multifrequency MR elastography for assessing hepatic fibrosis in pediatric non-alcoholic fatty liver disease

Jing Guo[1], Christian Hudert[2], Heiko Tzschätzsch[1], Andreas Fehlner[1], Florian Dittmann[1], Jürgen Braun[3], and Ingolf Sack[1]

[1]Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]Department of Medical Informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany

Multifrequency MR elastography (MMRE) was applied to 32 obese pediatric patients with non-alcoholic fatty liver disease (NAFLD). Magnitude shear modulus $|G^*|$ which relates to liver stiffness is sensitive to differentiate mild fibrosis (F0-2) from severe fibrosis (F3) with an AUROC of 0.93. The liver stiffness was positively correlated with serum alanine aminotransferase (ALT) and can potentially serve as a quantitative imaging marker for the noninvasive assessment of liver fibrosis in patients with NAFLD.

12:00 Adjournment & Meet the Teachers

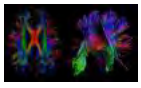
Educational Course

Diffusion & Perfusion: What Do You Know?

*Organizers:*Joshua S. Shimony, M.D., Ph.D., Steven Sourbron PhD, Linda Knutsson, Ph.D. & Eric C. Wong, M.D., Ph.D.

Nicoll 2 10:00 - 12:00 *Moderators:*Joshua Shimony & Steven Sourbron

10:00 Diffusion Imaging: From the Oops to the Aha



Alexander Leemans[1]

[1]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands

"We have acquired diffusion MRI data and now want analyze them... Help!"

Such a cry for help is often the result of bumping into unexpected complications at the early stage of analysis when trying to make sense of diffusion MRI data. In this talk, I will walk you through the most common "Oops" feelings that the novice may encounter and guide you towards the "Aha" victory moments where these issues get resolved.

10:40 Contrast Based Perfusion Imaging

David L. Buckley[1]

[1]Division of Biomedical Imaging, University of Leeds, Leeds, United Kingdom

11:20 Arterial Spin Labeling

Matthias van Osch[1]

[1]C.J. Gorter Center for high field MRI, Radiology, LUMC, Leiden, Netherlands

In this presentation the audience will be guided through the theory and applications of Arterial Spin Labeling MRI in an interactive manner. Emphasis will be put on the pitfalls of the acquisition, post-processing and interpretation of perfusion measurements by ASL.

12:00 Adjournment & Meet the Teachers

Educational Course

Fetal & Placental MRI

*Organizers:*Michael S. Hansen, Ph.D. & Guoying Liu, Ph.D.

Nicoll 3 10:00 - 12:00 *Moderators:*Guoying Liu

10:00 State of the Art Clinical Fetal MRI

Teresa Victoria

10:30 Advanced Fetal Brain Imaging
P. Ellen Grant[1]

[1]*Boston Children's Hospital*

11:00 Fetal Cardiovascular MRI
Chris Macgowan[1]

[1]*Hospital for Sick Children / University of Toronto, ON, Canada*

MRI is an appealing technology for fetal cardiovascular assessment because it can visualize both cardiac and vascular anatomy, it can quantify flow through the complex fetal circulation, and it is also sensitive to the oxygen saturation of blood. In this presentation, I provide an overview of MRI methods able to quantify fetal cardiovascular function, and describe our initial experience using these methods to study healthy and at-risk pregnancies.

11:30 Placental
Penny Gowland[1]

[1]*University of Nottingham, Nottingham, United Kingdom*

12:00 Adjournment & Meet the Teachers

Traditional Poster : Functional MRI (Neuro)

Exhibition Hall 13:30 - 15:30 *(no CME credit)*

Traditional Poster : Acquisition, Reconstruction & Analysis

Exhibition Hall 16:00 - 18:00 *(no CME credit)*

Electronic Poster : Neuro

Exhibition Hall 13:30 - 14:30 *(no CME credit)*

Electronic Poster : Diffusion

Exhibition Hall 14:30 - 15:30 *(no CME credit)*

Electronic Poster : Engineering

Exhibition Hall 16:00 - 17:00 *(no CME credit)*

Electronic Poster : Interventional

Exhibition Hall 17:00 - 18:00 *(no CME credit)*

Electronic Poster : MR Safety: Safety & Bioeffects

Exhibition Hall 17:00 - 18:00 *(no CME credit)*

Study Groups

Interventional MR

Hall 406 D 13:30 - 15:30

Study Groups

MR of Cancer

Hall 405 E 16:00 - 18:00

Study Groups

Diffusion

Power Pitch

MSK: The Most Powerful Hour

Power Pitch Theatre, Exhibition Hall 13:30 - 14:30 *Moderators:*Feliks Kogan & Hollis Potter

363 summa cum laude

13:30

Bone Quantitative Susceptibility Mapping using tissue specific R2* and multi-peak fat spectrum to model ultra-short TE gradient echo signal

Alexey V. Dimov[1,2], Zhe Liu[1,2], Pascal Spincemaille[2], and Yi Wang[1,2]

[1]Department of Biomedical Engineering, Cornell University, Ithaca, NY, United States, [2]Radiology Department, Weill Cornell Medical College, New York, NY, United States

364

13:33

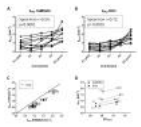
Reproducibility and regional variations of an optimized gagCEST protocol for the in vivo evaluation of knee cartilage at 7 Tesla

Markus Matthias Schreiner[1,2], Stefan Zbyn[2], Benjamin Schmitt[3], Stephan Domayer[1], Reinhard Windhager[1], Siegfried Trattnig[2], and Vladimir Mlynarik[2]

[1]Department of Orthopaedic Surgery, Medical University of Vienna, Vienna, Austria, [2]Department of Biomedical Imaging and Imag-Guided Therapy, High Field MR Centre, Medical University of Vienna, Vienna, Austria, [3]Siemens Healthcare Pty Ltd, Macquarie Park, Australia

365 summa cum laude

13:36



Muscle functional oxidative capacity varies along the length of healthy tibialis anterior

Andreas Boss[1], Linda Heskamp[1], Mark Jacobus van Uden[1], Lauren Jean Bains[2,3], Vincent Breukels[1], and Arend Heerschap[1]

[1]Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands, [2]Donders Institute for Brain, Cognition and Behaviour, Radboud University, Nijmegen, Netherlands, [3]Donders Centre for Cognitive Neuroimaging, Radboud University, Nijmegen, Netherlands

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13:39

Assessment of meniscus with adiabatic $$$T_{1\rho}$$$ and $$$T_{2\rho}$$$ in asymptomatic subjects and patients with early osteoarthritis: Oulu knee osteoarthritis study

Abdul Wahed Kajabi[1,2,3], Victor Casula[2,3], Arttu Peuna[2,3,4], Simo Saarakkala[2,5], Eveliina Lammentausta[3,4], Ali Guermazi[6], and Miika T. Nieminen[2,3,4]

[1]Department of Biomedical Engineering, University of Oulu, Oulu, Finland, [2]Research Unit of Medical Imaging, Physics and Technology, University of Oulu and Oulu University Hospital, Oulu, Finland, [3]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [4]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland, [5]Department of Medical Technology, Institute of Biomedicine, University of Oulu, Oulu, Finland, [6]Department of Radiology, Boston University School of Medicine, MA, MA, United States

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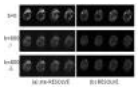
13:42



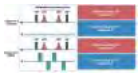
Diffusion Tensor Imaging of Human Achilles Tendon by Stimulated Echo RESOLVE (ste-RESOLVE)

Xiang He[1], Kenneth Wengler[2], Alex C Sacher[3], Marco Antonio Oriundo Verastegui[1], Alyssa Simeone[4], Mingqian Huang[1], Elaine Gould[1], and Mark Schweitzer[1]

[1]Department of Radiology, Stonybrook University School of Medicine, Stony Brook, NY, United States, [2]Department of Biomedical Engineering, Stonybrook University School of Medicine, Stony Brook, NY, United States, [3]SUNY Binghamton University, Binghamton, NY, United States, [4]New York Medical College, Valhalla, NY, United States

368

13:45



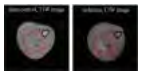
MR NeuroAngiography: Simultaneous Acquisition of Brachial Plexus MR Neurography and Subclavian MR Angiography Using phase-cycling Motion-Sensitized Driven-Equilibrium (pcMSDE)

Masami Yoneyama[1], Hajime Tanji[2], Tomoya Yamaki[2], Daisuke Takahashi[2], Makoto Obara[1], Tomoyuki Okuaki[3], and Marc Van Cauteren[3]

[1]Philips Electronics Japan, Tokyo, Japan, [2]Kita-Fukushima Medical Center, Fukushima, Japan, [3]Philips Healthcare Asia Pacific, Tokyo, Japan

369 summa cum laude

13:48



Detection of Alterations in Intramyocellular Lipid and Creatine Diffusivities during Muscle Ischemia by Diffusion Weighted MRS

Anna M. WANG[1,2] and Ed X. Wu[1,2]

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

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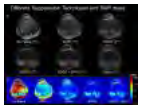
13:51

Clinically Viable Diffusion-Weighted Imaging Near Metal using 2D-MSI PROPELLER DUO

Suryanarayanan Sivaram Kaushik[1], Ajeet Gaddipati[2], Brian Hargreaves[3], Dawei Gui[4], Robert Peters[2], Tugan Muftuler[5], and Kevin Koch[1]

[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [2]GE Healthcare, Waukesha, WI, United States, [3]Radiology, Stanford University, Stanford, CA, United States, [4]GE Healthcare, Waukesh, WI, United States, [5]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States

371 13:54



Evaluation of Different Fat Suppression Techniques for Clinical Knee MRI at 7.0 Tesla

Michael Wyss[1], Andrei Manoliu[2], Georg Spinner[1], Magda Marcon[2], Roger Luechinger[1], Daniel Nanz[2], Klaas P. Pruessmann[1], and Gustav Andreisek[2]

[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland, [2]Institute of Diagnostic and Interventional Radiology, University Hospital Zurich and University of Zurich, Zurich, Switzerland

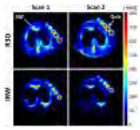
372 13:57

3-D cones UTE-T2* maps show early cartilage degeneration 2 years after ACL reconstruction

Ashley Anne Williams[1], Matthew R Titchenal[1], and Constance R Chu[1]

[1]Orthopaedic Surgery, Stanford University, Stanford, CA, United States

373 14:00

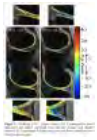


Longitudinal sodium MRI of cartilage in patients with knee osteoarthritis: Baseline vs. 16 months follow-up

Guillaume Madelin[1], Ding Xia[1], Gregory Chang[1], Svetlana Krasnokutsky[2], Steven B Abramson[2], and Ravinder R Regatte[1]

[1]Department of Radiology, New York University Langone Medical Center, New York, NY, United States, [2]Department of Rheumatology, New York University Langone Medical Center, New York, NY, United States

374 14:03

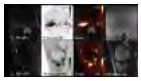


PCA-T1ρ Voxel-Based Relaxometry of the Articular Cartilage: a Comparison of Biochemical Pattern Changes in Knees with Osteoarthritis and ACL Injury

Valentina Pedoia[1], Colin Russell[1], Allison Randolph V[1], Keiko Amano[1], Xiaojuan Li[1], and Sharmila Majumdar[1]

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

375 14:06



Correlation of Bone Pathology on MRI with 18F-fluoride PET Uptake in Subchondral Bone

Feliks Kogan[1], Audrey Fan[1], Emily McWalter[1], Edwin Oei[2], Andrew Quon[1], and Garry Gold[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Radiology, Erasmus Medical Center, Rotterdam, Netherlands

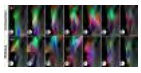
376 14:09

Quantitative assessment of muscle metabolism and dynamics of oxygen consumption with vPIVOT

Erin Kristine Englund[1], Zachary Bart Rodgers[1], Michael C Langham[2], Emile R Mohler[3], Thomas F Floyd[4], and Felix W Wehrli[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 Medicine, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Anesthesiology, Stony Brook University, Stony Brook, NY, United States

377 14:12



Synchronous Magnetic Resonance Imaging of Muscle Contraction induced by Electrical Stimulation

Xeni Deligianni[1,2], Michele Pansini[3], Meritxell Garcia[4], Anna Hirschmann[4], Arno Schmidt-Trucksäss[5], Oliver Bieri[1], and Francesco Santini[1,2]

[1]Department of Radiology, Division of Radiological Physics, University of Basel Hospital, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland, [3]Radiology, Kantonsspital Basel-Landschaft, Brudeholz, Switzerland, [4]Department of Radiology, University of Basel Hospital, Basel, Switzerland, [5]Department of Sports Medicine, University of Basel, Basel, Switzerland

Power Pitch

TOP CV's

Power Pitch Theatre, Exhibition Hall 16:00 - 17:00 *Moderators*:Jeff Maki & Chun Yuan

453 16:00

Hybrid Interleaved Multi-contrast Imaging (HIMI) for Simultaneous Brain and Carotid Vessel Wall Imaging

Shuo Chen[1], Zechen Zhou[1], Rui Li[1], Xihai Zhao[1], Huijun Chen[1], Changwu Zhou[1,2], Bida Zhang[3], and Chun Yuan[1,4]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of, [2]Department of Radiology, Yangzhou First People's Hospital, Yangzhou, China, People's Republic of, [3]Healthcare Department, Philips Research China, Shanghai, China, People's Republic of, [4]Vascular Imaging Laboratory, Department of Radiology, University

of Washington, Seattle, WA, United States

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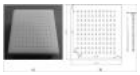
454 16:03



How Accurately and Precisely Are we Measuring Coronary Endothelial Function with Radial MRI?

Jerome Yerly[1,2], Danilo Gubian[3], Jean-Francois Knebel[2,4], Thomas Robin[5], Giulia Ginami[1], and Matthias Stuber[1,2]

[1]CardioVascular Magnetic Resonance (CVMR) research center, Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [3]University Hospital (CHUV), Lausanne, Switzerland, [4]Laboratory for Investigative Neurophysiology (The LINE), Departments of Radiology and Clinical Neurosciences, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [5]Transport and Mobility Laboratory (TRANSP-OR), Swiss Federal Institute of Technology of Lausanne (EPFL), Lausanne, Switzerland

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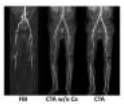
455 16:06



Evaluation of lower extremity arteries with severe wall calcification in peripheral arterial disease (PAD); comparison of Fresh blood imaging (FBI) with CT angiography with using a commercially available calcification removable tool

Katsumi NAKAMURA[1,2], Akiyoshi Yamamoto[1], Hiroki Matoba[1], Yuji Shintani[1], Daiji Uchiyama[1], Seigo Yoshida[1], and Mitsue Miyazaki[3]

[1]Radiology, Tobata Kyoritsu Hospital, Kitakyushu, Japan, [2]Nexus Image Lab, Kitakyushu, Japan, [3]Toshiba Medical Research Institute USA, Inc., Vernon Hills, IL, United States

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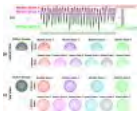
456 16:09



A Novel Concept for Motion Suppression Applied to Free-Breathing 3D Whole-Heart Coronary MRA: Respiratory Motion-Resolved Reconstruction

Davide Piccini[1,2], Li Feng[3], Gabriele Bonanno[2], Simone Coppo[2], Jérôme Yerly[2,4], Ruth P. Lim[5], Juerg Schwitter[6], Daniel K. Sodickson[3], Ricardo Otazo[3], and Matthias Stuber[2,4]

[1]Advanced Clinical Imaging Technology, Siemens Healthcare, Lausanne, Switzerland, [2]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [3]Center for Advanced Imaging Innovation and Research, New York University School of Medicine, New York City, NY, United States, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [5]Department of Radiology, Austin Health and The University of Melbourne, Melbourne, Australia, [6]Division of Cardiology and Cardiac MR Center, University Hospital of Lausanne (CHUV), Lausanne, Switzerland

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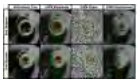
457 16:12



Preliminary Results: Cardiac Cine "Watermark" MRI provides both Anatomical Function via Magnitude Cine and 2D Myocardial Strain via Spatially Modulated Phase

Ronald J Beyers[1], Davis M Vigneault[2], Dean Schwartz[3], Nouha Salibi[1,4], David A Bluemke[2], and Thomas Denney[1]

[1]MRI Research Center, Auburn University, Auburn University, AL, United States, [2]Radiology and Imaging Sciences, National Institutes of Health, Bethesda, MD, United States, [3]Anatomy, Physiology and Pharmacology, Auburn University, Auburn University, AL, United States, [4]MR R&D, Siemens Healthcare, Malvern, PA, United States

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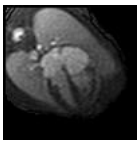
458 16:15

summa cum laude



Fetal cardiac cine imaging from motion-corrected super-resolution reconstruction of highly-accelerated real-time MRI

Joshua FP van Amerom[1], Maria Kuklisova Murgasova[1], Anthony N Price[1], Shaihan J Malik[1], Paul Aljabar[2], David A Lloyd[1], Kuberan Pushparajah[1,3], Maelene Lohezic[1], Matthew J Fox[2], Joanna M Allsop[2], Mary A Rutherford[1,2], Reza Razavi[1,3], and Joseph V Hajnal[1]

[1]Division of Imaging Sciences & Biomedical Engineering, King's College London, London, United Kingdom, [2]Centre for the Developing Brain, King's College London, London, United Kingdom, [3]Department of Congenital Heart Disease, Evelina London Children's Hospital, London, United Kingdom

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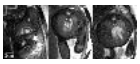
459 16:18

summa cum laude



A Golden-Angle Acquisition Coupled with k-t Sparse SENSE Reconstruction for Fetal Self Retro-Gated Cine Cardiac MRI: an In Vivo Feasibility Study

Jerome Chaptinel[1], Yvan Mivelaz[2], Jerome Yerly[1,3], Leonor Alamo[1], Milan Prsa[2], Yvan Vial[4], François Gudinchet[1], Gregoire Berchier[1], Jean-Baptiste Ledoux[1], and Matthias Stuber[1,3]

[1]Department of Radiology, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Department of Pediatrics, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [3]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland, [4]Department of Gynecology-Obstetrics, University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland

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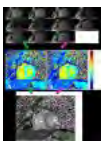
460 16:21



Accurate T1 mapping in patients with Pulmonary Hypertension and age matched volunteers using synthetic image based registration

Laura Claire Saunders[1], Neil J Stewart[1], Charlotte Hammerton[1], David Capener[1], Valentina O Puntmann[2], David G Kiely[3], Martin J Graves[4], Andy Swift[1], and Jim M Wild[1]

[1]Academic Unit of Radiology, The University of Sheffield, Sheffield, United Kingdom, [2]Department of Cardiovascular Imaging, Kings College London, London, United Kingdom, [3]The University of Sheffield, Sheffield, United Kingdom, [4]University of Cambridge School of Clinical Medicine, University of Cambridge, Cambridge, United Kingdom

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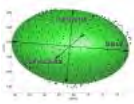
461 16:24

Towards a quantitative MRI-based measure of disease burden in patients with atrial fibrillation

Maurce Pradella[1], Sven Knecht[2], Michael Kühne[2], Aline Mühl[2], Tobias Reichlin[2], Gian Voellmin[2], David Conen[2], Jens Bremerich[1], Stefan



Osswald[2], Christian Sticherling[2], and Bram Stieltjes[1]

[1]*Department of Radiology, University of Basel Hospital, Basel, Switzerland,* [2]*Department of Cardiology, University of Basel Hospital, Basel, Switzerland*

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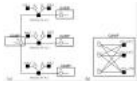
462 16:27

summa cum laude



Joint Processing of Highly Accelerated Multi-Directional PC-MRI Data Using ReVEAL

Adam Rich[1], Lee C. Potter[1], Ning Jin[2], Juliana Serafim da Silveira[3], Orlando P. Simonetti[3], and Rizwan Ahmad[3]

[1]*Electrical and Computer Engineering, The Ohio State University, Columbus, OH, United States,* [2]*Siemens Medical Solutions, The Ohio State University, Columbus, OH, United States,* [3]*Dorthy M. Davis Heart and Lung Research Institute, The Ohio State University, Columbus, OH, United States*

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463 16:30

A new hybrid approach for quantitative multi-slice myocardial DCE perfusion

Edward DiBella[1], Devavrat Likhite[1], Ganesh Adluru[1], Chris Welsh[1], and Brent Wilson[1]

[1]*University of Utah, Salt Lake City, UT, United States*

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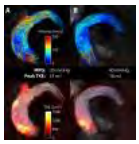
464 16:33



Added Value of Phase-Contrast MRI based Turbulent Kinetic Energy Quantification for the Assessment of Aortic Stenosis Severity

Alexander Gotschy[1,2], Christian Binter[1], Simon H Sündermann[3], Michelle Frank[2], Felix C Tanner[2], Robert Manka[2], and Sebastian Kozerke[1]

[1]*Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland,* [2]*Department of Cardiology, University Hospital Zurich, Zurich, Switzerland,* [3]*Division of Cardiovascular Surgery, University Hospital Zurich, Zurich, Switzerland*

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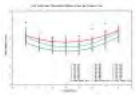
465 16:36

summa cum laude



In-Vivo Quantification of Myocardial Stiffness in Heart Failure with Preserved Ejection Fraction Using Magnetic Resonance Elastography: Assessment in a Porcine Model

Ria Mazumder[1,2], Samuel Schroeder[2,3], Xiaokui Mo[4], Bradley D Clymer[5], Richard D White[2,6], and Arunark Kolipaka[2,6]

[1]*Department of Electrical and Computer Enginerring, The Ohio State University, Columbus, OH, United States,* [2]*Department of Radiology, The Ohio State University, Columbus, OH, United States,* [3]*Department of Mechanical Engineering, The Ohio State University, Columbus, OH, United States,* [4]*Department of Biomedical Informatics, The Ohio State University, Columbus, OH, United States,* [5]*Department of Electrical and Computer Engineering, The Ohio State University, Columbus, OH, United States,* [6]*Department of Internal Medicine-Division of Cardiovascular Medicine, The Ohio State University, Columbus, OH, United States*

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466 16:39

Free breathing self-gated PC-MRI with Pseudo Random sampled kt-Sparse-Sense

Volker Herold[1], Patrick Winter[1], Philipp Mörchel[2], Fabian Gutjahr[1], and Peter Michael Jakob[1]

[1]*Department of Experimental Physics 5, University of Wuerzburg, Wuerzburg, Germany,* [2]*Research Center for Magnetic Resonance Bavaria e.V., Wuerzburg, Germany*

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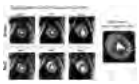
467 16:42



End-systolic Myocardial Perfusion MRI Using a Hybrid 2D/3D Steady-State Acquisition Scheme: Towards Reliable Detection of Subendocardial Ischemia in Coronary Microvascular Dysfunction

Behzad Sharif[1], Rohan Dharmakumar[1], Daniel Berman[2], Debiao Li[1], and Noel Bairey Merz[2]

[1]*Biomedical Imaging Research Institute, Dept of Biomedical Sciences, Cedars-Sinai Medical Center, Los Angeles, CA, United States,* [2]*Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States*

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468 16:45

Dual-modal cardiovascular in vivo assessment in rats using a highly integrated MPI-MRI hybrid system – initial result

Jochen Franke[1,2], Nicoleta Baxan[3], Ulrich Heinen[1], Alexander Weber[1,4], Heinrich Lehr[1], Martin Ilg[1], Wolfgang Ruhm[1], Michael Heidenreich[1], and Volkmar Schulz[2]

[1]*Preclinical Imaging Devision, Bruker BioSpin MRI GmbH, Ettlingen, Germany,* [2]*Physics of Molecular Imaging Systems, University RWTH Aachen, Aachen, Germany,* [3]*Biomedical Imaging Centre, Imperial College London, London, United Kingdom,* [4]*Institute of Medical Engineering, University of Lübeck, Lübeck, Germany*

Oral

MRSI: What's New?

Room 300-302 13:30 - 15:30 *Moderators:*Patrick Cozzone & Dong-Hyun Kim

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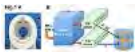
378 13:30 Multi-Band MRSI at 7T using 3D B1 Shimming based Outer Volume Suppression



Hoby Patrick Hetherington[1], Tiejun Zhao[2], Victor Yushmanov[1], and Jullie Pan[3]

[1]Radiology, University of Pittsburgh, Pittsburgh, PA, United States, [2]Siemens Medical Systems, New York, NY, United States, [3]Neurology, University of Pittsburgh, Pittsburgh, PA, United States

To provide near whole brain coverage for both anatomical imaging and MRSI we used an 8x2 transceiver array with 8 independent RF channels and eight 1 to 2 splitters. This configuration provided a homogeneous RF distribution (<12% SD, 750Hz peak B1) while enabling 3D RF shimming based outer volume suppression to minimize extra-cerebral lipid signals. MRSI data was acquired at 7T from control subjects and patients with mTBI with a multi-band MRSI sequence (four simultaneous slices) using two RF distributions. Increases in choline/NAA were seen in both the anterior frontal lobe and the hippocampi.

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379 13:42

Accelerated High-Resolution Multidimensional 1H-MRSI Using Low-Rank Tensors

Chao Ma[1], Fan Lam[1], Qiegen Liu[1], and Zhi-Pei Liang[1,2]

[1]Beckman Institute, University of Illinois Urbana-Champaign, Urbana, IL, United States, [2]Electrical and Computer Engineering, University of Illinois Urbana-Champaign, Urbana, IL, United States

Multidimensional spectroscopy increases spectral dispersion and enables accurate detection of more metabolites (e.g., Glu and GABA in 1H-MRSI of the brain) whose spectra largely overlap with other metabolites. However, the additional dimension of spectral information is obtained at the cost of increased data acquisition time, limiting the practical utility of in vivo multidimensional MRSI. This work presents a novel tensor-based approach to accelerated high-resolution multidimensional 1H-MRSI. The proposed method has been validated using phantom and in vivo J-resolved 2D 1H-MRSI experimental studies on a 3T scanner, producing encouraging results. The method should enhance the practical utility of multidimensional MRSI.

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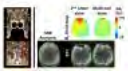
380 13:54

summa cum laude



Improved spiral chemical shift imaging at 3 Tesla using a 32-channel integrated RF-shim coil array

Eren Kizildag[1], Jason P Stockmann[2], Borjan Gagoski[2,3,4], Bastien Guerin[2,4], P. Ellen Grant[2,3,4], Lawrence L. Wald[2,4], and Elfar Adalsteinsson[1,5,6]

[1]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [2]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [3]Boston Children's Hospital, Boston, MA, United States, [4]Harvard Medical School, Boston, MA, United States, [5]Harvard-MIT Health Sciences and Technology, Cambridge, MA, United States, [6]Institute for Medical Engineering and Science, Cambridge, MA, United States

Severe B_0 inhomogeneity manifests itself in the in vivo brain Chemical Shift Imaging (CSI) by broadening the lineshapes and diminishing the quality of the observed spectra. We mitigate this problem by employing a 32-channel integrated RF-shim coil array which uses an optimal combination of local B_0 fields from each coil to cancel higher order local field inhomogeneities in the CSI volume. We observed 50% reduction in $\Delta\sigma B_0$ over the slab as compared with 2nd order shimming, corresponding to pronounced improvements in the linewidths of 13 out of 24 CSI voxels while modestly worsening in only 3 voxels.

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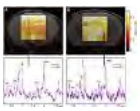
381 14:06

magna cum laude



Multi-slice functional FID based spectroscopic imaging on mice using dynamic shimming at 9.4T

Aline Seuwen[1], Markus Wick[2], Franek Hennel[1], Aileen Schroeter[1], and Markus Rudin[1,3]

[1]Institute for biomedical engineering, ETH & University of Zürich, Zürich, Switzerland, [2]Bruker BioSpin MRI GmbH, Ettlingen, Germany, [3]Institute for pharmacology and toxicology, University of Zürich, Zürich, Switzerland

In order to increase the volume coverage of 2D FID based spectroscopic imaging in mice i.e. the simultaneous measurement of several brain slices, we implemented a dynamic shimming approach involving the separate optimization of first and second order shim terms for volumes of interest in individual slices. When acquiring two slices covering cortical and thalamic regions similar spectra quality has been observed in both slices using dynamic shimming as compared to measuring each slice individually. This allows simultaneous acquisition of metabolite signal changes in several brain regions associated with stimulus evoked neural activity upon sensory stimulation.

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382 14:18

magna cum laude

Multiband Spectral-Spatial RF Excitation for Hyperpolarized [2-13C]Dihydroxyacetone 13C-MR Metabolism Studies

Irene Marco-Rius[1], Peng Cao[1], Cornelius von Morze[1], Matthew Merritt[2], Karlos X Moreno[3], Gene-Yuan Chang[4], Michael A Ohliger[1], David Pearce[4], John Kurhanewicz[1], Peder EZ Larson[1], and Daniel B Vigneron[1]

[1]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Department of Biochemistry and Molecular Biology, University of Florida, Gainesville, FL, United States, [3]Department of Chemistry, Engineering, Pre-Pharmacy, and Physics, South Texas College, Weslaco, TX, United States, [4]Department of Medicine, Division of Nephrology, University of California San Francisco, San Francisco, CA, United States

^{13}C-MR spectra of hyperpolarized [2-^{13}C]dihydroxyacetone (DHAc), a new agent for imaging gluconeogenesis, was acquired using specialized acquisition methods in the rat liver and kidney in vivo. Because the resonances originating from the metabolism of [2-^{13}C]DHAc have a large frequency distribution, we designed a novel spectral-spatial (SPSP), multi-band excitation pulse that corrects for chemical shift misregistration, resulting in accurate spatial-spectral selectivity. The metabolic products phosphoenolpyruvate (PEP) and glycerol 3-phosphate (G3P) were detected, evidencing metabolism of the hyperpolarized substrate towards the glycolytic pathway and activity of the enzyme glycerol 3-phosphate dehydrogenase.

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383 14:30

Compressed Sensing Accelerated MR Spectroscopic Imaging of Lactate
Rohini Vidya Shankar[1], Shubhangi Agarwal[1], and Vikram D Kodibagkar[1]

[1]*Biomedical Engineering, Arizona State University, Tempe, AZ, United States*

Lactate plays a key role in the development and progression of tumors and its spatial profile can be mapped using magnetic resonance spectroscopic imaging (MRSI). However, the long scan time involved in MRSI acquisitions is a deterrent to its inclusion in routine clinical protocols. A MRSI sequence containing lactate editing components combined with prospective compressed sensing acquisitions was developed for fast mapping of lactate metabolism, particularly in response to treatment. Results from in vivo experiments demonstrate a reduction in acquisition time by up to 80%, with the accelerated MRSI datasets maintaining high fidelity with the fully sampled reference dataset.

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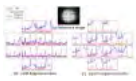
384 14:42



Low-rank based compartmentalized reconstruction algorithm for high resolution MRSI without lipid suppression methods
Ipshita Bhattacharya[1] and Mathews Jacob[1]

[1]*Department of Electrical and Computer Engineering, The University of Iowa, Iowa City, IA, United States*

A novel compartmental low rank algorithm and data acquisition method for high resolution MR spectroscopic imaging without the use of any lipid suppression methods is introduced. The field inhomogeneity compensated data is modeled as the sum of a lipid dataset and a metabolite dataset using the spatial compartmental information obtained from the water reference data. These datasets are modelled to be low-rank subspaces and are assumed to be mutually orthogonal. The high resolution spiral acquisition method achieves in plane resolution of upto 1.8x1.8 mm^2 in 7.2 mins. Recovery from these measurements is posed as a low rank recovery problem. Experiments on in-vivo data demonstrates comparable results for both lipid suppressed and lipid unsuppressed data.

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385 14:54

Ultrahigh-Resolution Metabolic Imaging at 9.4 Tesla
Fan Lam[1], Hanbing Lu[2], Yihong Yang[2], Bryan Clifford[1,3], Chao Ma[1], Gene E Robinson[4], and Zhi-Pei Liang[1,3]

[1]*Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL, United States,* [2]*Neuroimaging Research Branch, National Institute on Drug Abuse, Baltimore, MD, United States,* [3]*Department of Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States,* [4]*Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, Urbana, IL, United States*

We present a multislice short-TE 1H-MRSI method to achieve fast, ultrahigh-resolution metabolic imaging of rats on a 9.4 Tesla animal scanner. The proposed method uses a subspace-based hybrid data acquisition strategy and a low-rank-model-based image reconstruction scheme. In vivo experiments have been performed to demonstrate the feasibility of the proposed method. We are able to produce high-SNR, spatially resolved metabolic profiles from the rat brain with 1x1x2mm^3 nominal resolution in 16 minutes.

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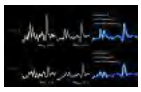
386 15:06



Overdiscrete Reconstruction in Echo-Planar Spectroscopic Imaging with Auto Calibrated B0 Field Map Estimation
Eduardo Coello[1,2], Martin Janich[2], Timo Schirmer[2], Ralf Noeske[3], Tamas Borbath[2], Axel Haase[1], and Rolf Schulte[2]

[1]*Technische Universität München, Munich, Germany,* [2]*GE Global Research, Garching, Germany,* [3]*GE Healthcare, Potsdam, Germany*

An overdiscrete reconstruction for in-vivo 3D Echo-Planar Spectroscopic Imaging (EPSI) data is used for SNR improvement and voxel bleeding reduction. We propose the estimation of a B_0 field map, which is needed for the reconstruction, using the residual water signal in the dataset. A mean SNR enhancement of a factor of 2.8 was achieved for NAA and comparable reconstruction results were obtained with both the measured and the estimated B_0 field maps.

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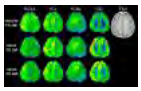
387 15:18



Metabolic mapping of the brain using ultra-high resolution MRSI at 7 T
Gilbert Hangel[1], Bernhard Strasser[2], Michal Považan[2], Lukas Hingerl[1], Marek Chmelík[2], Stephan Gruber[2], Siegfried Trattnig[2,3], and Wolfgang Bogner[2]

[1]*MR Centre of Excellence, Medical University of Vienna, Vienna, Austria,* [2]*MRCE, Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria,* [3]*Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria*

Increasing the resolution of MRSI is desirable to delineate small structures and pathologic deviations such as Multiple Sclerosis lesions and increase local B0-homogeneity per voxel. We show that using an FID-MRSI sequence with short TR and L2-regularisation for lipid contamination removal, the major brain metabolites can be mapped with a 128x128 matrix over a whole brain slice with unprecedented detail, with a nominal voxel volume of 1.7×1.7×8 mm^3. The additional application of parallel imaging allows reducing measurement times enough for potential clinical applications.

Oral

Dipoles & Dielectrics

Room 324-326 13:30 - 15:30 *Moderators:*Riccardo Lattanzi & Thoralf Niendorf

388 13:30

Numerical evaluation of the optimal coupling scheme of a cylindrical dielectric resonator operating at 600 MHz (14T)
Wei Luo[1], Rui Liu[2], Thomas Neuberger[3,4], and Michael T Lanagan[1,2]

[1]Material Research Institute, University Park, PA, United States, [2]Department of Engineering Science and Mechanics, University Park, PA, United States, [3]Huck Institute of Life Science, University Park, PA, United States, [4]Department of Biomedical Engineering, University Park, PA, United States

To maximize the energy transfer to the cylindrical dielectric resonator utilized in magnetic resonant imaging probe head, a three-loop coupling method was investigated using electromagnetic field simulations. The simulation results demonstrate the supreme performance of this coupling method and verify the previous preliminary experimental results.

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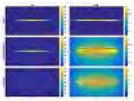
389 13:42



More than meets the eye: The mixed character of electric dipole coils, and implications for high-field performance

Daniel K Sodickson[1,2], Graham C Wiggins[1,2], Gang Chen[1,2], Karthik Lakshmanan[1], and Riccardo Lattanzi[1,2]

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

We present a fundamental electrodynamic explanation for the SNR performance of electric dipole antennae at high field. We demonstrate that typical electric dipole coils combine divergence-free and curl-free surface current components, allowing them to exceed the performance limits for either component alone. We also show that z-directed electric dipoles have a strong overlap with ideal current patterns associated with the ultimate intrinsic SNR at high field strength.

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390 13:54

Towards imaging the body at 10.5 Tesla using a fractionated dipole antenna array

M. Arcan Erturk[1], Gregor Adriany[1], Pierre-Francois Van de Moortele[1], Yigitcan Eryaman[1], Alexander J Raaijmakers[2], Lance DelaBarre[1], Edward Auerbach[1], J. Thomas Vaughan[1], Kamil Ugurbil[1], and Gregory J Metzger[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Imaging Division, UMC Utrecht, Utrecht, Netherlands

We have developed a fractionated dipole antenna (fDA) for body imaging at 10.5T, investigated its electro-magnetic field behavior in a 10-channel array using numerical simulations in a human model, and compared its performance to a 10-channel fDA array at 7.0T. The 10.5T fDA array provided similar B1+ transmit efficiency and peak 10g-averaged SAR compared to the 7.0T array inside the prostate, however had a less uniform B1+ distribution. Simulation results indicated that fDA elements have sufficient B1+ penetration at 10.5T, but B1+ non-uniformities may need to be alleviated even in small imaging targets using dynamic RF strategies including parallel transmit.

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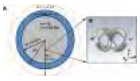
391 14:06



Disentangling Signal propagation and Noise-related Effects in the Presence of High Permittivity Materials via Ideal Current Patterns

Manushka V. Vaidya[1,2,3], Christopher M. Collins[1,2,3], Daniel K. Sodickson[1,2,3], Giuseppe Carluccio[1,2], and Riccardo Lattanzi[1,2,3]

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

There is no single mechanism to describe how high permittivity materials (HPMs) improve signal-to-noise ratio when placed between radiofrequency coils and the object. We separately investigated the effects of HPMs on signal propagation and sample noise by studying ideal current patterns, the corresponding optimal electric (***E***) field and a signal-only propagation model. Our results suggest that phase changes in the ideal current patterns with HPMs are primarily due to signal-propagation effects while their increase in size is due to reduced ***E*** field penetration into the sample, which allows larger current patterns that maximize signal reception with a limited noise penalty.

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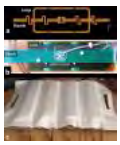
392 14:18



Combined loop-dipole transceiver array for body imaging at 7.0 Tesla

M. Arcan Erturk[1], Alexander J Raaijmakers[2], Gregor Adriany[1], Kamil Ugurbil[1], and Gregory J Metzger[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States, [2]Imaging Division, UMC Utrecht, Utrecht, Netherlands

We developed a 16-channel transceiver body array (16LD) by combining loop and dipole elements, and compared performance against 16-channel microstrip-line (16ML) and 10-channel fractionated dipole antenna (10DA) arrays. Complementary field characteristics of loop and dipole elements were utilized by symmetrically placing them along their long-axes. The loop-dipole combination allowed increased channel counts and density while limiting inter-element coupling. The 16LD had improved transmit and receive performance over the 16ML and 10DA in both simulations and experiments. Images of the prostate, kidneys and heart were acquired showing the potential of the 16LD to successfully image targets throughout the body at 7.0T.

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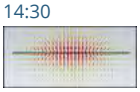
393 14:30



Modular 7 Tesla transmit/receive arrays designed using thin very high permittivity dielectric resonator antennas

Thomas O'Reilly[1], Thomas Ruytenberg[1], Bart Steensma[2], Alexander Raaijmakers[2], and Andrew Webb[1]

[1]Leiden University Medical Centre, Leiden, Netherlands, [2]Utrecht Medical Centre, Utrecth, Netherlands

A transmit/receive dielectric resonator antenna array has been designed for operation at 7 Tesla. By using very thin high permittivity material the inter-element coupling is very low, allowing small resonators to be placed very close to one another. An eight-element array has been simulated and constructed, and in vivo images of the extremities acquired.

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394 14:42

Practical improvements in the design of high permittivity pads for dielectric shimming in 7T neuroimaging
Thomas O'Reilly[1], Wyger Brink[1], and Andrew Webb[1]

[1]Leiden University Medical Centre, Leiden, Netherlands

Improvements are proposed for practical use of high permittivity materials in high field neuroimaging. These result in a simple formula to design materials with specified permittivity, formulation to improve the short term rigidity and long term stability of the material, and a method to incorporate devices such as headphones into the dielectric pad design.

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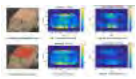
395 14:54



Body imaging at 7 Tesla with much lower SAR levels: an introduction of the Snake Antenna array
Bart Steensma[1], Alexa Viviana Obando Andrade[2], Dennis Klomp[1], Nico van den Berg[1], Peter Luijten[1], and Alexander Raaijmakers[1]

[1]University Medical Centre Utrecht, Utrecht, Netherlands, [2]TU Delft, Utrecht, Netherlands

The snake antenna is introduced as a novel transmit array element for body-imaging at ultrahigh-field strengths. It has been shown in simulations that the snake antenna causes a very low local peak SAR compared to the fractionated dipole antenna, while maintaining sufficient B_1^+-signal strength. In vivo prostate scans show that the snake antenna array reaches a B1+-signal strength in the prostate that is slightly higher than the signal strength reached by the fractionated dipole antenna array. The lower SAR of the snake antenna considerably relaxes scanning constraints for body imaging.

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396 15:06

Prospect of SNR and SAR Improvement on a Whole-body Human 10.5T Scanner using High Dielectric Material
Sebastian Rupprecht[1], Hannes M Wiesner[2], Pierre-Francois van De-Mortelle[2], Byeong-Yeul Lee[2], Wei Luo[3], Xiao-Hong Zhu[2], Isaiah Duck[1], Gregor Adriany[2], Christopher Sica[1], Kamil Ugurbil[2], Michael Lanagan[3], Wei Chen[2], and Qing Yang[1]

[1]Department of Radiology, The Pennsylvania State University College of Medicine, Hershey, PA, United States, [2]Radiology Department, Center for Magnetic Resonance Research, Minneapolis, MN, United States, [3]Department of Engineering Sciences and Mechanics, The Pennsylvania State University, State College, PA, United States

We compared and characterized the RF field wave behavior for human brain imaging at 10.5T and 7T. Additionally we explored the feasibility of using monolithic high dielectric constant materials to potentially further enhance SNR and circumvent SAR limitations and show that there can be great benefits through phantom experiments and computer modeling.

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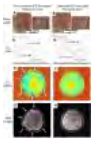
397 15:18



Optimized ICE-decoupled Monopole Array for Human Head Imaging at 7T
Xinqiang Yan[1] and Xiaoliang Zhang[2]

[1]Key Laboratory of Nuclear Analysis Techniques, Institute of High Energy Physics, Chinese Academy of Sciences, Beijing, China, People's Republic of, [2]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States

Induced current elimination (ICE) method has proved to be a useful approach in decoupling radiative monopole and dipole arrays. In this study, we aim to investigate the effect of ICE decoupling elements and their position to the B_1 fields. The MR imaging and simulation results show that an optimized arrangement of ICE decoupling elements can be found to minimize the perturbation of decoupling elements. Compared with the non-optimized ICE decoupled monopole array, the optimized array has more homogeneous transmit field and has no dark spots or signal cancellations in the MR images.

Oral

Breast Disease & Cancer

Room 334-336 13:30 - 15:30 *Moderators:*Ritse Mann & Katja Pinker

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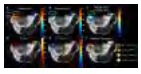
398 13:30



Assessment of tumor perfusion, oxygenation, and metabolism using DCE, BOLD, and hyperpolarized 13C MRI in a mouse model of breast cancer
Erin B Adamson[1], Roberta M Strigel[1,2,3], David J Niles[1], Kai D Ludwig[1], Ben L Cox[1,4,5], Amy R Moser[2,6], and Sean B Fain[1,3,7]

[1]Medical Physics, University of Wisconsin-Madison, Madison, WI, United States, [2]Carbone Cancer Center, University of Wisconsin-Madison, Madison, WI, United States, [3]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [4]Morgridge Institute for Research, Madison, WI, United States, [5]Laboratory for Optical and Computational Instrumentation, University of Wisconsin-Madison, Madison, WI, United States, [6]Human Oncology, University of Wisconsin-Madison, Madison, WI, United States, [7]Biomedical Engineering, University of Wisconsin-Madison, Madison, WI, United States

Hyperpolarized (HP) ^{13}C MRSI, dynamic contrast-enhanced (DCE) MRI, and blood-oxygen-level dependent (BOLD) MRI have the potential to non-invasively characterize tumor metabolism, perfusion, and oxygenation, respectively, and aid in the development of individualized treatment plans for cancer patients. However, a regional comparison of these non-invasive techniques for probing the tumor

microenvironment has not been explored. This work aims to test the feasibility of performing quantitative, spatial analysis and comparison of HP ^{13}C MRSI and BOLD and DCE MRI in a murine breast cancer model.

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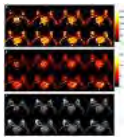
399 13:42



3D Magnetic Resonance Fingerprinting for Quantitative Breast Imaging

Yong Chen[1], Shivani Pahwa[1], Jesse Hamilton[2], Sara Dastmalchian[1], Donna Plecha[3], Nicole Seiberlich[2], Mark Griswold[1], and Vikas Gulani[1]

[1]Department of Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [3]Department of Radiology, University Hospitals Case Medical Center, Cleveland, OH, United States

In this study, a rapid relaxometry method was developed for breast imaging using the MRF technique, which allows simultaneous and volumetric quantification of T_1 and T_2 relaxation times for breast tissues.

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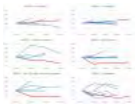
400 13:54



Breast tissue lipid and metabolite deregulation precedes malignant transformation in women with BRCA gene mutations: a longitudinal study

Gorane Santamaria[1], Jessica Buck[2,3], Leah Best[4], David Clark[5], Judith Silcock[5], Peter Lau[4], Saadallah Ramadan[6], Scott Quadrelli[3,7], Peter Malycha[3], and Carolyn Mountford[3]

[1]Hospital Clinic de Barcelona, Barcelona, Spain, [2]Oxford University, Oxford, United Kingdom, [3]Translational Research Institute, Brisbane, Australia, [4]Hunter New England Area Health, Newcastle, Australia, [5]The Breast and Endocrine Centre, Gateshead, Gateshead, Australia, [6]University of Newcastle, Australia, Newcastle, Australia, [7]Queensland University of Technology, Brisbane, Australia

Women carrying the BRCA1 and BRCA2 gene mutations exhibited lipid and metabolite profiles consistent with very early deregulation recorded earlier in cancer cell models. The deregulation was different for BRCA1 and BRCA2. Here we report a longitudinal study where these same women are monitored every six month using the L-COSY MRS method and every 12 month with contrast enhanced MRI. For most women in the study the biomarkers remained relatively stable over time. Of the 6 BRCA1 and 10 BRCA2 patients examined, one BRCA1 patient and one BRCA2 patient showed further deregulation.

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401 14:06

Fat-Based Registration of Breast DCE Water Images

Subashini Srinivasan[1], Brian A Hargreaves[1], and Bruce L Daniel[1]

[1]Radiology, Stanford University, Stanford, CA, United States

Three-dimensional breast dynamic contrast-enhanced imaging is susceptible to deformable motion and affects both semi-quantitative and pharmacokinetic parameters. B-Spline motion registration with a mutual information metric is often used to register DCE images but is sometimes susceptible to introduction of new motion. Here we have introduced a fat-based motion registration, using a mean-squared-difference signal metric, to register the water images without introducing new motion. The acquired images and both registration methods were qualitatively assessed in 16 breasts. Voxel-by-voxel pharmacokinetic mapping was also performed in 21 tumors. Our results show that fat-based registration can be used to register the water images with improved image quality and reduced errors in quantification.

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402 14:18

gagCEST imaging in patients with breast tumors at 7 Tesla - preliminary results

Olgica Zaric[1], Katja Pinker-Domenig[2,3], Esau Poblador [1], Vadimir Mlynarik[1], Thomas Helbich[4], Siegfrid Trattnig[1,5], and Wolfgang Bogner[1]

[1]High Field Magnetic Resonance Centre, Medical University of Vienna, Vienna, Austria, [2]Department of Biomedical Imaging and Image-guided Therapy, Medical University Vienna, Vienna, Austria, [3]Molecular Imaging and Therapy Service, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria, [5]Christian Doppler Lab for Clinical Molecular MRI, Christian Doppler Forschungsgesellschaft, Vienna, Austria, Vienna, Austria

Proteoglycans content in malignant tumors may provide information regarding the altered metabolism and neoplastic cell behavior. The aim of this study was to investigate the feasibility of gagCEST imaging in patients with breast tumors at 7 Tesla. Eleven patients with 15 lesions were examined. gagCEST imaging was performed with 1.7mm in-plane resolution and nine minutes of measurement time. Results based on MTRasym showed excellent differentation between malignant and benign lesions (CI=95%, p=0.001) and insignificant difference between benign and healthy tissue (CI=95%, p=0.159). gagCEST has a great potential in breast tumors evaluations providing substantially different information obtained with standard MRI techniques.

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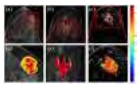
403 14:30



Directional-gradient based radiogenomic descriptors on DCE-MRI appear to distinguish different PAM50-identified subtypes of HER2+ Breast Cancer

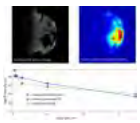
Prateek Prasanna[1], Nathaniel Braman[1], Salendra Singh[1], Donna Plecha[2], Hannah Gilmore[2], Lyndsay Harris[2], Tao Wan[3], Vinay Varadan[1], and Anant Madabhushi[1]

[1]Case Western Reserve University, Cleveland, OH, United States, [2]University Hospitals, Cleveland, OH, United States, [3]Beihang University, Beijing, China, People's Republic of

We present the initial results of using a novel radiogenomic descriptor, CoLlAGe, on breast DCE-MRI to identify associations with HER2+ breast cancer subtypes. Current method involves using a PAM50 assay to analyze primary tumor tissues. CoLlAGe is a quantitative measurement of the degree of order/disorder of localized image gradient orientations. We extract CoLlAGe entropy from the regions of interest. Unsupervised hierarchical clustering of the entropy statistics show that we can segregate the cohort into three distinct

subtypes (enriched, basal and luminal), as identified by PAM50 assay. CoLlAGe resulted in higher clustering accuracy as compared to pharmacokinetic parameters and signal intensities.

404 14:42



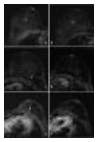
Rapid high-resolution sodium relaxometry in human breast

Glen Morrell[1], Josh Kaggie[2], Matthew Stein[1], Scott Parker[1], and Neal Bangerter[3]

[1]Radiology, University of Utah, Salt Lake City, UT, United States, [2]Radiology, University of Cambridge, Cambridge, United Kingdom, [3]Electrical and Computer Engineering, Brigham Young University, Provo, UT, United States

We have performed rapid high-resolution breast sodium MRI relaxometry using a custom sodium breast phased array coil. Clear delineation of short- and long-T2* components of the sodium signal is possible with a spatial resolution of 3.75 x 3.75 x 4mm over the entire breast with a total imaging time of under 10 min. This method will allow the investigation of the potential of sodium relaxometry to improve the specificity of breast MRI for the detection of breast cancer.

405 14:54



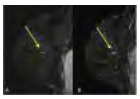
The performance of MRI screening in the detection of breast cancer in an intermediate and high risk screening program

Suzan Vreemann[1], Albert Gubern-Merida[1], Susanne Lardenoije[1], Nico Karssemeijer[1], and Ritse M. Mann[1]

[1]Radiology and Nuclear Medicine, Radboudumc, Nijmegen, Netherlands

Women at increased risk for breast cancer require annual mammography and MRI. The purpose of this study is to evaluate cancers detected in MRI screening and assess the visibility on prior MRI-examinations. MRI-scans of breast cancers detected in our MRI screening program were re-evaluated and lesions on the diagnostic MRI and prior MRI were scored according to Breast Imaging Reporting and Data (BI-RADS) MR-lexicon. The visibility of the lesions on the prior MRI was rated as visible, minimal sign and invisible. Our results show that almost one third of the breast cancers should have been recalled based on consensus review.

406 15:06



Comparison of Conventional DCE-MRI and a Novel Golden-Angle Radial Compressed-Sensing and Parallel Imaging Method for the Evaluation of Breast Lesion Conspicuity and Morphology

Laura Heacock[1], Yiming Gao[1], Samantha Heller[1], Amy Melsaether[1], Sungheon Kim[1,2], and Linda Moy[1]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States

GRASP DCE-MRI (Golden-angle Radial Sparse Parallel) DCE-MRI allows simultaneous high spatial and temporal resolution. The purpose of this study was to evaluate breast lesion conspicuity between GRASP and conventional Cartesian sampling DCE-MRI. Readers assessed conspicuity of 48 biopsy-proven lesions on conventional DCE-MRI and subsequent GRASP biopsy. No significant difference was found between the two techniques for all lesions (p=0.21, p=0.19, p=0.46), masses (p=1.0, p=0.48, p=0.7) or NME (p=0.18,p=0.08, p=0.64). There was strong reader agreement in evaluating conspicuity (ICC=0.735). GRASP DCE-MRI is comparable to conventional DCE-MRI imaging for masses and NME with diagnostic-quality high spatial resolution and flexibility of temporal resolution.

407 15:18

magna cum laude

Different anti-angiogenic drugs have different effects on the relationship between vascular structure and function in a patient-derived breast cancer model

Eugene Kim[1], Jana Cebulla[1], Astrid Jullumstrø Feuerherm[2], Berit Johansen[2], Olav Engebråten[3], Gunhild Mari Mælandsmo[3], Tone Frost Bathen[1], and Siver Andreas Moestue[1]

[1]MR Cancer Group, Department of Circulation and Medical Imaging, Norwegian University of Science and Technology, Trondheim, Norway, [2]Avexxin AS, Department of Biology, Norwegian University of Science and Technology, Trondheim, Norway, [3]Department of Tumor Biology, Institute for Cancer Research, Oslo University Hospital, Oslo, Norway

This study investigated the relationship between tumor vascular function (DCE-MRI) and structure (ex vivo micro-CT). Control tumors did not exhibit any significant correlations between micro-CT and DCE-MRI parameters. Tumors treated with bevacizumab or a cPLA2 inhibitor (AVX235), both anti-angiogenic drugs, displayed reduced perfusion and vascularization. But interestingly, there was a significant positive correlation between vascular surface area and Ktrans in AVX235-treated tumors, whereas the corresponding correlation was negative in bevacizumab-treated tumors. This suggests that different therapies can differentially modulate the vascular structure-function relationship, which highlights the challenge in interpreting DCE-MRI measurements and adopting them as clinical biomarkers of therapeutic response.

Oral

CV Innovations

Room 334-336 13:30 - 15:30 *Moderators*:Rene Botnar & Mathias Stuber

408 13:30

3D black-blood thrombus imaging (BTI) for the diagnosis of deep vein thrombosis: initial clinical experience

Guoxi Xie[1], Hanwei Chen[2], Zhuonan He[2], Jianke Liang[2], Xueping He[2], Qi Yang[3,4], Xin Liu[1], Debiao Li[3], and Zhaoyang Fan[3]

[1]Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences, Shenzhen, China, People's Republic of, [2]Department of Radiology,

Guangzhou Panyu Central Hospital, Guangzhou, China, People's Republic of, [3]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [4]Xuanwu Hospital, Beijing, China, People's Republic of

Deep vein thrombosis (DVT) is a common but elusive illness that can lead to fatal pulmonary embolism and sudden death. Effective treatment of DVT requires accurate evaluation of thrombus distribution and stage. n this work, we further accommodated the DANTE-SPACE technique to the deep vein system and conducted preliminary clinical validation. Experiment results demonstrated that DANTE-SPACE could provide excellent venous blood signal suppression and definitive thrombus detection and the technique may outperform conventional SPACE, MPRAGE, and and become a non-contrast alternative to CEMRV for the diagnosis of DVT.

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409 13:42

A Combined Saturation and Imaging RF-Pulse for Fast and Continuous Black-Blood Preparation in Dynamic Imaging

Simon Reiss[1], Axel Joachim Krafft[1,2,3], Marius Menza[1], Constantin von zur Mühlen[4], and Michael Bock[1]

[1]Dept. of Radiology - Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]German Cancer Consortium (DKTK), University Medical Center Freiburg, Heidelberg, Germany, [3]German Cancer Research Center (DKFZ), Heidelberg, Germany, [4]Department of Cardiology and Angiology I, University Heart Center, Freiburg, Germany

Black-blood preparation is a tool for improved contrast generation in cardiovascular MRI to assess vessel wall constitution, to delineate plaques and to characterize myocardial tissue. Conventionally, black-blood MRI can be done with dual inversion recovery pulses so that selective signal nulling of the inflowing blood is achieved. The inversion delays required to establish the black-blood contrast can be favorably integrated into ECG-triggered diastolic cardiac measurements, but they are by far too time-consuming for dynamic measurements that cover the total cardiac cycle. In this work we investigate the use of conventional saturation pulses for black-blood imaging. We propose a very time-efficient pulse implementation that combines the saturation and the imaging RF pulse into a single pulse structure and enables black-blood contrast in dynamic measurements.

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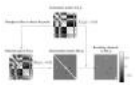
410 13:54



A Novel Method for Contact-Free Cardiac Synchronization Using the Pilot Tone Navigator

Lea Schroeder[1], Jens Wetzl[1,2], Andreas Maier[1,2], Lars Lauer[3], Jan Bollenbeck[4], Matthias Fenchel[3], and Peter Speier[3]

[1]Pattern Recognition Lab, Department of Computer Science, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [2]Erlangen Graduate School in Advanced Optical Technologies, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [3]Magnetic Resonance, Product Definition and Innovation, Siemens Healthcare GmbH, Erlangen, Germany, [4]Magnetic Resonance, Research and Development, Hardware, Siemens Healthcare GmbH, Erlangen, Germany

We evaluate the information content of externally generated Pilot Tone signals, received with standard MR local coils, with respect to cardiac motion. Free-breathing and breathhold fluoroscopic measurements were performed with applied electrocardiogram leads to provide ground truth. Average mean correlation between RR intervals of our method and the ground truth was 0.95. Our early results indicate that locally generated PT signals contain information about cardiac motion and suggest that the proposed method could be developed into an electrocardiogram replacement by providing a continuous signal for retrospective gating with minimal hardware requirements.

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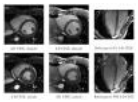

Free-Breathing, Self-Navigated Isotropic 3-D CINE Imaging of the Whole Heart Using Cartesian Sampling

Jens Wetzl[1,2], Felix Lugauer[1], Michaela Schmidt[3], Andreas Maier[1,2], Joachim Hornegger[1,2], and Christoph Forman[3]

[1]Pattern Recognition Lab, Department of Computer Science, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [2]Erlangen Graduate School in Advanced Optical Technologies, Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany, [3]Magnetic Resonance, Product Definition and Innovation, Siemens Healthcare GmbH, Erlangen, Germany

We present a method for free-breathing, isotropic 3-D CINE imaging of the whole heart, demonstrated with experiments in 7 healthy volunteers. Respiratory information for retrospective gating is derived directly from the imaging data. Ventricular function parameters were compared to reference 2-D CINE acquisitions. Excellent image quality and match to ground truth ventricular function parameters could be achieved in an acquisition time similar to multi-slice 2-D CINE with equivalent coverage. Cartesian sampling combined with dual-GPU acceleration enabled a fast reconstruction in under 5 minutes for left-ventricular and under 7 minutes for whole heart coverage.

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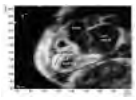

Using intrinsic Cardiac Shear Waves to measure Myocardial Stiffness: Initial results on a Patient Cohort with Heart failure with preserved Ejection Fraction

Jessica Webb[1], Ondrej Holub[1], Rachel Clough[1], Gerald Carr-White[2], Reza Razavi[1], and Ralph Sinkus[1]

[1]King's College London, London, United Kingdom, [2]Guys and St Thomas' NHS Trust, London, United Kingdom

Heart Failure with preserved Ejection Fraction (HFpEF) is common and associated with high morbidity and mortality. There are challenges in diagnosing HFpEF and a non invasive technique to detect myocardial stiffness would have an enormous clinical impact.

We have developed a novel non invasive technique to quantify myocardial stiffness in vivo using transient Magnetic Resonance Elastography (tMRE). The technique relies on accurately identifying the aortic valve closure time. The speed of the propagating shear wave, created by the valve closure, is measured using a short navigated free breathing MRI sequence. Increased myocardial stiffness results in increased speed of shear wave propagation.

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413 14:30

Three-Dimensional Modelling of the Fetal Vasculature from Prenatal MRI using Motion-Corrected Slice-to-Volume Registration

David F A Lloyd[1,2], Bernhard Kainz[3], Joshua F P van Amerom[1], Kuberan Pushparajah[1,2], John M Simpson[2], Vita Zidere[2], Owen Miller[2], Gurleen Sharland[2], Tong Zhang[1], Maelene Lohezic[1], Joanne Allsop[1], Matthew Fox[1], Christina Malamateniou[1], Mary Rutherford[1], Jo Hajnal[1], and Reza Razavi[1,2]

[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Evelina Children's Hospital, London, United Kingdom, [3]Department of Computing (BioMedIA), Imperial College London, London, United Kingdom

The diagnosis of potentially life-threatening vascular abnormalities in the fetus can be difficult with ultrasound alone. MRI is one of the few safe alternative imaging modalities in pregnancy; however to date it has been limited by unpredictable fetal and maternal motion during acquisition. We present six antenatal cases, four with important structural congenital heart disease, in which we employed a novel algorithm for motion-corrected slice-volume registration, producing a navigable 3D volume of the fetal thoracic vasculature. The anatomical findings in each case were then correlated to fetal echocardiographic findings, and finally displayed as interactive surface rendered models.

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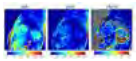
414 14:42

magna cum laude



The Physiological Noise Contribution to Temporal Signal-to-Noise Increases with Decreasing Resolution and Acceleration in Quantitative CMR

Terrence Jao[1] and Krishna Nayak[2]

[1]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Electrical Engineering, Los Angeles, CA, United States

Advances in MR hardware, pulse sequences, and calibration have made quantitative CMR a reality. Quantitative maps (e.g. T1, T2, ECV) are formed from multiple images, which make them susceptible to errors caused by signal fluctuations from cardiac or respiratory motion, termed physiological noise. Reproducibility of quantitative CMR maps is critical for future clinical adoption and depends on the ratio of signal amplitude to physiological noise, termed temporal SNR. In this study, we measure temporal SNR in bSSFP quantitative CMR to characterize physiological noise for a range of image resolutions, acceleration factors, and post inversion delays.

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415 14:54

Multi-Resolution Registration and Segmentation for cardiac BOLD MRI

Ilkay Oksuz[1,2], Rohan Dharmakumar[3,4], and Sotirios A. Tsaftaris[2,5]

[1]Diagnostic Radiology, Yale University, New Haven, CT, United States, [2]IMT Institute for Advanced Studies Lucca, Lucca, Italy, [3]Biomedical Imaging Research Institute, Cedars Sinai Medical Center, Los Angeles, CA, United States, [4]University of California, Los Angeles, CA, United States, [5]The University of Edinburgh, Edinburgh, United Kingdom

Cardiac Phase-resolved Blood Oxygen-Level-Dependent (CP-BOLD) MRI is a new contrast and stress-free approach for detecting myocardial ischemia, that identifies the ischemic myocardium by examining changes in myocardial signal intensity patterns as a function of cardiac phase. But, these changes coupled with cardiac motion, challenge automated standard CINE MR myocardial segmentation and registration techniques resulting in a significant drop of segmentation and registration accuracy. We propose a dictionary learning based multi-resolution registration scheme for supervised learning and sparse representation of the myocardium. Our results show an improvement of 15% myocardial segmentation w.r.t. the state of the art.

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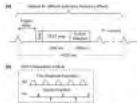
416 15:06



Optimized Cardiac CEST MRI for Assessment of Metabolic Activity in the Heart

Zhengwei Zhou[1,2], Yuhua Chen[3], Yibin Xie[1], Christopher Nguyen[1], Mu Zeng[4], James Dawkins[5], Zhanming Fan[4], Eduardo Marbán[5], and Debiao Li[1,2,5]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Department of Bioengineering, University of California, Los Angeles, Los Angeles, CA, United States, [3]Department of Computer and Information Science, University of Pennsylvania, Philadelphia, PA, United States, [4]Department of Radiology, Anzhen Hospital, Capital Medical University, Beijing, China, People's Republic of, [5]Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States

In this work, we developed an optimized cardiac CEST method to detect myocardial metabolic change with significantly reduced scan time. Our initial results in porcine model with chronic myocardial infarction show that scar region has lower metabolic activity compared to healthy myocardium, using LGE as reference. This study also shows the feasibility of cardiac CEST imaging in a patient, for the first time.

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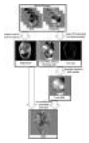


In vivo Quantitative Susceptibility Mapping (QSM) in cardiac MRI

Yan Wen[1], Thanh D. Nguyen[2], Zhe Liu[1], Pascal Spincemaille[2], Dong Zhou[2], Alexey Dimov[1], Youngwook Kee[2], Jiwon Kim[3], Jonathan W. Weinsaft[3], and Yi Wang[1,2]

[1]Biomedical Engineering, Cornell University, New York, NY, United States, [2]Physics in Radiology, Weill Cornell Medicine, New York, NY, United States, [3]Medicine, Weill Cornell Medicine, New York, NY, United States

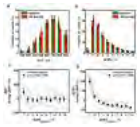
Quantitative Susceptibility Mapping (QSM) has yet to be applied on cardiac patients due to the challenges from motion artifacts and background fields. In this first attempt to apply QSM in cardiac MRI, we overcome these data acquisition and processing challenges by using robust graph cut phase analysis and a novel preconditioned inversion of total field. Our preliminary results demonstrate high quality susceptibility maps, and the measured heart chamber blood oxygenation level is consistent with reported values from literature.

Oral

Normal Brain Physiology

Hall 606 | 13:30 - 15:30 | *Moderators:*Manus Donahue & Peiying Liu

418 | 13:30



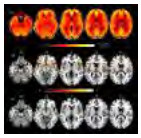
A differential arterial blood volume response during Lower Body Negative Pressure measured using Pulsed Arterial Spin Labelling with multiple short inversion times

Joseph R Whittaker[1], Molly G Bright[1,2], Ian D Driver[1], Adele Babic[1,3], Martin Stuart[1], and Kevin Murphy[1]

[1]CUBRIC, School of Psychology, Cardiff University, Cardiff, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, University of Nottingham, Nottingham, United Kingdom, [3]Department of Anesthesia and Intensive Care Medicine, Cardiff University School of Medicine, Cardiff, United Kingdom

A custom made MRI compatible lower body negative pressure (LBNP) chamber induced central hypovolemia in a group of healthy volunteers. Pulsed ASL data with multiple short inversion times was acquired during a baseline period and -40mmHg LBNP in order to estimate arterial cerebral blood volume changes related to cerebral autoregulation. We found a differential response, in which arterial blood volume changes during LBNP were dependent on vessel size. These data provide a useful first step for fully understand the complex vascular changes that occur in the brain to maintain perfusion during systemic physiological perturbations.

419 | 13:42



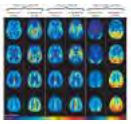
Short-term cerebral blood flow reduction induced “apparent” brain tissue density reduction

Qiu Ge[1], Wei Peng[1], Yong Zhang[2], Yu-Feng Zhang[1], Thomas Liu[3], Xuchu Weng[1], and Ze Wang[1]

[1]Hangzhou Normal University, Hangzhou, China, People's Republic of, [2]GE Healthcare, MR Research China, Beijing, Shanghai, China, People's Republic of, [3]University of California San Diego, San Diego, CA, United States

MRI-identified short-term brain tissue changes have been in debate because of the lack of solid evidence of neurogenesis. Cerebral blood flow (CBF) has been traced as one contributing factor. We used caffeine to modulate CBF and to subsequently examine brain tissue change using MRI. Both CBF reduction and grey matter decrease were observed after caffeine ingestion, which were further related to each other in some brain regions. The data provide direct evidence for the CBF contribution to the short-term apparent tissue changes.

420 | 13:54



Rethinking macro-vascular artifacts from single post-label delay ASL: can we extract a "free-lunch" arterial transit time metric?

Henk Mutsaerts[1], Lena Vaclavu[2], Jan-Willem van Dalen[2], Andrew Robertson[1], Paul Groot[2], Mario Masellis[1], Edo Richard[2], Aart J Nederveen[2], and Bradley MacIntosh[1]

[1]Sunnybrook Research Institute, Toronto, ON, Canada, [2]Academic Medical Center, Amsterdam, Netherlands

In this work, we propose a novel method to infer an ATT estimate from the spatial signal distribution of single-time point ASL CBF maps, using a spatial Coefficient of Variation (CoV). In a large population of elderly with hypertension, we compare crushed (C CBF) and non-crushed CBF maps (NC CBF), from which we derive C CoV and NC CoV, and the FEAST-based ATT estimate. These explorative results show that both ATT and BMI are associated with NC CoV but not with NC CBF, suggesting that ATT – as estimated by the spatial CoV – might serve as a global biomarker of cerebrovascular disease.

421 | 14:06

Traffic and cargo on the venous highway: distribution of venous flow and oxygenation in the human brain.

Jill B. De Vis[1], Hanzhang Lu[2], Harshan Ravi[2], Jeroen Hendrikse[1], and Peiying Liu[3]

[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [3]Radiology, Johns Hopkins University Medical Center, Baltimore, MD, United States

Arterial territory and flow have been well studied, but few studies have been performed to investigate the venous flow distribution. Similarly, little is known about the oxygenation and its heterogeneity among the different venous structures. The purpose of this study was to investigate venous flow distribution and oxygenation.

422 | 14:18

Using 3D ASL to assess the change of cerebral blood flow at high altitude: a longitudinal study

Wenjia Liu[1], Bing Wu[2], Dandan Zheng[2], Xin Lou[1], Yulin Wang[1], Li Zheng[3], Jie Liu[4], and Lin Ma[1]

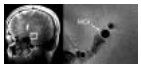
[1]Department of Radiology, PLA General Hospital, Beijing, China, People's Republic of, [2]GE Healthcare, MR Research China, Beijing, Beijing, China, People's Republic of, [3]Biomedical Engineering, Peking university, Beijing, China, People's Republic of, [4]General Hospital of Tibetan Military Area Command, Lhasa, China, People's Republic of

Although cerebral blood flow(CBF) at high altitude have been researched for years, most previous studies are limited by the use of transcranial Doppler. The conclusion of changes in CBF depend on the assumption that the middle cerebral arterial diameter does not alter in hypoxia, but recent studies suggesting that this is not the case. In our study, CBF was measured by 3D arterial spin labeling (ASL) technique at sea level and high altitude in order to seek the cerebrovascular response to altitude environment.

423 | 14:30

Imaging Changes in Cross-Sectional Area of the Middle Cerebral Artery through the Cardiac Cycle at 7 Tesla

Esther AH Warnert[1], Jasper Verbree[2], Richard G Wise[1], and Matthias JP van Osch[2]



[1]Cardiff University Brain Research Imaging Centre, Cardiff University, Cardiff, United Kingdom, [2]Radiology, Leiden University Medical Center, Leiden, Netherlands

Arterial stiffness is an important marker for cerebrovascular health, as increased stiffness can lead to a range of cerebrovascular pathologies. A non-invasive assessment of cerebral arterial stiffness could therefore be an important imaging marker for cerebrovascular health. Here we show the feasibility of using high field MRI to non-invasively assess cerebral arterial stiffness by measuring the changes in cross-sectional area of the middle cerebral artery throughout the cardiac cycle.

424

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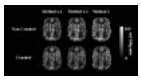

Impact of calibration method on the reproducibility of CBF mapping using multiple post-labeling-delay PASL

Joana Pinto[1], Pedro Vilela[2], Michael A. Chappell[3], and Patrícia Figueiredo[1]

[1]ISR-Lisboa/LARSyS and Department of Bioengineering, Instituto Superior Técnico – Universidade de Lisboa, Lisbon, Portugal, [2]Imaging Department, Hospital da Luz, Lisbon, Portugal, [3]Institute of Biomedical Engineering, University of Oxford, Oxford, United Kingdom

Absolute CBF quantification using ASL requires the normalization of the control-label difference images by the equilibrium magnetization, M0. A voxelwise calibration method is currently recommended for single post-labelling-delay (PLD) PCASL. However, the impact of using an M_{0t} map obtained directly from the ASL data, with no need for an extra scan, by fitting a saturation-recovery curve to the control image time-series in multiple-PLD PASL remains to be investigated. Here, we show that, using this type of acquisition, voxelwise calibration significantly reduced inter- and intra-subject variability in gray matter CBF measurements relative to methods based on a reference tissue.

425

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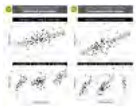

Regional differences in absolute metabolite level couplings in a longitudinal study of children

Martha J Holmes[1], Frances C Robertson[1], Francesca Little[2], Mark F Cotton[3], Els Dobbels[3], Andre JW van der Kouwe[4,5], Barbara Laughton[3], and Ernesta M Meintjes[1]

[1]MRC/UCT Medical Imaging Research Unit, Department of Human Biology, University of Cape Town, Cape Town, South Africa, [2]Department of Statistical Sciences, University of Cape Town, Cape Town, South Africa, [3]Children's Infectious Diseases Clinical Research Unit, Department of Paediatrics & Child Health, Tygerberg Children's Hospital and Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa, [4]A.A. Martinos Centre for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [5]Department of Radiology, Harvard Medical School, Boston, MA, United States

1H-MRS non-invasively quantifies metabolites that play important roles in neurodevelopment. The physiological functions of these metabolites, however, are still debated. Examining the regional intercorrelations between metabolites such as NAA, creatine, choline and glutamate provides insight about the role of individual and coupled biochemicals in the developing brain. We examined correlations between pairs of metabolites in the midfrontal gray matter (MFGM), peritrigonal white matter (PWM), basal ganglia (BG) at 5, 7 and 9 years in a cohort of South African children. We found significant metabolite couplings in both the MFGM and PWM, however no significant couplings were observed in the BG.

426

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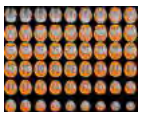


Differential effects of ketamine-propofol vs propofol anaesthesia on cerebral perfusion in children

Ruth L O'Gorman[1], Philipp Buehler[2], Carola Sabandal[2], Ianina Scheer[3], Malek Makki[1], Markus Weiss[2], Christian Kellenberger[3], and Achim Schmitz[2]

[1]Center for MR Research, University Children's Hospital, Zurich, Switzerland, [2]Anaesthesia, University Children's Hospital, Zurich, Switzerland, [3]Radiology, University Children's Hospital, Zurich, Switzerland

Anaesthetics such as those used for sedation in pediatric MRI affect cerebral blood flow and hemodynamics to varying degrees. This study examines differences in cerebral perfusion in children undergoing elective MRI under sedation with propofol vs. a combination of propofol and ketamine. Children induced for sedation with ketamine demonstrated on average 14% higher whole brain perfusion values than those induced for sedation with propofol, confirming that ketamine and propofol exert a differential effect on brain activity and hemodynamics.

427

15:18

Evidencing different neurochemical profiles between thalamic nuclei using 2D-semilaser 1H-MRSI at 7T

Maxime Donadieu[1,2,3], Yann Le Fur[1,2], Sylviane Confort-gouny[1,2], Arnaud Le Troter[1,2], Maxime Guye[1,2], and Jean-Philippe Ranjeva[1,2]

[1]CRMBM UMR 7339, Aix Marseille Université CNRS, Marseille, France, Metropolitan, [2]CEMEREM Pole d'Imagerie, AP-HM CHU Timone, Marseille, France, Metropolitan, [3]Siemens Healthcare, Saint-Denis, France, Metropolitan

Using 2D-semilaser 1H-MRSI sequence centered on thalamus and acquired at 7T in 10 healthy volunteers, we demonstrate that the neurochemical profiles (relative NAA, Cr and Cho levels) are different between pulvinar, ventral-lateral, dorsal-medial and anterior nuclei. Moreover, left/right differences in neurochemical profiles, especially for NAA levels, showed a left NAA lateralization for the ventral-lateral nucleus and the pulvinar and in contrast higher right NAA levels in the anterior nucleus. These results suggest that the various neurochemical profiles of these thalamic nuclei may be related to their functional specificity.

Fingerprinting

Summit 1 | 13:30 - 15:30 | *Moderators:*Mariya Doneva

428 | 13:30

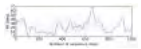
Pseudo Steady State Free Precession for MR-Fingerprinting

Jakob Assländer[1], Steffen Glaser[2], and Jürgen Hennig[1]

[1]Dept. of Radiology - Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]Dept. of Chemistry, Technische Universität München, Munich, Germany

This work discusses steady state issues in SSFP-based fingerprinting sequences. It is shown that variations of the flip angle destroy the steady state, causing instabilities with respect to intra-voxel dephasing. A pseudo steady state can be achieved by adapting TR and TE to a given flip angle pattern, restoring the typical SSFP behavior. Furthermore, an iterative reconstruction algorithm for fingerprinting data is proposed.

429 | 13:42



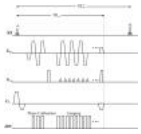
Towards Judging the Encoding Capability of Magnetic Resonance Fingerprinting Sequences

Karsten Sommer[1], Thomas Amthor[1], Peter Koken[1], Mariya Doneva[1], and Peter Börnert[1]

[1]Philips Research Europe, Hamburg, Germany

A key question of magnetic resonance fingerprinting (MRF) is the appropriate choice of sequence parameters to achieve a high sensitivity to the tissue parameters of interest. In this contribution, different candidates for a measure of MRF sequence encoding capability are evaluated. While interpretation of measures that rely on local or global dot products proved difficult, a 'brute force' Monte Carlo approach showed good agreement with experimental results. By restricting this Monte Carlo method to small local dictionaries, substantial acceleration could be achieved.

430 | 13:54



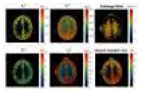
In Vivo Optimized Fast MR Fingerprinting in the Human Brain

Ouri Cohen[1,2], Mathieu Sarracanie[1,3], Matthew S. Rosen[1,3], and Jerome L. Ackerman[1,2]

[1]Athinoula A. Martinos Center, Charlestown, MA, United States, [2]Radiology, Massachusetts General Hospital, Boston, MA, United States, [3]Physics, Harvard University, Cambridge, MA, United States

In this work we demonstrate an in vivo human brain application of a previously described schedule optimization method for rapid MR Fingerprinting. The method is validated in a phantom by comparison to a spin-echo sequence. The optimized schedule allowed acquisition of a single slice in 2.4 seconds without the use of any k-space undersampling.

431 | 14:06



MR Fingerprinting with Chemical Exchange (MRF-X) for In Vivo Multi-Compartment Relaxation and Exchange Rate Mapping

Jesse Ian Hamilton[1], Anagha Deshmane[1], Mark Griswold[1,2], and Nicole Seiberlich[1,2]

[1]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Radiology, University Hospitals, Cleveland, OH, United States

MR Fingerprinting with Chemical Exchange (MRF-X) is presented for in vivo quantification of relaxation times, volume fraction, and exchange rate for tissues with two compartments. Data are presented in healthy volunteers in both brain and leg skeletal muscle and compared with previously reported measurements.

432 | 14:18

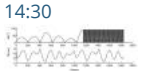
Low Rank Matrix Completion-based Reconstruction for Undersampled Magnetic Resonance Fingerprinting Data

Mariya Doneva[1], Thomas Amthor[1], Peter Koken[1], Karsten Sommer[1], and Peter Börnert[1]

[1]Philips Research Europe, Hamburg, Germany

In this work, we present a method for reconstruction of undersampled Magnetic Resonance Fingerprinting (MRF) data based on low rank matrix completion, which is performed entirely in k-space and has low computational cost. The method shows significant improvement in the MRF parameter maps accuracy compared to direct matching from undersampled data, potentially enabling more robust highly accelerated MR Fingerprinting.

433 | 14:30



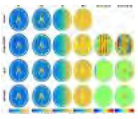
Spiral MRF at 7T with simultaneous B1 estimation

Guido Buonincontri[1], Rolf Schulte[2], Mirco Cosottini[3,4], Stephen Sawiak[5], and Michela Tosetti[4,6]

[1]INFN Pisa, Pisa, Italy, [2]GE Global Research, Munich, Germany, [3]Department of Radiology, University of Pisa, Pisa, Italy, [4]IMAGO7 Foundation, Pisa, Italy, [5]Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom, [6]IRCCS Stella Maris, Pisa, Italy

MR fingerprinting (MRF) can be used to rapidly estimate quantitative parameters in MRI. However, the homogeneity of the transmission radiofrequency field (B1+) can introduce errors in the measurements. Here, we modified spiral MRF acquisitions and included the effects of B1+ directly in the reconstruction framework. We could obtain B1-corrected T1 and T2 maps without using an extra scan. These advances are demonstrated in human brain images at 7T.

434 14:42



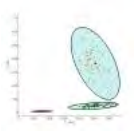
AIR-MRF: Accelerated iterative reconstruction for magnetic resonance fingerprinting

Christopher C. Cline[1,2], Xiao Chen[1], Boris Mailhe[1], Qiu Wang[1], and Mariappan Nadar[1]

[1]Medical Imaging Technologies, Siemens Healthcare, Princeton, NJ, United States, [2]Biomedical Engineering, University of Minnesota, Minneapolis, MN, United States

We propose an accelerated iterative reconstruction for magnetic resonance fingerprinting (AIR-MRF) with comprehensive integration of temporal compression of fingerprints and accelerated dictionary matching with approximate nearest neighbor search. Faster and more accurate MRF reconstruction was achieved, as demonstrated by simulations with a numerical phantom.

435 14:54



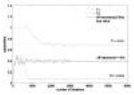
The Partial Volume Problem in MR Fingerprinting from a Bayesian Perspective

Debra F. McGivney[1], Anagha Deshmane[2], Yun Jiang[2], Dan Ma[1], and Mark A. Griswold[1]

[1]Radiology, Case Western Reserve University, Cleveland, OH, United States, [2]Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States

Magnetic resonance fingerprinting (MRF) is a technique that allows us to produce quantitative maps of tissue parameters such as T1 and T2 relaxation times, however it is susceptible to artifacts due to the partial volume effect. The aim of this work is to provide a blind solution to the partial volume problem in MRF using the Bayesian statistical framework. A complete description of the algorithm is presented as well as applications to in vivo data.

436 15:06



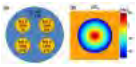
MR Fingerprinting Reconstruction with Kalman Filter

Xiaodi Zhang[1,2], Rui Li[1], and Xiaoping Hu[2]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of, [2]The Wallace H. Coulter Department of Biomedical Engineering, Georgia Institute of Technology and Emory University, Atlanta, GA, United States

The reconstruction of MR fingerprinting currently relies on matching with a dictionary. In this paper, we describe an alternative method using Kalman filter instead of dictionary in the reconstruction. The method is shown to allow the reconstruction of MR Fingerprinting without the use of dictionary and achieves better results.

437 15:18



Analysis of estimation error from system imperfection in MRF

Taehwa Hong[1], Min-Oh Kim[1], Dongyeob Han[1], and Dong-Hyun Kim[1]

[1]Electrical and Electronic engineering, Yonsei university, Seoul, Korea, Republic of

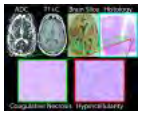
MR fingerprinting (MRF) is a rapid method for quantifying multiple tissue properties. However, estimation errors can increase when systematic imperfections including RF and gradient coils exist. In this study, we analyzed estimation errors from non-ideal slice profile and gradient delay by simulation. Our results showed that these systematic imperfections can cause significant errors in parameter estimation.

Oral

Tumour Diffusion, Perfusion & Vessel Imaging

Summit 2 13:30 - 15:30 *Moderators:*Sungheon Gene Kim & Arvind Pathak

438 13:30



Progressing bevacizumab induced diffusion restriction is associated with coagulative necrosis surrounded by viable tumor and decreased overall survival in recurrent glioblastoma patients

Ha Son Nguyen[1], Nelson Milbach[2], Sarah L Hurrell[2], Elizabeth Cochran[3], Jennifer Connelly[4], Mona Al-Gizawiy[2], Joseph Bovi[5], Scott D Rand[2], Kathleen M Schmainda[2], and Peter S. LaViolette[2,6]

[1]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Pathology, Medical College of Wisconsin, Milwaukee, WI, United States, [4]Neurology, Medical College of Wisconsin, Milwaukee, WI, United States, [5]Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI, United States, [6]Biophysics, Milwaukee, WI, United States

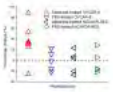
It is the standard of care to initiate bevacizumab therapy for patients with recurrent glioblastoma. Some patients develop areas of diffusion restriction on diffusion imaging following the onset of therapy. We recruited five patients with this condition to donate their brains postmortem. A histological analysis was performed and compared to MR images to discover what caused the diffusion restriction. It was found to be coagulative necrosis surrounded by viable hypercellular tumor. A second population study shows that patients with progressively expanding diffusion restriction had a significantly lower survival compared to those without.

439 13:42

In vivo quantification of antimitotic-treatment-induced microstructural changes using temporal diffusion

xiaoyu jiang[1], hua li[1], jingping Xie[1], ping zhao[1], junzhong xu[1], dineo khabele[2], and John Gore[1]

[1]vanderbilt university institute of imaging science, nashville, TN, United States, [2]vanderbilt university, nashville, TN, United States



Reliable and sensitive methods for assessing the response of tumors to treatment are critical in rapid selection of the most appropriate therapy for individual patients, and development of novel therapies. Temporal diffusion spectroscopy, which measures the variation of apparent diffusion coefficient (ADC) over a range of effective diffusion times, is proposed to measure tumor microstructural variations in response to chemotherapy. The proposed method is shown to detect the increase in cell size in response to the antimitotic-treatment in both well-characterized cell culture and solid tumors in vivo. The MR observations are supported by flow cytometric, microscopic, and histological analysis.

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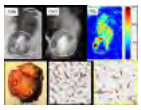
440 13:54



Quantitative Arterial Spin Labeled (ASL) Perfusion and Diffusion Weighted Imaging (DWI) in Clear Cell Renal Cell Carcinoma: Correlation with Heterogeneous Tumor Vascularity and Cellularity at Histopathology

Qing Yuan[1], Payal Kapur[2,3], Yue Zhang[1], Yin Xi[1], Sabina Signoretti[4], Ananth Madhuranthakam[1,5], Ivan E Dimitrov[5,6], Jeffrey A Cadeddu[1,3], Vitaly Margulis[3], and Ivan Pedrosa[1,5]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Pathology, UT Southwestern Medical Center, Dallas, TX, United States, [3]Urology, UT Southwestern Medical Center, Dallas, TX, United States, [4]Pathology, Brigham and Women's Hospital, Boston, MA, United States, [5]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [6]Philips Medical Systems, Cleveland, OH, United States

We investigated intratumor heterogeneity of perfusion and diffusion *in vivo* using ASL and DWI in clear cell renal cell carcinoma (ccRCC), and correlated these measures with tumor vascularity and cellularity at histopathology. Focused histopathologic analysis of tumor areas corresponding to high perfusion regions on ASL confirmed higher microvessel density (MVD) and demonstrated higher cellularity compared to tumor areas with low perfusion on ASL. A negative correlation between MRI diffusion measures and tissue cellularity further supports noninvasive MRI techniques as potential imaging biomarker in ccRCC for assessment of heterogeneity in tumor angiogenesis and microenvironment *in vivo*.

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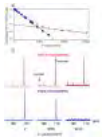
441 14:06



Apparent diffusion coefficient of hyperpolarized lactate reports on lactate production and efflux in renal cell carcinomas

Renuka Sriram[1], Bertram Koelsch[1], Jeremy W Gordon[1], Mark Van Criekinge[1], Celine Baligand[1], Robert A Bok[1], Dan B Vigneron[1], Kayvan R Keshari[2], Peder E Larson[1], Zhen Jane Wang[1], and John Kurhanewicz[1]

[1]University of California, San Francisco, San Francisco, CA, United States, [2]Memorial Sloan-Kettering Cancer Center, New York, NY, United States

This study demonstrated that diffusion weighted HP ^{13}C MRI can provide an estimate of the amount of extra- versus intracellular HP ^{13}C lactate based on its apparent diffusion coefficient (ADC). In metastatic renal cell carcinoma, a large portion of the HP ^{13}C lactate signal arises from an extracellular lactate pool, based on reliable estimates of ADC in the same cell line in a the MR compatible bioreactor. The juxtaposition of cells in bioreactor and the in vivo animal model is a powerful tool for interpretation of the hyperpolarized ADC measurements. This unique combination can be further extended to investigate the relationship between lactate transport and tumor metastatic potential.

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442 14:18 Diagnostic value of intravoxel incoherent motion (IVIM) for differentiating benign and malignant thyroid nodules

hui Tan[1], jun CHEN[1], YUN-fei ZHA[1], liang ZHANG[1], jing LU[1], Chang-sheng LIU[1], and hui LIN[2]

[1]Renmin Hospital of Wuhan University, wuhan, China, People's Republic of, [2]GE healthcare, shanghai, China, People's Republic of

To preliminary explore the value of intravoxel incoherent motion (IVIM) in the differention between benign and malignant thyroid lesions, 45 patients with 56 thyr 1000 s/mm^2). Data was postprocessed by IVIM model for quantitation of apparent diffusion coefficient (ADC), perfusion fraction f, diffusivity D and pseudo diffusi

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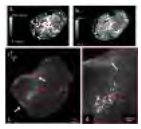
443 14:30



Combined MRI and optical CT imaging of tumour vasculature in a preclinical model of neuroblastoma

Ciara M McErlean[1], Yann Jamin[1], Jessica KR Boult[1], Alexander Koers[1], Laura S Danielson[1], David J Collins[1], Martin O Leach[1], Simon P Robinson[1], and Simon J Doran[1]

[1]Institute of Cancer Research, London, United Kingdom

This study compares MRI functional measurements of the vasculature in a preclinical model of neuroblastoma with *ex vivo* optical CT high-resolution 3D imaging of the functional vasculature using India ink staining. MRI showed a heterogeneously perfused tumour with high fractional blood volume and vessel size index, characteristic of hypervascular neuroblastoma. The high resolution optical CT images allowed visualisation of individual vessels and corroborated the MRI findings. With improved registration, optical CT could help validate MRI functional biomarkers of the vasculature and accelerate both our understanding of vessel biology and the evaluation of vascular-targeted treatment in cancer and other vascular-related pathologies.

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444 14:42

Exploring the Relationship between MR-derived Apparent Diffusion Coefficient, Cellularity, and Extracellular Porosity: A Preliminary Animal Study in Prostate Cancer

Deborah K. Hill[1,2], Andreas Heindl[3], Daniel N. Rodrigues[3], Øystein Størkersen[2], Yinyin Yuan[3], Siver A. Moestue [1,2], Martin O. Leach[3], Tone F. Bathen[1], David J. Collins[3], and Matthew D. Blackledge[3]

[1]Norwegian University of Science and Technology, Trondheim, Norway, [2]St. Olavs University Hospital, Trondheim, Norway, [3]The Institute of Cancer Research and Royal Marsden NHS Foundation Trust, London, United Kingdom

An increased ADC can imply reduced cellularity; DWI is considered a useful tool for assessing tumour treatment response, although

there is little validation of this relationship in cancer. We compared ADC, cellularity, and extracellular porosity using a transgenic adenocarcinoma of the mouse prostate model. ADC values were derived from DWI data, and cellularity was assessed from histology using novel visualisation and segmentation tools. We investigated the relationship between extracellular porosity and ADC, and validated our findings using cell segmentation analysis of histology slides. This analysis is useful to inform on tissue cellularity for cases where histology samples are not available.

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445 14:54

Non-enhanced Hypercellular Volume in Glioblastoma identified by High b-value Diffusion Weighted Imaging

Yue Cao[1,2], Daniel Wahl[1], Priyanka Pramanik[1], Michelle Kim[1], Theodore S Lawrence[1], and Hemant Parmar[2]

[1]Radiaiton Oncology, University of Michigan, Ann Arbor, MI, United States, [2]Radiology, University of Michigan, Ann Arbor, MI, United States

It is a challenge to differentiate non-enhanced components of glioblastoma (GBM) from edema and normal tissue using conventional MRI. The ill-differentiation could lead to inadequate treatment for GBM by surgery and radiation therapy. This study evaluated the enhanced and non-enhanced hypercellular volume (HCV) of GBM identified by high b-value diffusion weighted (DW) imaging with gross tumor volume defined on post-Gd T1 weighted images, abnormality volume on T2 FLAIR images, high dose coverage planned according to conventional MRI, and progression. This study found that the HCV was an aggressive component of GBM and predicted progression free survival.

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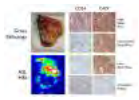
446 15:06



Differential tumor perfusion in vivo on Arterial Spin Labeled MRI correlates with heterogeneity in the molecular phenotype of clear cell Renal Cell Carcinoma

Manoj Bhasin[1], Rupal Bhatt[2], Phillip M Robson[3], Deepa Rajamani[1], Sabina Signoretti[4], David C Alsop[3], and Ivan Pedrosa[5]

[1]Division of Interdisciplinary Medicine & Biotechnology, and Genomics, Proteomics, Bioinformatics and Systems Biology Center, Department of Medicine, Beth Israel Deaconess Medical Center, Boston, MA, United States, [2]Division of Hematology and Oncology, Beth Israel Deaconess Medical Center, Boston, MA, United States, [3]Department of Radiology, Beth Israel Deaconess Medical Center, Boston, MA, United States, [4]Pathology, Brigam and Women's Hospital, Boston, MA, United States, [5]Radiology, UT Southwestern Medical Center, Dallas, TX, United States

We used Arterial Spin Labeled (ASL) MRI to explore the association between heterogeneous in vivo perfusion in clear cell renal cell carcinoma (ccRCC) and the underlying genomic profile to identify key genes linked to tumor angiogenesis. Ephrin-A5 (EFNA5) expression correlated with ASL perfusion (R2 = 0.504, P value= .002) and exhibited highest significant differences between low and high perfusion (Fold Change = 2.88, P value < 0.02). Higher expression of EFNA5 is associated with poor 3 and 5 years survival (P = 0.0009). We propose MRI-based targeted tissue sampling to characterize the heterogeneous genetic alterations driving angiogenesis in ccRCC.

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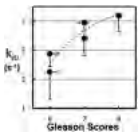
447 15:18



DCE-MRI High-resolution Metabolic Prostate Imaging is Insensitive to AIF Uncertainty

Xin Li[1], Mark G. Garzotto[2,3], Fergus V. Coakley[4], Brendan Moloney[1], William J. Woodward[1], Yiyi Chen[5], Wei Huang[1], William D. Rooney[1], and Charles S. Springer, Jr.[1]

[1]Advanced Imaging Research Center, Oregon Health & Science University, Portland, OR, United States, [2]Portland VA Medical Center, Portland, OR, United States, [3]Urology, Oregon Health & Science University, Portland, OR, United States, [4]Department of Diagnostic Radiology, Oregon Health & Science University, Portland, OR, United States, [5]Division of Biostatistics, Dept. of Public Health and Preventive Medicine, Knight Cancer Institute, Oregon Health and Science University, Portland, OR, United States

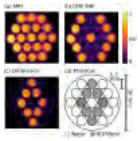
Accurate arterial input function (AIF) measurement in Dynamic Contrast Enhanced MRI (DCE-MRI) remains challenging. This hinders DCE-MRI's wider adoption. Since the contrast reagent (CR) is detected indirectly through water proton R_1 relaxation rate constant change, DCE-MRI intrinsically works as a dual-probe (CR and water) method. In this study, we demonstrate that while the common pharmacokinetic parameters associated with CR extravasation are highly sensitive to AIF accuracy, the transcytolemmal water exchange parameter is not. With the recent correlation of water exchange kinetics and cellular metabolic activity, this current work demonstrates the practicability of high-resolution metabolic imaging of the prostate.

Oral

Molecular Probes, DNP & Hyperpolarisation

Room 300-302 16:00 - 18:00 *Moderators:*Moriel Vandsburger & Rene in t Zandt

469 16:00



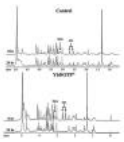
Nanodiamond Imaging with Room Temperature Dynamic Nuclear Polarization

David E J Waddington[1,2,3], Mathieu Sarracanie[2,3,4], Huiliang Zhang[3,5], Torsten Gaebel[1], David R Glenn[3,5], Ewa Rej[1], Najat Salameh[2,3,4], Ronald L Walsworth[3,5], David J Reilly[1], and Matthew S Rosen[2,3,4]

[1]School of Physics, University of Sydney, Sydney, Australia, [2]A.A Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [3]Department of Physics, Harvard University, Cambridge, MA, United States, [4]Harvard Medical School, Boston, MA, United States, [5]Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, United States

Overhauser-enhanced MRI (OMRI) is a double resonance technique that has been developed to image free radicals *in vivo*. Here, we use an ultra-low field MRI scanner with a highly efficient b-SSFP OMRI protocol to image synthetic nanodiamonds (NDs) in water at room temperature. Surprisingly, we find that high contrast can be generated via the Overhauser effect due to paramagnetic impurities in the ND. Given the already established application of ND as a biocompatible platform for drug delivery, these results are encouraging for applications based on the non-invasive tracking of nanoparticles using MRI.

470 16:12



Imaging Spermine using LnDOTP5-Towards a Noninvasive Staging of Prostate Cancer

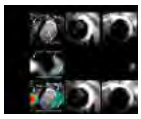
Abiola Olatunde[1], Taylor Fuss[1], Phillip Zhe Sun[1], Leo L Cheng[1], and Peter Caravan[1]

[1]Massachusetts General Hospital, Boston, MA, United States

Prostate cancer (PCa) is the most frequently diagnosed malignancy in men worldwide. Previous studies have indicated the utility of spermine as a potential biomarker for prostate cancer; however, quantifying spermine using MRS is difficult due to overlapping chemical shifts of spermine with other metabolites. We used $LnDOTP^{5-}$, an anionic lanthanide macrocyclic complex, to form a stable ternary complex with positively-charged spermine to selectively shift spermine MR resonances. Here we report the affinity of different $LnDOTP^{5-}$ complexes for spermine and the effect of complex formation on spermine MR resonances in both D_2O and serum solutions and intact human prostate tissue.

471 16:24

magna cum laude



Molecular imaging of inflammation and extracellular matrix remodelling after myocardial infarction

Isabel Ramos[1,2], Markus Henningsson[1], Maryam Nezafat[1], Begoña Lavin[1,2], Pierre Gebhardt[1], Andrea Protti[1,2], Sara Lacerda[1,2], Silvia Lorrio[1,2], Alkystis Phinikaridou[1,2], Ulrich Flögel[3], Ajay M. Shah[2], and René M. Botnar[1,2]

[1]Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Cardiovascular Division, The British Heart Foundation Centre of Excellence, King's College London, London, United Kingdom, [3]Department of Molecular Cardiology, Heinrich Heine University Düsseldorf, Düsseldorf, Germany

Optimal post-MI healing relies on a suitable degree of inflammation and its timely resolution, which is directly related to a well-orchestrated degradation and deposition of extracellular matrix (ECM) proteins, leading to cardiac remodeling. Here we explored the merits of multinuclear $^{1}H/^{19}F$ MRI for the simultaneous assessment of cardiac inflammation and subsequent remodelling in a murine model of MI. To investigate inflammatory cell recruitment into injured myocardium, a ^{19}F containing nanoparticle that is avidly taken up by macrophages was used[1]. To evaluate changes of elastin content in the ECM post-MI, a small molecular weight gadolinium-based elastin-specific MR contrast agent was investigated[2].

472 16:36

Correlation of Hyperpolarized 13C-Lactate Measurements and Ex Vivo NMR using a [3-13C]Pyruvate Injection

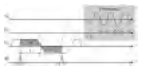
Casey Y. Lee[1,2], Justin Y. C. Lau[1,2], Albert P. Chen[3], Yi-Ping Gu[2], and Charles H. Cunningham[1,2]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]GE Healthcare, Toronto, ON, Canada

Lactate has been proposed as a potential marker to non-invasively predict cancer progression and monitor response to the therapy. Previously, hyperpolarized [1-^{13}C]pyruvate have been used to study the metabolic properties of tumor through measuring the rapid conversion of pyruvate to lactate. However, the fate of the ^{13}C-lactate, following the hyperpolarized experiment, has been less understood due to the fast, irreversible decay of the hyperpolarized signal. In this work, lactate concentrations (total, $^{13}C_1$- and $^{13}C_3$-lactate) has been estimated in rat tumor extracts following the injection of hyperpolarized [1-^{13}C]pyruvate and non-hyperpolarized [3-^{13}C]pyruvate in rats.

473 16:48

summa cum laude



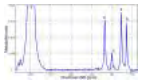
Velocity-Selective Tip-Back Excitation for Hyperpolarized [13C] Urea Cardiac Perfusion Imaging

Maximilian Fuetterer[1], Julia Busch[1], Constantin von Deuster[1,2], Christian Binter[1], Nikola Cesarovic[3], Miriam Lipiski[3], Christian Torben Stoeck[1,2], and Sebastian Kozerke[1,2]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [3]Division of Surgical Research, University Hospital Zurich, Zurich, Switzerland

A velocity-selective excitation scheme with bipolar slice-select gradients for hyperpolarized cardiac perfusion imaging is presented. Using the approach, an excitation ratio of >5 of myocardial signal to left-ventricular blood pool signal can be achieved based on differences in blood and tissue velocities. Thereby increased myocardial signal and reduced left-ventricular signal spilling is obtained. Dynamic perfusion images acquired with hyperpolarized [^{13}C]urea in pigs show higher SNR and less signal leakage in the myocardium relative to a conventional excitation approach.

474 17:00



Investigating in vivo cardiac ketone bodies metabolism using hyperpolarized 13C acetoacetate

Way Cherng Chen[1], Xing Qi Teo[1], and Teck Hock Philip Lee[1]

[1]Laboratory of metabolic imaging, Singapore Bioimaging Consortium, Singapore, Singapore

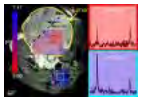
The use of hyperpolarized 3-13C acetoacetate to probe in vivo cardiac ketone bodies metabolism was investigated. Preliminary results showed the successful detection of 1-13C citrate and 1-13C acetylcarnitine after hyperpolarized acetoacetate delivery. Specifically, a significant increase in citrate with a corresponding decrease in acetylcarnitine was observed in the rat heart in vivo after 24hrs of fasting.

475 17:12

Dynamic Nuclear Polarization of Biocompatible 13C-Enriched Carbonates for In vivo pH Imaging

David E Korenchan[1,2], Robert Flavell[1], Renuka Sriram[1], Celine Baligand[1], Kiel Neumann[1], Subramaniam Sukumar[1], Daniel B Vigneron[1,2], Henry VanBrocklin[1], David M Wilson[1], and John Kurhanewicz[1,2]

summa cum laude



[1]Radiology and Biomedical Imaging, University of California at San Francisco, San Francisco, CA, United States, [2]Bioengineering, University of California at Berkeley, Berkeley, CA, United States

Although large gains in hyperpolarized ^{13}C-bicarbonate signal are obtainable for extracellular pH imaging, toxicity becomes a concern for clinical implementation of current methods. We report an approach in which a precursor molecule, 1,2-glycerol carbonate, is hyperpolarized and decomposed to form bicarbonate, CO_2, and glycerol using base-catalyzed hydrolysis. This technique enables concentrations and polarizations similar to those previously reported, and its application to pH imaging, both in phantom experiments and *in vivo* in a mouse model of prostate cancer, is demonstrated.

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476 17:24

Towards High Resolution Chemical Shift Imaging of the Lungs using Hyperpolarized Carbon-13

Mehrdad Pourfathi[1,2], Stephen J. Kadlecek[1], Harrilla Profka[1], Sarmad M. Siddiqui[1,3], Heather Gatens[1], and Rahim R. Rizi[1]

[1]Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA, United States, [3]Bioengineering, University of Pennsylvania, Philadelphia, PA, United States

We present the utility of a under-sampled single-shot turbo spin-echo (TSE) sequence for high resolution T_2 mapping and imaging of the lungs using hyperpolarized carbon-13 agents. We then demonstrate the possibility of using this sequence selectivity excite different carbon-13 species via a minimum-phase frequency-selective excitation pulse.

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477 17:36

Heteronuclear cross- relaxation and polarization transfer effects enable spectroscopic measurements of enzymatic activity by hyperpolarized proton NMR.

Piotr Dzien*[1], Anne Fages*[2], Kevin Michael Brindle[3], Markus Schwaiger[1], and Lucio Frydman[2]

[1]Nuklearmedizinische Klinik und Poliklinik Klinikum rechts der Isar der TUM, Technische Universität München, Munich, Germany, [2]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel, [3]CRUK Cambridge Institute, University of Cambridge, Cambridge, United Kingdom

Disolution DNP increases the sensitivity of 13C MR sufficiently to allow real time measurements of 13C- labelled substrates and products of their metabolism in vivo. While advantages could also result from hyperpolarized observations based on 1H MR, the fast relaxation times of 1H resonances prevent in vivo applications of this kind. Here we demonstrate, in vitro, that a substantial enhancement of the 1H resonance of [1-1H, 2,2,2-2H3,1-13C] acetaldehyde, produced in situ by solutions containing purified yeast Pyruvate Decarboxylase (yPDC) from 13C - hyperpolarized [U-2H3,2-13C] pyruvate, can be achieved. This enhancement can arise from either spontaneous or INEPT-driven 13C --> 1H polarization transfers.

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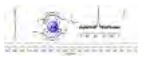
478 17:48



Functionalized Cryptophane-129Xe MRI Biosensor for Biothiols Detection through Thiol-addition Reaction

Shengjun Yang[1], Weiping Jiang[1], Qing Luo[1], Qianni Guo[1], and Xin Zhou[1]

[1]Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences, Wuhan, China, People's Republic of

Biothiols such as cysteine, homocysteine and glutathione play an important role in regulating the vital functions of living organisms. Here, we report a biosensor for biothiol detection and imaging using nuclear spin resonance of 129Xe. The 129Xe biosensor consists of cryptophane-A cage encapsulating xenon atom and acrylate group. The latter serves as a reactive site to covalently bond biothiols through thiol-addition reaction. The selectivity of the biosensor enables discrimination of Cys from Hcy and GSH through the chemical reaction rate. Our results indicate that this biosensor is a promising strategy for the real-time imaging of biothiol distributions.

Oral

fMRI Basic Neuroscience, Including Optogenetics

Room 324-326 16:00 - 18:00 *Moderators:*Cornelius Faber & Yihong Yang

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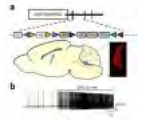
479 16:00

summa cum laude



Deciphering the Functional Role of Locus Coeruleus-derived Norepinephrine using Chemogenetic fMRI and 18FDG-PET

Esteban Adrian Oyarzabal[1,2], Manasmita Das[3], Sung-Ho Adrian Lee[4], Natale Sciolino[2], Irina Evsyukova[2], Patricia Jensen[2], and Yen-Yu (Ian) Shih[3]

[1]Neurology, UNC-Chapel Hill, Carrboro, NC, United States, [2]Laboratory of Neurobiology, NIEHS/NIH, Research Triangle Park, NC, United States, [3]Neurology, UNC-Chapel Hill, Chapel Hill, NC, United States, [4]UNC-Chapel Hill, Chapel Hill, NC, United States

This study examines how selective chemogenetic stimulation of noradrenergic neurons of the Locus Coeruleus (LC) in mice modulates cerebral metabolism and vascular tone. This was achieved by using a transgenic mouse line selectively expresses Designer Receptors Exclusively Activated by Designer Drugs (DREADDs) in the LC noradrenergic neurons. A multimodal imaging approach was used, with MRI being used to evaluate hemodynamic changes and PET being used to assess glucose metabolism.

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480 16:12

Light-driven single-vessel fMRI on the rat hippocampus

Xuming Chen[1,2], Hellmut Merkle[1], and Xin Yu[1]

[1]High-Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tübingen, Germany, [2]Neurology, Renmin Hospital of Wuhan University, Wuhan, China, People's Republic of

Previously, we have developed a single-vessel fMRI method to visualize the hemodynamic signal propagation from individual venules and arterioles in the deep layer cortex. Here, we combined single-vessel fMRI with optogenetic photo-activation to map vessel-specific fMRI signal from the rat hippocampus. A MGE sequence was used to distinguish the individual arterioles and venules penetrating the main structure of the hippocampus. The BOLD-fMRI signal was mapped to overlap with the individual venules. This result makes it possible to study the coupled neuronal and vascular interaction in the focal hippocampal stroke rat model, which may mimic the pathophysiological basis of transient global amnesia in human.

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481 16:24

Combined auditory and optogenetic fMRI for investigation of visual cortical descending modulation of auditory midbrain processing

Patrick P. Gao[1,2], Russell W. Chan[1,2], Alex T.L. Leong[1,2], Celia M. Dong[1,2], and Ed X. Wu[1,2]

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

In the auditory system, the midbrain inferior colliculus (IC) receives massive corticofugal projections, yet their functional implications remain unclear. Previous studies utilizing single neuron recordings and electrical activation or cryogenical inactivation of the cortex could not provide a cell-type specific understanding of the large-scale corticofugal modulation effects. This study combines auditory and optogenetic fMRI to investigate the corticofugal influences on auditory midbrain processing. Large-view fMRI was used to monitor the IC noise response during cell-type specific optogenetic stimulation of the VC. The results demonstrate the feasibility of this novel approach and show that VC normally facilitates auditory midbrain responses.

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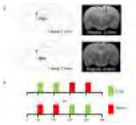
482 16:36



Optogenetic fMRI reveals differences between paralemniscal and lemniscal somatosensory thalamocortical circuit

Alex T. L. Leong[1,2], Russell W. Chan[1,2], Patrick P. Gao[1], Yilong Liu[1,2], Xunda Wang[1,2], Kevin K. Tsia[2], and Ed X. Wu[1,2]

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

Identifying key differences between the paralemniscal and lemniscal pathway in the somatosensory system remains a challenge for electrophysiological studies due to limitations in spatial coverage. The use of optogenetic fMRI (ofMRI) however, provides an opportunity to map the large scale differences between the two pathways. Our key findings include, (1) differences in multisensory and motor system interaction when stimulating paralemniscal compared to lemniscal pathway and (2) differences in activity patterns when stimulating paralemniscal pathway within the whisking frequency range. In all, ofMRI provides an added dimension to existing electrophysiological studies to advance our understanding of information processing in thalamocortical circuits.

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483 16:48

Pharmacological MRI combined with DREADD-technology enables detection of induced brain activity in projections relevant for feeding behavior

Tessa J.M. Roelofs[1,2], Geralda A.F. van Tilborg[1], Mieneke C.M. Luijendijk[2], Roger A.H. Adan[2], and Rick M. Dijkhuizen[1]

[1]Biomedical MR Imaging and Spectroscopy Group, Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [2]Translational Neurosciences, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands

With the aim to develop a novel MRI-based approach for detection of activation in neuronal networks associated with feeding behavior in a rat model, we evaluated the potential of pharmacological MRI (phMRI) to detect DREADD (***Designer Receptor Exclusively Activated by Designer Drug***)-evoked neuronal activity. BOLD phMRI was conducted under 1.5% isoflurane anesthesia at 9.4T. Pharmacological activation induced a significant BOLD response in DREADD-targeted areas, which was confirmed by cFos-based immunohistochemistry of neuronal activation. Our study shows that phMRI allows detection of specific DREADD-evoked neuronal activity, providing exciting opportunities to assess network activity in association with feeding-related behavioral phenotypes.

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484 17:00

Deciphering the Functional Connectome of the External Globus Pallidus with Electrical and Optogenetic Deep Brain Stimulation-fMRI

Daniel Albaugh[1], Nathalie Van Den Berge[2], Andrew Salzwedel[3], Wei Gao[3], Garret Stuber[4], and Yen-Yu Ian Shih[5]

[1]Curriculum in Neurobiology, UNC-Chapel Hill, Chapel Hill, NC, United States, [2]University of Ghent, Ghent, Belgium, [3]Cedars-Sinai Medical Center, Los Angeles, CA, United States, [4]Psychiatry, UNC-Chapel Hill, Chapel Hill, NC, United States, [5]Biomedical Research Imaging Center, UNC-Chapel Hill, Chapel Hill, NC, United States

In this study, we unraveled the circuit and network connectivity of the rodent external globus pallidus (GPe), both in the healthy animals and a parkinson's disease model. We also employed multiple stimulation types (electrical and optogenetic), as well as fMRI modalities (evoked-fMRI and functional connectivity analyses) to provide an exhaustive analysis of this dynamic brain nucleus.

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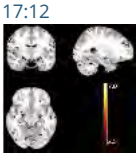
485 17:12



Study of the Transfer Functions of Hippocampal Subfields during a Spatial Memory Task using High-Resolution fMRI

Xiaowei Zhuang[1], Zhengshi Yang[1], Tim Curran[2], and Dietmar Cordes[1,2]

[1]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States, [2]Department of Psychology and Neuroscience, University of Colorado Boulder, Boulder, CO, United States

In this abstract, the input/output transfer relationship in human hippocampal subfields (mainly CA1, CA3, and DG) was studied using fMRI during a spatial memory task with increments in the change of FOV in the stimuli. Whole brain activation was obtained for all lure v/s control contrasts. Mean activation t value for each hippocampal subregions (CA1, CA2&3 and CA4&DG) was extracted, averaged over

all the subjects and plotted against FOV changes to compare with the existing models. K-means clustering was then applied. Data from one of the k-means clusters showed a pattern separation/completion curve similar to the animal model.

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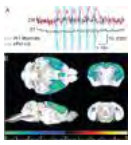
486 17:24



Visualizing adaptation of the central serotonin circuit in the living brain

Bechara J. Saab[1], Joanes Grandjean[2], Alberto Corcoba[3], Martin C. Kahn[4], Louise A. Upton[4], Erich Seifritz[1], Fritjof Helmchen[5], Isabelle Mansuy[1], Edward O. Mann[4], and Markus Rudin[2]

[1]University of Zurich, Zurich, Switzerland, [2]University and ETH Zurich, Zurich, Switzerland, [3]EPFL, Lausanne, Switzerland, [4]University of Oxford, Oxford, United Kingdom, [5]University and ETH Zurich, Zuerich, Switzerland

Mouse functional MRI was used to investigate the effect of selective stimulation of serotonergic neurons of the dorsal raphe via channelorodopsin-mediated optical control. Electrophysiological recordings in the nucleus and in projection areas confirmed neuronal activity changes upon illumination with blue light. Acute pharmacological modulation with fluoxetine, a serotonin reuptake inhibitor, lead to increased CBV response upon 5HT release, while animal restraint prior to measurements lead to a reduction of the elicited response. This study demonstrates the feasibility to assess a neurotransmitter function non-invasively at a whole brain level and investigate alterations in mood-controlling systems.

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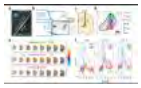
487 17:36



Direct mapping of functional connectivity with a novel MR-compatible high resolution brain stimulation array

Sung-Ho Lee[1], Hsin-Yu Lai[1], Yu-Chieh Jill Kai[1], You-Yin Chen[2], and Yen-Yu Ian Shih[1]

[1]University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [2]Department of Biomedical Engineering, University of National Yang Ming, Taipei, Taiwan

In this study, we aim to provide in vivo evidence of using this novel electrode array for selective deep brain stimulation (DBS) in rats with simultaneous fMRI readouts. This novel development opens up a new avenue to explore and validate functional connectivity in the brain with a resolution and specificity that cannot be achieved by traditional fMRI or fcMRI approach.

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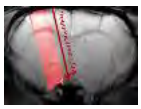
488 17:48



Line scanning BOLD fMRI upon optogenetic stimulation

Franziska Albers[1], Florian Schmid[1], Lydia Wachsmuth[1], and Cornelius Faber[1]

[1]Department of Clinical Radiology, University of Münster, Münster, Germany

With the line scanning technique BOLD responses can be recorded with 50 ms temporal resolution. Here line scanning fMRI was combined with optogenetic stimulation of excitatory neurons in rat somatosensory cortex. The light for optogenetic stimulation was delivered by an optical fiber implanted in the brain. It was possible to compare BOLD responses upon optogenetic and sensory stimulation with high temporal resolution and shorter times to reach half maximum were found for optogenetic stimulation. Furthermore the spatial resolution offered the possibility to observe cortical layer-specific BOLD signals.

Oral

Novel Concepts in MR Technology

Room 331-332 16:00 - 18:00 *Moderators:*Stuart Crozier & Thomas Witzel

489 16:00

DC plasma coils for MRI

Vincent Oltman Boer[1] and Esben Thade Petersen[1]

[1]Danish Research Centre for Magnetic Resonance, Centre for Functional and Diagnostic Imaging and Research, Copenhagen University Hospital Hvidovre, Hvidovre, Denmark

Coupling between conducting structures is one of the major design limitations for in-bore MRI equipment. Here we show how switchable plasma conductors can be used in a direct current (DC) MR coil for B_0 field manipulation. This can be applied in for example B_0 shimming, signal de-phasing or ultimately even gradient coil design.

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490 16:12

Integration of Miniaturized Ultrasound and Single-Sided, Low-Field MRI

Cheng Chen[1], Mason Greer[1], Michael Twieg[1], Mark A. Griswold[1,2], and Soumyajit Mandal[1]

[1]Department of Electrical Engineering and Computer Science, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Radiology, Case Western Reserve University and University Hospitals of Cleveland, Cleveland, OH, United States

Ultrasound (US) and magnetic resonance (MR) are two well-established imaging modalities with largely complementary contrast mechanisms. We propose and experimentally evaluate the feasibility of a fundamentally new tool; miniaturized two-dimensional (2-D) US collocated with a one-dimensional (1-D) single-sided MR system for bimodal imaging in portable or wearable form factors. The proposed system will be capable of scheduling both measurements in real-time, thus enabling closed-loop operation in which the output of one sensor is used to optimize the operation of the other. We study the feasibility of such a system and show preliminary experimental results obtained by combining a commercial US imaging system with a custom single-sided planar MR sensor.

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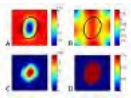
491 16:24



Traveling Internal Plane-wave Synthesis for Uniform B1(+) in High Field MRI

Adam W Anderson[1]

[1]*Biomedical Engineering, Vanderbilt University, Nashville, TN, United States*

Image quality in high field MRI is limited by B_1 inhomogeneity. This work describes a new approach to improving B_1 homogeneity using parallel transmission. Rather than transmitting a conventional traveling wave, which is diffracted and reflected by the human body, thereby creating a non-uniform internal field, the new method seeks a solution to the inverse problem—what external field produces a traveling plane wave within the body? Simulations suggest dramatic improvements in B1 homogeneity can be obtained given a sufficient number of transmitted field modes.

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492 16:36

Magnetic Pebbles – Materials with Controllable Magnetism for Compact, Low-Power Shim Units

David Otto Brunner[1], Simon Gross[1], Jonas Reber[1], and Klaas Paul Pruessmann[1]

[1]*Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland*

B_0 shimming with very high channel count encounters many implementation problems due to the size and current handling requirements of the shim units. Here we present an approach using distributions of ferromagnetic materials with controllable magnetic moments to generate shim fields. These units are small, require only low currents and can hence be implemented in large numbers into RF receive arrays.

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493 16:48

Size-adaptable "Trellis" receive array concept for knee imaging

Graham C Wiggins[1], Bei Zhang[1], and Barbara Dornberger[2]

[1]*Center for Advanced Imaging Innovation and Research (CAI2R) and Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States,* [2]*Siemens Healthcare, Erlangen, Germany*

For optimal performance an array should conform closely to the anatomy being imaged. Knee coils typically have rigid formers which must be large enough to accommodate most subjects, but which necessarily are not optimal for small ones. We present here a cylindrical surface coil array which can adapt in size while maintaining good tuning, match and decoupling. It is built on a trellis-like structure which controls the configuration and morphs the surface coils.

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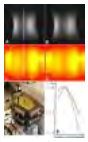
494 17:00

magna cum laude



Doppler Ultrasound Triggering for Cardiac Magnetic Resonance Imaging at 7 Tesla

Fabian Kording[1], Christian Ruprecht[1], Bjoern Schoennagel[1], Mathias Kladeck Kladeck[1], Jin Yamamura[1], Gerhard Adam[1], Juliane Goebel[2,3], Kai Nassenstein[2], Stefan Maderwald[3], Harald Quick[3,4], and Oliver Kraff[3]

[1]*Department of Diagnostic and Interventional Radiology, University Medical Center Hamburg, Hamburg, Germany,* [2]*Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital, University Duisburg-Essen, Essen, Germany,* [3]*Erwin L. Hahn Institute for Magnetic Resonance Imaging, University Duisburg-Essen, Essen, Germany,* [4]*High Field and Hybrid MR Imaging, University Hospital, University Duisburg-Essen, Essen, Germany, Essen, Germany*

Cardiac synchronization for magnetic resonance imaging at ultra-high-field MRI remains a challenge as disturbances in the inherent electrical measurement of the ECG increase with field strength. An ultrasound transducer and transmission line was developed and the feasibility of Doppler Ultrasound as an alternative method for cardiac synchronization was evaluated in terms of safety concerns, signal and image quality. The transmission line and transducer did not disturb the transmit RF field or image homogeneity and were approved for RF safety. Doppler Ultrasound was successfully applied for cardiac synchronization without signal disturbances and represents a promising alternative for ultra-high field CMR.

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495 17:12

The Multi-Pole Antenna Array

Qi Duan[1], Natalia Gudino[1], and Hellmut Merkle[1]

[1]*Laboratory of Functional and Molecular Imaging, National Institute of Neurological Disorders and Stroke, National Institutes of Health, Bethesda, MD, United States*

In this work, we propose concepts of transmit arrays based on combination of monopole and dipole antennas and their variations for high field imaging. Based on these concepts, transmit arrays for a variety of applications can be derived based on parameters such as desired and possible transmit field-of-view, number of available transmit ports, etc. For illustration purpose, a special case of the second order array, a.k.a. the Trident antenna, was built for spine or posterior cortex imaging and tested on phantom at a 7T scanner.

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496 17:24

A High-Speed, High Power T/R Switching Frontend

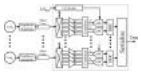
David Otto Brunner[1], Lukas Furrer[2], Markus Weiger[1], Werner Baumberger[2], Thomas Schmid[1], Jonas Reber[1], Benjamin Emanuel Dietrich[1], Bertram Jakob Wilm[1,3], Romain Froidevaux[1], and Klaas Paul Pruessmann[1]

[1]*Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland,* [2]*ZSN Center for Signal Processing and Communications, University of Applied Sciences Winterthur, Winterthur, Switzerland,* [3]*Skope Magnetic Resonance Technologies, Zurich, Switzerland*

Dead-times after the excitation pulse of the order of 1 µs are required for imaging approaches for short T_2 compounds such as UTE, ZTE

or SWIFT. Here we present a multi-channel T/R interface box employing symmetrically biased T/R switches which, in conjunction with a novel diode driver, provide signal rise times of 350 ns. The unit further comprises fiber-optic triggering, biasing, and malfunction detection. Its performance is demonstrated by low artefact ZTE scans with 500 kHz at 7T.

497 17:36



N-path frequency mixers for ultra-high density receive arrays

Michael Twieg[1], Soumyajit Mandal[1], and Mark A Griswold[1,2]

[1]*Electrical Engineering and Computer Science, Case Western Reserve University, Cleveland, OH, United States,* [2]*Radiology, Case Western Reserve University, Cleveland, OH, United States*

Dense MRI receiver arrays face challenges associated with RF cabling, power consumption, and space required by on-coil RF LNAs. On-coil frequency mixers and ADCs have been proposed as solutions to these challenges. Here we propose the use of passive N-path mixers implemented in CMOS for on-coil frequency conversion. We demonstrate a prototype fabricated in a 0.5µm CMOS process, and compare its measured and simulated performance. We also show simulations of a similar design in 65nm CMOS with greatly improved performance. The improved version may handle multiple RF channels on a single chip, and eliminates the need for RF LNAs entirely.

498 17:48

Progress Toward a Portable MRI System for Human Brain Imaging

J. Thomas Vaughan[1], Bert Wang[2], Djaudat Idiyatullin[1], Sung-min Sohn[1], Albert Jang[1], Lance DelaBarre[1], and Michael Garwood[1]

[1]*Center for Magnetic Resonance Research - University of Minnesota, Minneapolis, MN, United States,* [2]*Wang NMR, Inc, Livermore, CA, United States*

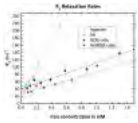
Critical magnet, imaging physics, RF and gradient technology were built and tested to demonstrate the feasibility of a portable 1.5T MRI system for imaging the brain in real world environments. Feasibility is demonstrated.

Oral

Relaxation Based Contrast

Room 334-336 16:00 - 18:00 *Moderators:*Wenbo Li & Charles Springer

499 16:00



Multiparametric MRI Characterization of Magnetic Viral Complexes

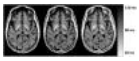
Alexander Joos[1], Olga Mykhaylyk[2], Norbert Löwa[3], Dietmar Eberbeck[3], Bernhard Gleich[1], and Axel Haase[1]

[1]*Zentralinstitut für Medizintechnik der Technischen Universität München, Garching, Germany,* [2]*Department of Experimental Oncology, Klinikum rechts der Isar der TU München, Munich, Germany,* [3]*Physikalisch-Technische Bundesanstalt, Berlin, Germany*

Magnetic nanoparticles can be used for magnetic drug targeting while MRI can serve as non-invasive therapy monitoring. We investigated the influence of the assembling of magnetic nanoparticles with oncolytic viruses and their uptake into cancer cells on the MRI relaxivities r_1, r_2 and r_2^* and magnetically characterized all samples using magnetic particle spectroscopy. Our results show that R_2^* measurements seem most suitable for particle quantification while R_2 is sensitive to the uptake of the particles into the cells. Magnetic particle spectroscopy proves to be an important validation technique for MRI relaxometry.

500 16:12

summa cum laude



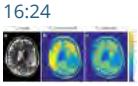
Fast Quantitative T2 Mapping using Simultaneous-Multi-Slice and Model-Based Reconstruction

Tom Hilbert[1,2,3], Jennifer Schulz[4], Lauren J. Bains[4], José P. Marques[4], Reto Meuli[2], Jean-Philippe Thiran[2,3], Gunnar Krueger[2,3,5], David G. Norris[4], and Tobias Kober[1,2,3]

[1]*Advanced Clinical Imaging Technology (HC CMEA SUI DI BM PI), Siemens Healthcare AG, Lausanne, Switzerland,* [2]*Department of Radiology, University Hospital (CHUV), Lausanne, Switzerland,* [3]*LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland,* [4]*Radboud University Nijmegen, Donders Institute for Brain, Cognition and Behaviour, Nijmegen, Netherlands,* [5]*Siemens Medical Solutions USA, Inc., Boston, MA, United States*

Long acquisition times of quantitative magnetic resonance imaging (qMRI) are one obstacle that prevents qMRI to be used in clinical routine. Acceleration methods, such as simultaneous-multi-slice and model-based iterative reconstruction proved in the past to allow high acceleration factors in MRI. Here we suggest combining these two methods to allow fast quantitative T2 mapping, yielding a high-resolution (0.7x0.7x3mm³) whole brain (40 slices) acquisition within a clinically acceptable acquisition time of less than 3 minutes. T2 values of the proposed method are similar to the values of the standard method as it is shown on phantom experiments.

501 16:24



A robust T1ρ-mapping method for in-vivo glucose detection at 7T whole-body scanners

Patrick Schuenke[1], Moritz Zaiss[1], Christina Koehler[2], Alexander Radbruch[2,3], Mark Edward Ladd[1], and Peter Bachert[1]

[1]*Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany,* [2]*Department of Neuroradiology, University of Heidelberg Medical Center, Heidelberg, Germany,* [3]*Department of Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany*

Recently it was demonstrated that on–resonant chemical–exchange–sensitive spin–lock (CESL) allows to observe the uptake of administered D–glucose *in vivo* and thus could be used for glucose metabolism studies. However, conventional spin–lock produces artifacts owing to B_1–field inhomogeneities, which are a common problem especially at high-field whole-body MR scanners. Therefore

we developed an adiabatic water–$T_{1\rho}$ mapping sequence which outperforms conventional spin-lock sequences with respect to its insensitivity to B_1–inhomogeneities; its sensitivity to glucose in the millimolar range as well as its applicability to *in vivo* studies is proven.

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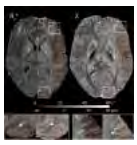
502 16:36



Imaging Subcortical White Matter by High Resolution 7 T MRI in vivo: Towards Potential U-Fiber Density Mapping in Humans

Evgeniya Kirilina[1,2], Juliane Dinse[1], Pierre-Louise Bazin[1], Carsten Stueber[3,4], Stefan Geyer[1], Robert Trample[1], Andreas Deistung[5], Juergen R Reichenbach[5], and Nikolaus Weiskopf[1,6]

[1]Neurophysics, Max Plank Institute for Human Cognitive and Brain Science, Leipzig, Germany, [2]Neurocomputation and Neuroimaging Unit, Department of Educational Science and Psychology, Free University Berlin, Berlin, Germany, [3]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [4]Department of Neurology, Yale School of Medicine, Yale University, New Haven, CT, United States, [5]Medical Physics Group, Jena University Hospital - Friedrich Schiller University Jena, Jena, Germany, [6]Wellcome Trust Centre for Neuroimaging, University College London, London, United Kingdom

Subcortical white matter (SWM) incorporates U-fibers, the intra-hemispheric connections between adjacent gyri. Despite their importance for cortical connectivity little is known about the U-fiber distribution in humans due to the lack of appropriate imaging methods. Herein we investigate SWM using high-resolution in-vivo MRI at 7T. A clear-cut discrimination of SWM from the adjacent brain regions was obtained based on higher qR_2*, qR_2 and susceptibility in-vivo. These new findings may pave the way for future in-vivo segmentation strategies for this crucial brain region as well as potential U-fiber density mapping in humans.

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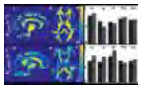
503 16:48



Mapping orientation dependent and independent components of R2star in the human white matter - an in vivo study

Diana Khabipova[1,2], Rita Gil[2], Marcel Zwiers[2], and José Pedro Marques[2]

[1]CIBM-AIT, EPFL, Lausanne, Switzerland, [2]Centre for Cognitive Neuroimaging, Donders Institute, Nijmegen, Netherlands

Anisotropic microstructure of the white matter causes the apparent transverse relaxivity, $$$R_2^*$$$, to depend on the orientation of white matter fibres in respect to the applied magnetic field. Using the fibre orientation prior knowledge from DTI orientation dependent $$$R_{2,ANISO}^*$$$ and independent $$$R_{2,ISO}^*$$$ components of $$$R_2^*$$$ were calculated. For all studied WM fibres a consistency for the (an)isotropic components between both hemispheres was present. The isotropic component showed higher variability compared to the anisotropic component.

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504 17:00

Gradient echo signal decay of bone material at high field requires a gaussian augmentation of the mono-exponential model for T2* determination

Weiqiang Dou[1] and Arend Heerschap[1]

[1]Radiology, Radboud University Medical Centre, Nijmegen, Netherlands

Previously reported T_2^*quantification for calcium phosphate cement (CPC), a widely used bone material, remained unsatisfactory with a mono-exponential (ME) fit. A recently proposed Gaussian augmentation of the mono-exponential (GAME) model was reported to have robust fit for gradient echo (GRE) signals. To accurately evaluate GRE-signal decay of CPC, GAME and ME fits were applied in this study for multi-echo time GRE signals acquired at 11.7T. Compared to ME, GAME showed optimal fitting with significantly smaller sum of squared errors and larger R-squared values. Therefore, GAME model is demonstrated to be suitable for GRE signal modeling in CPC at ultra-high field.

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505 17:12

Simultaneous estimation of reversible and irreversible transverse relaxation rates in the basal ganglia at 7T: implications for brain iron deposition studies

Mukund Balasubramanian[1,2], Jonathan R. Polimeni[2,3], and Robert V. Mulkern[1,2]

[1]Department of Radiology, Boston Children's Hospital, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Charlestown, MA, United States

Reversible and irreversible transverse relaxation rates were measured at 7T, using the GESSE pulse sequence, in basal ganglia structures in 11 volunteers (ages: 23-81 years). We found that, with a judicious choice of echo times, irreversible rates (R_2) in the globus pallidus were conspicuous for all subjects. Furthermore, both reversible and irreversible rates increased with age in a manner consistent with prior postmortem studies of iron concentration in these structures. Since these rates are differentially affected by field perturbations at different spatial scales, their consideration may provide information about the microscopic and mesoscopic distribution and concentration of iron in tissue.

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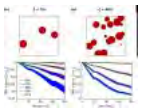
506 17:24



A General Solution for Transverse Signal Decay Under the Weak Field Approximation: Theory and Validation with Spherical Perturbers

Avery J.L. Berman[1,2] and Bruce Pike[2]

[1]Montreal Neurological Institute, McGill University, Montreal, QC, Canada, [2]Department of Radiology and Hotchkiss Brain Institute, University of Calgary, Calgary, AB, Canada

This study presents a closed-form analytical solution that describes transverse signal relaxation using the weak field approximation (WFA). The closed-form solution (CFS) fully describes the net signal dynamics under any train of 180° refocusing pulses, and we show that it is in close agreement with a commonly employed mono-exponential expression of the WFA. We compared the CFS to simulations from a medium containing spherical perturbers, with a focus on modelling red blood cells. The CFS and simulations were in close

agreement but the results systematically varied depending on whether or not the spheres were allowed to overlap. This theory can be applied in areas such as tissue iron imaging or relaxometry of blood.

507 17:36

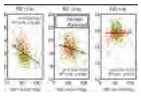
Rotating frame MRI in human subjects with Multiple Sclerosis

Silvia Mangia[1], Alena Svatkova[2,3], Peter Bednarik[1,3], Igor Nestrasil[2], Lynn E. Eberly[4], Adam Carpenter[5], and Shalom Michaeli[1]

[1]Radiology, CMRR, University of Minnesota, Minneapolis, MN, United States, [2]Department of Pediatrics, University of Minnesota, Minneapolis, MN, United States, [3]Central European Institute of Technology, Masaryk University, Brno, Czech Republic, [4]Division of Biostatistics, University of Minnesota, Minneapolis, MN, United States, [5]Neurology, University of Minnesota, Minneapolis, MN, United States

Rotating frame MRI methods including adiabatic T1ρ, T2ρ, and RAFF4 were here employed for characterizing the white matter (WM) of relapsing-remitting Multiple Sclerosis (MS) patients. We calculated relaxograms from subcortical WM of MS patients (excluding lesions) and age-matched controls, and compared them with histograms of DTI outcomes. T1ρ, T2ρ and TRAFF4 were significantly different in the WM of MS patients vs controls, while DTI outcomes did not detect group differences. These findings are supported by recent validation studies using demyelination/dysmyelination animal models, where RAFF4 exhibited exceptional ability to probe myelin content/integrity which we attribute to enhanced sensitivity to slow/ultra-slow motion.

508 17:48



R2' is the Best Transverse Relaxation Rate for Oxygenation Mapping: Experience in Moyamoya Disease with Acetazolamide Challenge

Wendy Ni[1,2], Thomas Christen[2], and Greg Zaharchuk[2]

[1]Department of Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Department of Radiology, Stanford University, Stanford, CA, United States

Transverse MR spin relaxation rates, R_2*, R_2 and R_2' have all been considered sensitive to brain tissue oxygenation. In this study, we focus on a cohort of pre-operative Moyamoya disease patients and simultaneously map all three rates in addition to cerebral blood flow, both before and after the injection of the vasodilatory drug, acetazolamide. We found our measurements to be consistent with physiology and previous studies, and to support the use of R_2' for oxygenation mapping instead of R_2* and R_2.

Oral

Non-Cartesian Imaging

Summit 1 16:00 - 18:00 *Moderators:*Herbert Köstler & Yunhong Shu

516 16:00

"Windowed" Composite Reconstruction Improves Rotating Short-Axis High-Resolution DWI (RSA-DWI) in both Simulation and Human data

Qiuting Wen[1], Chandana Kodiweera[2], and Yu-Chien Wu[1]

[1]Radiology and Imaging Sciences, Indiana University, Indianapolis, IN, United States, [2]Darmonth College, Hanover, NH, United States

High-resolution DWI often relies on multi-shot acquisitions, which suffer from long acquisition time and motion-related phase issues. However, highly correlated information exists in DWIs as they are weighting the same structure. To take advantages of this feature, rotating short-axis DWI was proposed to accelerate DWI acquisition by acquiring only one rotating blade per diffusion direction. In the previous reconstruction, high-resolution DWI was achieved by integrating the full set of DWIs. In this work, we propose a "windowed" composite reconstruction where only a subset of DWIs was selected to reconstruct each high-resolution DWI. Improved image quality was appreciated in both simulation and human data.

517 16:12

Multi-frequency reconstruction for frequency-modulated stack-of-stars bSSFP

Anne Slawig[1], Tobias Wech[1], Valentin Ratz[1], Johannes Tran-Gia[1,2], Henning Neubauer[1], Thorsten Bley[1], and Herbert Köstler[1]

[1]Departement for Diagnostic and Interventional Radiology, University of Würzburg, Würzburg, Germany, [2]Department of Nuclear Medicine, Würzburg, Germany

Banding artefacts in images acquired by bSSFP are a big challenge in fast MRI as they can considerably reduce image quality and deteriorate the diagnostic value. As the steady state tolerates small shifts in frequency, it is possible to acquire a frequency-modulated bSSFP. Unfortunately a simple gridding reconstruction of such a measurement suffers from signal loss. Our study proposes a multi-frequency reconstruction and demonstrates its capability of reconstructing banding-free 3D images while retaining the high signal levels of standard bSSFP.

518 16:24

Distortion correction of Golden Angle radial images with GIRF-predicted k-space trajectories using the gradient waveform history

Adrienne E Campbell-Washburn[1], Robert J Lederman[1], Anthony Z Faranesh[1], and Michael S Hansen[1]

[1]Cardiovascular and Pulmonary Branch, Division of Intramural Research, National Heart, Lung, and Blood Institute, National Institutes of Health, Bethesda, MD, United States

Balanced SSFP Golden Angle radial imaging uses a rapidly varying gradient scheme and thus is susceptible to image distortion caused by gradient delays and eddy currents. We propose that storing a history of the gradient waveforms in each axis can enable us to better

predict our true k-space coordinates during sampling. We use the gradient system impulse response function to predict k-space coordinates and demonstrate reduced image distortion (shading and streaking) in a phantom and in vivo when utilizing the gradient waveform history. This method will be useful for dynamic and real-time imaging with Golden Angle balanced SSFP imaging schemes.

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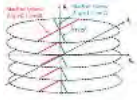
519 16:36



Cosine-modulated acquisition cleans spectra for better respiratory cine

Cihat Eldeniz[1], Yasheng Chen[1], and Hongyu An[1]

[1]*Washington University in St. Louis, St. Louis, MO, United States*

Breath-hold or navigator-based MR acquisition has been widely used to remove the effect of motion from the images. However, breath holding can be challenging for patients. On the other hand, navigator-based methods suffer from lengthened acquisition time and the disturbance of magnetization history. In this respect, we will developed a self-gated free-breathing MR imaging method to obtain 4D MRI (3D spatial+1D respiratory phases) for deformable motion derivation.

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520 16:48

Self-calibrated off-resonance correction method for linogram MRI

Ali Ersoz[1] and L Tugan Muftuler[2,3]

[1]*Department of Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States,* [2]*Department of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States,* [3]*Center for Imaging Research, Medical College of Wisconsin, Milwaukee, WI, United States*

Although radial MRI has favorable properties, a major disadvantage is the image blurring caused by off-resonance effects. This is less tolerable than image distortions typically seen in Cartesian scans. Linogram MRI, which carries advantages of radial MRI, has an off-resonance behavior similar to Cartesian sampling. Thus, linogram combines the beneficial properties of two sampling techniques and avoids the disadvantages. In this study, we propose a self-calibrated off-resonance correction method for linogram sampling, which doesn't require a field map. Both experimental phantom and human studies demonstrated that the proposed method significantly improved the image quality and provided sharper images.

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521 17:00

Fast, Iterative Subsampled Spiral Reconstruction via Circulant Majorizers

Matthew J. Muckley[1,2], Douglas C. Noll[1], and Jeffrey A. Fessler[1,2]

[1]*Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States,* [2]*Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, United States*

Majorize-minimize algorithms are a powerful tool for solving image reconstruction problems with sparsity-promoting regularization; however, when non-Cartesian trajectories are used it becomes challenging to design a suitable majorizer for these methods due to the high density of samples near the center of k-space. We derive a new circulant majorizer that is related to the density compensation function of the k-space trajectory. We then use the frequency localization properties of wavelets and the circulant majorizer to design an algorithm that converges faster than conventional FISTA for reconstructing images from undersampled, non-Cartesian k-space data.

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522 17:12

T2*-Weighted Imaging with A Distributed Spiral In-Out Trajectory

Dinghui Wang[1], Zhiqiang Li[1], and James G. Pipe[1]

[1]*Imaging Research, Barrow Neurological Institute, Phoenix, AZ, United States*

T2*-weighted (T2*w) gradient-echo (GRE) sequences are commonly used in neuroimaging to depict hemorrhage, calcification and iron deposition. Compared to three-dimensional (3D) GRE sequences, 2D GRE sequences are more sensitive to the deleterious T2* effects at air-tissue interfaces. However, 3D Cartesian high-resolution T2*w GRE sequences usually require long scan times, because of the preferred long TRs and TEs. In this study, we implement a fast, scan efficient 3D T2*w imaging method with a distributed spiral in-out trajectory.

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523 17:24

Model-based Spiral Trajectory Correction using Scanner-specific Gradient Calibration

Craig H. Meyer[1], Samuel W Fielden[1], Josef Pfeuffer[2], John P. Mugler III[3], Alto Stemmer[2], and Berthold Kiefer[2]

[1]*Department of Biomedical Engineering, University of Virginia, Charlottesville, VA, United States,* [2]*Application Predevelopment, Siemens Healthcare GmbH, Erlangen, Germany,* [3]*Department of Radiology & Medical Imaging, University of Virginia, Charlottesville, VA, United States*

The purpose of this work was to apply a spiral k-space characterization method to a variety of scanner models to assess the consistency of characterization parameters and the ability of the method to yield high-quality spiral images on the different scanners. Characterization of gradient-system performance on 11 MR scanners yielded only minor variation in parameter values among scanners, and in all cases model-based correction of spiral trajectories yielded very similar image results to reconstruction based on measured trajectories. These results suggest that model-based reconstruction may represent a viable approach for obtaining high-quality spiral images without the need for characterization of specific spiral-trajectory implementations.

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524 17:36

3D MRI with non-linear gradient field, 3D O-space

Sangwon Oh[1], Gigi Galiana[1], Dana Peters[1], and R. Todd Constable[1]

[1]*Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States*

MRI with non-linear spatial encoding magnetic (SEM) fields was originally introduced to realize faster gradient switching time without peripheral nerve stimulation (PNS) [1]. Since then various MRI encoding method such as O-Space, 4D-RIO, and FRONSAC have been introduced for more efficient accelerated spatial encoding [2, 3, 4]. However, these methods are mostly focused on 2-dimensional MRI and there is uncertainty in its applicability to 3-dimensional MRI. We apply O-Space to 3D MRI and find practical challenges and improvement over 3D radial sequence.

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525 17:48

PowerGrid: A open source library for accelerated iterative magnetic resonance image reconstruction

Alex Cerjanic[1,2], Joseph L Holtrop[1,2], Giang Chau Ngo[1], Brent Leback[3], Galen Arnold[4], Mark Van Moer[4], Genevieve LaBelle[2,5], Jeffrey A Fessler[6], and Bradley P Sutton[1,2]

[1]Bioengineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [2]Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [3]PGI Compilers & tools; an NVIDIA brand, Portland, OR, United States, [4]National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [5]Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States, [6]Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, United States

PowerGrid is an accelerated, open source, freely available toolkit for iterative reconstruction supporting non-Cartesian trajectories. Using high level compiler directives, GPU accelerated Fourier transform operators were implemented in a high level syntax designed to correlate with the popular Image Reconstruction Toolbox (IRT). A speed-up of up to 8.96x over the unaccelerated IRT reconstruction was obtained using an NVIDIA Tesla K40c accelerator.

Oral

Hepatobiliary 2: Pancreasbiliary

Summit 2 16:00 - 18:00 *Moderators:*Masoom Haider & Diego Hernando

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526 16:00

Magnetic Resonance Imaging of the Pancreas in a Transgenic Mouse Model of Pancreatic Carcinogenesis

Conny F. Waschkies[1,2], Theresia F. Reding[1], Gitta Maria Seleznik[1], Udo Ungethuem[1], and Rolf Graf[1]

[1]Division of Visceral and Transplantation Surgery, University Hospital Zurich, Zurich, Switzerland, [2]Institute for Biomedical Engineering, ETH and University Zurich, Zurich, Switzerland

Few preclinical studies rely on MRI to monitor pancreatic tissue changes in commensurate animal models, mostly due to inherently low conspicuity of the rodent pancreas. Pancreatic inflammation is a risk factor for pancreatic ductal adenocarcinoma development, and its initiation is linked to activating mutations in KRAS oncogene, known as the KPC mouse model. In the present study we demonstrate the potential of preclinical MRI to visualize the murine pancreas and its changes associated with cellular transformations in this mouse model of pancreatic carcinogenesis.

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527 16:12

Pilot Study of Rapid MR Pancreas Screening for Patients with BRCA Mutation Undergoing Screening Breast MRI – Preliminary Data

Mitchell C Raeside[1], Andrea Agostini[1], Richard K.G. Do[1], Amita Shukla-Dave[1,2], David Aramburu-Nunez[2], Ramesh Paudyal[2], Olga Smelianskaia[1], Monika Khan[1], David Kelsen[3], and Lorenzo Mannelli[1]

[1]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [2]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [3]Medicine, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

The purpose of this study was to develop and optimize a rapid MR pancreas screening protocol to be performed in conjunction with breast MRI screening in BRCA-positive individuals. 15 patients underwent a rapid pancreatic screening at the conclusion of their breast MRI examination. Images were acquired with the patient in the prone position, with the breast coil still in place, but using the built-in body coil on a 3T magnet, and evaluated for image quality (including SNR and CNR), and detection of pancreatic lesions. Rapid MR protocol for pancreatic cancer screening is feasible and provides diagnostic quality images.

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528 16:24

Contrast Agent Uptake Analysis at 3T for Pancreatic Cancer

Douglas Arthur Charles Kelley[1], Eric Collisson[2], Benjamin M Yeh[3], Michael Ohliger[3], and Zhen Wang[3]

[1]Neuro Applications and Workflow, GE Healthcare, Corte Madera, CA, United States, [2]Medicine, University of California, San Francisco, San Francisco, CA, United States, [3]Radiology, University of California, San Francisco, San Francisco, CA, United States

Pancreatic cancer is highly desmoplastic and slowly takes up extracellular gadolinium based contrast agents during MR imaging. Quantitative estimation of gadolinium based contrast uptake in pancreas cancers may help assess the tumor stroma, which is implicated in tumor aggressiveness and treatment response. However, tissue motion and sensitivity inhomogeneity on abdominal MR scans present complications for quantitative analysis of contrast uptake. A new MR PET system with higher performance gradient and RF capabilities coupled with data-driven analysis methods allow robust estimation of contrast agent concentration in pancreatic cancer patients.

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529 16:36

Differentiating Pancreatic Cancer from Mass-Forming Focal Pancreatitis with a Novel Inhomogeneity Index Based on ADC Map Analysis

Chao Ma[1], Li Liu[1], Jing Li[1], Li Wang[1], Xu Fang[1], Jianxun Qu[2], Shi-yue Chen[1], and Jianping Lu[1]

[1]Department of Radiology, Changhai Hospital of Shanghai, Shanghai, China, People's Republic of, [2]MR Research China, GE Healthcare, Beijing, China, People's Republic of

Differentiating mass-forming focal pancreatitis (FP) and pancreatic ductal adenocarcinoma (PDAC) is of great importance and yet remains a challenge in clinical practice. In this work, we propose a novel method to address the challenge with a new parameter (inhomogeneity index) based on the ADC map analysis with different region of interest (ROI) size.

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530 16:48

Prediction of response by DCE-MRI and DW-MRI for intrahepatic cholangiocarcinomas treated with locoregional and systemic chemotherapy: a preliminary analysis

Kristen L Zakian[1], Richard K Do[2], Taryn Boucher[2], Mithat Gonen[3], Andrea Cercek[4], William R Jarnagin[5], and Nancy Kemeny[4]

[1]Medical Physics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [2]Radiology, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [3]Epidemiology and Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [4]Medicine, Memorial Sloan-Kettering Cancer Center, New York, NY, United States, [5]Surgery, Memorial Sloan-Kettering Cancer Center, New York, NY, United States

Intrahepatic cholangiocarcinoma (ICC) is the second most common primary liver malignancy and has few treatment options. A previous study suggested that MRI may help identify patients likely to benefit from hepatic arterial infusion pump therapy with floxuridine (HAI-FUDR). The purpose of this prospective study was to investigate the ability of pre-treatment and early-in-treatment DCE and DW-MRI to predict ICC response to combined HAI-FUDR and systemic chemotherapy given in a Phase 2 clinical trial. Our preliminary analysis suggests that DW-MRI may predict response of unresectable ICC using data acquired at baseline or at 1 month after treatment start.

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531 17:00

An Indenting Abdominal Array for 2-Fold SNR Improvement in Pancreatic MRI

Scott B. King[1], Jarod Matwiy[1], Calvin Bewsky[1], Hung-Yu Lin[1], and Masoom A. Haider[2,3]

[1]Medical Devices, National Research Council Canada, Winnipeg, MB, Canada, [2]Dept of Medical Imaging, Sunnybrook Health Sciences Center, Toronto, ON, Canada, [3]Department of Medical Imaging, University of Toronto, Toronto, ON, Canada

The pancreas is difficult to image because of its central location deep in the abdomen, often with overlapping artifact in parallel MRI reconstruction through the mid abdomen and drop off of signal. In this new concept for improved SNR and parallel MRI in pancreas MRI, a surface array is pushed/indented into the abdomen, bringing smaller array elements closer to the pancreas. Compared to the benchmark array, the Indenting Array demonstrated >2x SNR and 40% improved R=3 A-P parallel MRI with g-factor = 1 within the pancreas. This new “indenting” array design could have a significant impact on pancreas diagnostic MRI.

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532 17:12

Repeatability of MRI and MRS pancreatic proton density fat fraction (PDFF) quantification methods

Alexandra N Schlein[1], Yesenia Covarrubias[1], Adrija Mamidipalli[1], Jonathan Hooker[1], Michael S Middleton[1], Rohit Loomba[2], Tanya Wolfson[3], Claude B Sirlin[1], and Gavin Hamilton[1]

[1]Radiology, UCSD, San Diego, CA, United States, [2]Hepatology, UCSD, San Diego, CA, United States, [3]Computational and Applied Statistics Laboratory UCSD, San Diego, CA, United States

Advanced MR techniques have been developed to estimate proton density fat fraction (PDFF) of pancreatic fat. The purpose of this study is to assess intra- and inter-examination repeatability of 1H MRS and multi-echo MRI to estimate pancreatic PDFF. Subjects were scanned with both MRI and MRS three times: twice without subject repositioning and then once more after having subjects get off and back on the table. The results suggest that MRI is more repeatable than MRS, especially when subjects are repositioned between acquisitions, which more closely simulates the conditions in which these techniques might be applied clinically and in research.

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533 17:24

Quantitative analysis of diagnosing pancreatic fibrosis using Magnetic resonance elastography

Yu Shi[1], qiyong guo[1], He An[1], Kevin J Glaser[2], and Ehman L Richard[3]

[1]Department of radiology, Shengjing hospital of China medical university, shenyang, China, People's Republic of, [2]Rochester, MN, United States, [3]Department of radiology, Mayo Clinic, Rochester, MN, United States

An accurate diagnosis of pancreatic fibrosis is important in clinical work. MR elastography (MRE) can be used for staging the degrees of pancreatic fibrosis that reflects the severity of chronic pancreatitis. Our work proved that both fibrosis ($P< 0.001$) and inflammation ($P= 0.014$) contribute to higher stiffness of pancreatic parenchyma, excluding fat deposition ($P= 0.082$). The sensitivity and specificity was 100% and 86% for diagnosing ≥F2, and 100% and 100% for diagnosing =F3 fibrosis stage, respectively.

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534 17:36

Impact of Inter-lobular Fat on the Repeatability of Pancreatic Fat Fraction Measurement by MRI.

Adam Jaster[1], Ivan Pedrosa[1,2], Robert E. Lenkinski[1,2], Ildiko Lingvay[3,4], and Takeshi Yokoo[1,2]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [3]Internal Medicine, UT Southwestern Medical Center, Dallas, TX, United States, [4]Clinical Sciences, UT Southwestern Medical Center, Dallas, TX, United States

In pancreatic steatosis, fat accumulates within intra-lobular (parenchyma) and inter-lobular (adipose) tissue. Regions of interest (ROIs)

placed in pancreas include heterogeneous population of pixels of lower-fat intra-lobular tissue, higher-fat inter-lobular tissue, and admixture of the two by partial volume effects. In this study of 21 subjects with insulin-dependent type 2 diabetes, we investigated the impact of inter-lobular fat on the repeatability of pancreatic fat fraction (FF) measurement by multiecho gradient-echo MRI. We found that the mean FF measurement within segmented pancreatic ROI is highly repeatable with intraclass correlation of 0.965 after exclusion of high-fat (FF≥50%) pixels contaminated by inter-lobular fat.

535 17:48 Longitudinal change of pancreatic proton density fat fraction (PDFF) and its correlates during weight loss in initially obese adults

Yesenia Covarrubias[1], Alexandra N Schlein[1], William M Haufe[1], Catherine A Hooker[1], Adrija Mamidipalli[1], Tanya Wolfson[2], Garth Jacobson[3], Santiago Horgan[3], Jeffrey B Schwimmer[4], Scott B Reeder[5], and Claude B Sirlin[1]

[1]Liver Imaging Group, Department of Radiology, University of California, San Diego, School of Medicine, San Diego, CA, United States, [2]Computational and Applied Statistics Laboratory (CASL), SDSC, University of California, San Diego, La Jolla, CA, United States, [3]Department of Surgery, University of California, San Diego, La Jolla, CA, United States, [4]Division of Gastroenterology, Hepatology, and Nutrition & Department of Pediatrics, University of California, San Diego, School of Medicine, San Diego, CA, United States, [5]Departments of Radiology, Medical Physics, Biomedical Engineering, Medicine, Emergency Medicine, University of Wisconsin, Madison, WI, United States

This pilot, prospective, longitudinal study in 9 obese adults explored the relationship between weight loss and longitudinal change in MRI-determined pancreatic proton density fat fraction (PDFF), as well as the relationships between rates of change in pancreatic PDFF, hepatic PDFF, and anthropometric measures. Pancreatic PDFF decreased in every subject from a mean of 15.5% at the first study visit to a mean of 8.6% at the last study visit (p=0.006). Further research in larger cohorts is needed to confirm our findings and to understand the clinical and biological relevance of pancreatic PDFF reduction.

Educational Course

Advances in Pulse Sequences for Body MRI

*Organizers:*Lorenzo Mannelli, M.D., Ph.D., Ivan Pedrosa, M.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 1 13:30 - 15:30 *Moderators:*Ananth Madhuranthakam & Shreyas Vasanawala

13:30 Quantitative Susceptibility Mapping in the Body

Samir D. Sharma[1]

[1]University of Wisconsin - Madison

Quantitative Susceptibility Mapping (QSM) is an emerging technique for measuring the magnetic susceptibility of tissue throughout the body. Within human tissue, the presence of certain biomaterials or pathologies can causes a large change in the magnetic susceptibility of the tissue. Knowledge of the magnetic susceptibility of the particular tissue may be useful in characterizing these conditions.

14:00 Dynamic Contrast Enhanced MRI / MRA

Shreyas Vasanawala

Dynamic contrast-enhanced imaging is a critical component of body MR exams. This lecture will review hardware requirements, and in particular considerations for optimization at 3T. Further, differences in contrast agents and the approach to contrast-enhanced dynamic imaging will be covered, along with bolus injection and timing considerations. Additionally, pulse sequence parameter selection, sampling techniques, fat suppression methods, and view-sharing approaches will be reviewed.

14:30 Acquisition and Modeling Optimization for Quantitative Body DWI Applications

Julien Sénégas[1]

[1]Philips Research Laboratories, Hamburg, Germany

Signal decay in diffusion weighted imaging experiments is governed by different effects such as diffusion, perfusion, and restricted diffusion whose influence varies with the b-values. As a result, more complex models than the popular mono-exponential model have been investigated to fit the measured data and compute diffusion parameters, such as the Intravoxel Incoherent Model (IVIM) and the kurtosis model. The selection of the b-values for the image acquisition has a strong influence on the accuracy and precision of the estimated diffusion parameters. Strategies to optimize the acquisition for clinical routine depending on the tissue properties and the selected model will be presented.

15:00 Update on Parallel Imaging & Body MRI

Katherine Wright

This presentation will explore parallel imaging methods and how they can be used to accelerate MR image acquisition. Potential artifacts and specific considerations for applying parallel imaging techniques to body MRI will also be discussed. In addition to reviewing parallel imaging techniques, clinical applications of parallel imaging will also be explored. Importantly, recent advances in parallel imaging methodology that could benefit body MRI protocols will be reviewed.

15:30 Adjournment & Meet the Teachers

Educational Course

Advanced Tumour Tutorial

*Organizers:*Jennifer A. McNab, Ph.D., Jeffrey Neil, M.D., Ph.D. & Howard Rowley, M.D.

Nicoll 2 13:30 - 15:30 *Moderators:*Howard Rowley & Steven Stufflebeam

13:30 Advanced Tumor Imaging: Pre-operative Mapping
Timothy Roberts[1]

[1]*Childrens Hospital of Philadelphia / U Penn*

Advanced Tumor Imaging: Preoperative Planning

14:10 Advanced Tumor Tutorial: Intra-Operative Imaging
Alberto Bizzi

14:50 Advanced Tumor Tutorial: Post-Treatment Response Assessment
Benjamin M Ellingson[1]

[1]*Radiology, University of California Los Angeles, Los Angeles, CA, United States*

The current lecture will discuss the current standard of care in glioblastoma and malignant glioma as well as new therapies and how they are integrated and may change into this therapeutic landscape. We will then introduce a brief history of response assessment from the WHO and Levin Criteria through Macdonald and classical response assessment in neuro-oncology (RANO) criteria. We will briefly discuss new RANO initiatives including RANO for low grade gliomas, RANO for immunotherapies (iRANO), and updates on classical RANO criteria being developed for the new GBM AGILE global adaptive trial. In addition to classic response assessment we will discuss new perfusion MR approaches including quantification of hypervascular tumor volume by comparison to a large-scale radiographic atlas, new leakage correction algorithms for improved quantification of cerebral blood volume, and the use of new multi-echo perfusion techniques including vascular size imaging (VSI) to characterize changes malignant glioma vasculature during therapy. Lastly we will discuss promising new clinical imaging techniques including pH- and hypoxia-weighted multi-echo amine chemical exchange saturation transfer echoplanar imaging (CEST EPI) of malignant gliomas under a variety of therapeutic conditions in both human and preclinical models.

15:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Imaging Drug Delivery & Drug Function

*Organizers:*Peter Caravan, Ph.D. & David P. Cormode, D.Phil.

Nicoll 3 13:30 - 15:30 *Moderators:*Peter Caravan & David Cormode

13:30 Direct & Indirect MRI Methods to Detect Drug Delivery
Christin Y. Sander[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*

Drug properties are initially defined through in vitro studies and characterized by parameters such as efficacy and affinity. However, in vivo drug profiles can vary widely and depend on the type of imaging modality used, species, methods of administration, and what we define as outcome measures. In this talk, we will show how we can use PET as a direct and fMRI as an indirect method to image drug delivery and its functional response. Taken together, we can establish models that link drug occupancy to functional output and classify drugs according to their in vivo potency.

13:50 Theranostics: Delivering Drug & Contrast Agent Simultaneously
Willem Mulder[1]

[1]*MSSM, United States*

In this educational imaging-facilitated optimization of nanomedicine and the “companion diagnostic" concept, the latest advances in these fields, and translational considerations will be discussed.

14:10

Use of MRI to Monitor Drug Delivery in Combination with Focused Ultrasound

Chrit T. Moonen[1] and Clemens Bos[1]

[1]*UMC Utrecht*

The recently published examples of the use of MR-HIFU for local drug delivery illustrate the important role of multi-modal molecular imaging in the various aspects of ultrasound triggered IGDD. Ultrasound triggered IGDD has been shown to be feasible (1,2), and initial clinical applications have started. (Real-time) molecular imaging methods based on MRI, optical and ultrasound, are used for guidance of actions to release or activate drugs and/or permeabilize membranes, and for evaluation of biodistribution, PK/PD. MRI offers many advantages in this field such as: excellent target definition, temperature monitoring, nanoparticle monitoring, biomarkers for drug release, and biomarkers for BBB opening.

448 14:30

Assessment of atherosclerotic burden using a novel tropoelastin-specific MR contrast agent

Alkystis Phinikaridou[1], Sara Lacerda[1], Begoña L Plaza[1], Marcelo Andia[2], and René M Botnar[1]

[1]*Biomedical Engineering, King's College London, London, United Kingdom,* [2]*Radiology, Pontificia Universidad Católica de Chile, Santiago, Chile*

The extracellular matrix protein (ECM) elastin contributes to 30% of the dry weight of the vascular wall. Vascular injury leads to de novo synthesis of tropoelastin molecules, the precursor of cross-linked mature elastin. Cross-linking has been shown to be inhibited in the presence of inflammation and low-density lipoproteins (LDL), both hallmarks of atherosclerosis and plaque instability. The accumulation of tropoelastin molecules in the pathologically altered vessel wall thus, may serve as a new imaging biomarker to detect atherosclerosis, and potentially plaque instability [1-4]. In this study, we developed a novel tropoelastin-specific MR contrast agent and investigated its merits to quantify disease progression in a murine model of accelerated of atherosclerosis.

449 14:42

Development of nitroxide-based theranostics probes for brain redox research by MRI

Miho C Emoto[1], Shingo Sato[2], and Hirotada G Fujii[1]

[1]*Sapporo Medical Univeristy, Sapporo, Japan,* [2]*Yamagata University, Yonezawa, Japan*

Theranostics probes, which have both therapeutic and diagnostic imaging capabilities in one dose, show great promise for use in MRI examinations. In the present study, we synthesized nitroxide-based theranostics probes by connecting anti-inflammatory drugs, ibuprofen and ketoprofen, to nitroxides that act as T1 contrast agents in MRI. MRI of mouse heads after injection of these synthesized probes showed that they worked as T1 contrast agents in mouse brains. Production of nitric oxide in septic mouse brains was remarkably inhibited by the addition of these probes, indicating that they also acted as anti-inflammatory drugs.

450 14:54

Initial Experience in a Pilot Study of Blood-Brain Barrier Opening for Chemo-Drug Delivery to Brain Tumors by MR-Guided Focused Ultrasound

Yuexi Huang[1], Ryan Alkins[2], Martin Chapman[3], James Perry[4], Arjun Sahgal[5], Maureen Trudeau[6], Todd Mainprize[7], and Kullervo Hynynen[1,2]

[1]*Sunnybrook Research Institute, Toronto, ON, Canada,* [2]*Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada,* [3]*Department of Anaesthesia, Sunnybrook Health Sciences Centre, Toronto, ON, Canada,* [4]*Division of Neurology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada,* [5]*Department of Radiation Oncology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada,* [6]*Division of Medical Oncology and Hematology, Sunnybrook Health Sciences Centre, Toronto, ON, Canada,* [7]*Division of Neurosurgery, Sunnybrook Health Sciences Centre, Toronto, ON, Canada*

In the first case of a pilot clinical study to establish the feasibility, safety and preliminary efficacy of focused ultrasound to temporarily open blood brain barrier (BBB) to deliver chemotherapy to brain tumors, BBB was successfully opened at two targeted volumes close to the peripheral margin of the tumor, approximately 4cm lateral from the midline of the brain. This may provide a new way to deliver therapeutic agents into brain for the treatment of tumors and other brain diseases.

451 15:06

Development of Gadoxetate DCE-MRI to Evaluate Liver Transporter Function: Reproducibility of Established Technique and Application in OATP KO Rats

Apoorva Mondal[1], Xiangjun Meng[2], Richard Kennan[3], Jocelyn Yabut[4], Cristian Salinas[5], and Catherine D. G. Hines[2]

[1]*Telecommunications Engineering, University of Maryland-College Park, College Park, MD, United States,* [2]*Translational Imaging Biomarkers, Merck Research Laboratories, West Point, PA, United States,* [3]*Translational Imaging Biomarkers, Merck Research Laboratories, Kenilworth, NJ, United States,* [4]*Pharmacokinetics, Merck Research Laboratories, Rahway, NJ, United States,* [5]*Biogen, Inc., Cambridge, MA, United States*

Recently, Ulloa et al described a compartmental modeling approach to measure gadoxetate influx and efflux as a potential biomarker of hepatobiliary transporter function, as uptake and efflux are mediated by known transporters. The purpose of this study was to reproduce the described acquisition and post-processing, and apply the MRI assay to variations of liver influx transporter Oatp1a/1b knock-out (KO) rats to potentially differentiate between degrees of transporter function. In vivo results demonstrate significant differences in influx constants between groups of KO rats, and that this assay may be suitable for investigating drug-induced liver injury and drug-drug interactions.

452 15:18 MRI assessment of Changes in Tumor Oxygenation post Hypoxia-targeted Therapy

Shubhangi Agarwal[1], Troy Kozlowski[1], Rohini Vidya Shankar[1], Landon J. Inge[2], and Vikram D. Kodibagkar[1]

[1]SBHSE, Arizona State University, Tempe, AZ, United States, [2]St. Joseph's Hospital and Medical Center, Phoenix, AZ, United States

Solid tumors have hypoxic foci that be targeted using hypoxia activated/targeting drugs. Utilizing quantitative MR oximetry techniques such as the PISTOL (Proton Imaging of Siloxanes to map Tissue Oxygenation Levels) technique could allow for patient stratification for personalized therapy. This study uses the PISTOL technique to evaluate how the hypoxia activated drug TPZ (Tirapazamine) depends on and affects the oxygenation and edema fraction of epidermoid carcinoma (A431) and non-small cell lung cancer (H1975). Surprisingly, TPZ was more effective on the H1975 tumors than A431, in spite of higher pre-treatment pO2 levels, potentially due to perfusion-related differences in tumor drug delivery.

15:30 Adjournment & Meet the Teachers

Focused Discussion Session

Focus Session: Gd in the Brain

Hall 606 16:00 - 18:00 *Moderators:*Jürgen Hennig & Robert Turner

16:00 Introduction

509 16:15 Deep brain nuclei T1 shortening after gadolinium in children: influence of radiation and chemotherapy

Sonja Kinner[1,2], Tilman B Schubert[1,3], Susan Rebsamen[1], Richard Bruce[1], Scott B Reeder[1,4,5,6,7], and Howard A Rowley[1]

[1]Department of Radiology, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [2]Department of Diagnostic and Interventional Radiology and Neuroradiology, University Hospital Essen, Essen, Germany, [3]Clinic for Radiology and Nuclear Medicine, Basel University Hospital, Basel, Switzerland, [4]Department of Medical Physics, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [5]Department of Emergency Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [6]Department of Medicine, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States, [7]Department of Biomedical Engineering, University of Wisconsin School of Medicine and Public Health, Madison, WI, United States

Recent studies report intrinsic T1 hyperintense signal in deep brain nuclei on MRI after multiple doses of gadolinium-based contrast agents in adults. We investigated whether similar T1 shortening was also found in children, and furthermore evaluated the influence of radiochemotherapy (RCTX) on its appearance. Signal increases were found in 2/60 children without RCTX and in 12/16 children with RCTX. Signal ratio changes were significantly different between the two groups and appeared with fewer doses in children with RCTX.

510 16:30 T1 relaxometry indicate cerebral gadolinium retention after multiple administration of a macrocyclic Gd-based contrast agent: A Retrospective Study in 27 patients with Glioblastoma Multiforme

Svein Are Vatnehol[1], Inge Rasmus Groote[1], Christopher Larsson[1], Magne Kleppestø[1], Jonas Vardal[1], and Atle Bjørnerud[1,2]

[1]The Intervention Center, Oslo University Hospital, Oslo, Norway, [2]Department of Physics, University of Oslo, Oslo, Norway

Recent publications have shown an increase in signal intensity on non-enhanced T1w-images for the Dentate Nucleus and Globus Pallidus. This effect seems to be linked to multiple administrations of linear gadolinium chelate. In this retrospective study we have analyzed the quantitative T1 values (qT1) and the normalized native T1 signal intensity (nSI) for the Globus Pallidus and the nSI for the Dentate Nucleus in patients with multiple injections of gadobutrol (Gadovist™). Our analysis suggest a significant change in the qT1 and nSI for the Globus Pallidus as well as in the nSI for the Dentate Nucleus

511 16:45 Gadolinium Deposition in the brain: Pre-clinical Investigation of differences in concentration, Distribution and histology in animals after repeated Administrations of linear and macrocyclic GBCAs

Hubertus Pietsch[1], Thomas Frenzel[1], Anna-Lena Frisk[1], Diana Constanze Lenhard[2], Gregor Jost[1], Martin Andrew Sieber[1], Astrid Zimmermann[3], Volker Nischwitz[3], and Jessica Lohrke[1]

[1]Bayer Healthcare, Berlin, Germany, [2]Charité, Humboldt University Berlin, Berlin, Germany, [3]Forschungszentrum Jülich, Jülich, Germany

Recent publications reported increased T1-weighted signal intensities in the dentate nucleus of patients who received multiple contrast-enhanced MRI scans. In this animal study histopathological changes and gadolinium retention in the skin and brain of rats after twenty intravenous injections of linear and macrocyclic GBCAs at high doses (2.5mmol/kgbw) were systematically investigated. The Gd brain concentrations of linear GBCAs (gadodiamide, gadopentetate dimeglumine) were significantly higher than those of macrocyclic agents (gadobutrol, gadoteridol). Since no morphological changes could be detected by routine H&E microscopic examination, immunohistochemistry and special stains, these findings are considered be of no toxicological relevance in rats.

512 17:00 T1-weighted signal increase in the rat brain after multiple, high-dose administrations of gadolinium based contrast agents: Comparison of linear and macrocyclic agents

Gregor Jost[1], Diana Lenhard[2], Jessica Lohrke[1], Thomas Frenzel[1], and Hubertus Pietsch[1]

[1]*MR and CT Contrast Media Research, Bayer Healthcare, Berlin, Germany,* [2]*Institute of Vegetative Physiology, Charité, Berlin, Germany*

Recent publications reported increased T1-weighted (T1w) signal intensities (SI) in the dentate nucleus and globus pallidus after repeated administrations of gadolinium based contrast agents (GBCAs). In the present animal study the T1w SI of three linear and two macrocyclic GBCAs were systematically evaluated after ten administrations each with a dose of 2.5 mmol/kg. Increased cerebellar nuclei to pons SI ratios were found after administration of linear GBCAs (significantly increased for gadodiamide and gadobenate dimeglumine, and non-significantly increased for gadopentetate dimeglumine). In contrast no elevated SI ratios were observed after administration of the macrocyclic GBCAs gadobutrol and gadoterate meglumine or saline.

513 17:15

Regional uptake and clearance of Gd(III) DTPA in the healthy adult mouse brain
Daniel Calle[1], Irene Guadilla[1], Pilar López-Larrubia[1], and Sebastián Cerdán[1]

[1]*Instituto de Investigaciones Biomédicas "Alberto Sols", CSIC, Madrid, Spain*

We report on the kinetics of uptake and clearance of Gd(III)DTPA from different brain structures to healthy mice. We fitted a biexponential model to cerebral time courses of increase and decrease of T_{1w} MRI signal intensity, calculating rate constants for the uptake (k_{abs}) and elimination (k_{el}). k_{abs} showed the rapid absorption in the ventricles and hypothalamus, slowing down significantly in the cortex, globus pallidus and dentante nucleus. These latter structures required 617 h. (cortex), 245 h. (globus pallidus) and approximately 100h (hypothalamus and dentate nucleus), to remove 99% of the administered agent, revealing very high cerebral residence times of Magnevist.

514 17:30

Contrast enhancement of perivascular spaces in the basal ganglia
Shinji Naganawa[1] and Toshiaki Taoka[1]

[1]*Department of Radiology, Nagoya University Graduate School of Medicine, Nagoya, Japan*

Perivascular spaces (PVS) have been described as non-enhancing structures with a fluid signal. In this study, we confirmed that PVS signals are enhanced in images obtained 4 hours after intravenous administration of gadolinium based contrast agent (GBCA) in human subjects without renal insufficiency. Contrast enhancement of CSF was also observed. It is possible that GBCA in the blood vessels might have permeated into the CSF space and PVS. This could be the route by which GBCA is distributed to brain parenchyma through the *glymphatic system* in subjects with a normal blood brain barrier.

515 17:45

Regional and global assessment on relaxometric quantitative MRI in patients with previous administration of a linear gadolinium-based contrast agent
Hirofumi Kuno[1], Hernan Jara[1], Karen Buch[1], Andrew Mills[1], Muhammad Mustafa Quresh[1], Neil Thayil [1], Margaret N Chapman[1], and Osamu Sakai[1]

[1]*Radiology, Boston University, Boston Medical Center, Boston, MA, United States*

To assess potential regional and global correlations between brain relaxation times and the number of prior administrations of linear gadolinium-based contrast agents (GBCA) using quantitative MRI. The subjects consisted of 40 patients (7 patients with multiple prior linear GBCA exposures and 33 patients with no prior GBCA exposures) with brain MRI using the mixed turbo spin-echo pulse sequence. T1 and T2 relaxation times were assessed in selected regions of brain parenchyma (GP, DN, thalamus, and pons) and the whole brain, and were demonstrated to be associated with the number of gadolinium administrations. A stronger relationship was demonstrated in gray matter.

Combined Educational & Scientific Session

Advanced Cartilage Imaging

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 16:00 - 18:00 *Moderators:*Miika Nieminen & Ravinder Regatte

16:00

Compositional Mapping Techniques
Xiaojuan Li

16:30

Advanced Cartilage Imaging: Clinical Applications
Michel Crema

Advanced MRI techniques enable evaluation of the biochemical composition of articular cartilage. Compositional MRI techniques have the potential to supplement clinical MRI sequences in identifying cartilage degeneration at an earlier stage than is possible today using morphologic sequences only. Although there is some evidence regarding the relationship with some compositional MRI techniques (mainly T2 mapping, T1rho, and dGEMRIC) with symptoms and progression of disease, additional work is needed to isolate the role of the different compositional MRI techniques in predicting structural and clinical outcomes taking into account feasibility of application, reliability and responsiveness of the different techniques available today.

536 17:00

Comparison of DESS T2 Relaxation Times and Apparent Diffusion Coefficient in Articular Cartilage at 3T and 7T

Garry E Gold[1], Bragi Sveinsson[2], Kevin Eppersson[2], Akshay Chaudhari[3], Marcus Alley[2], Daehyun Yoon[2], Brian A Hargreaves[3], and Feliks Kogan[2]

[1]Radiology, Bioengineering, and Orthopedic Surgery, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Radiology and Bioengineering, Stanford University, Stanford, CA, United States

Double-echo Steady-Sate (DESS) is an efficient 3D approach to measure cartilage thickness, T2, and apparent diffusion coefficient (ADC). We tested the DESS sequence at 3T and 7T in healthy volunteers. DESS can acquire accurate cartilage T2 and ADC values at both 3T and 7T, with more consistent ADC measurements at 7T, likely due to less image noise in the fit.

537 17:12

DESS T2 mapping in Knee Cartilage at Supine and Standing Positions in an Upright MR Scanner

Andrew C Yung[1], Reza Nickmanesh[2], Piotr Kozlowski[1,3], and David R Wilson[2,4]

[1]UBC MRI Research Centre, University of British Columbia, Vancouver, BC, Canada, [2]Centre for Hip Health and Mobility, University of British Columbia, Vancouver, BC, Canada, [3]Radiology, University of British Columbia, Vancouver, BC, Canada, [4]Department of Orthopaedics, University of British Columbia, Vancouver, BC, Canada

With the use of an upright open MR scanner, we demonstrate knee cartilage T2 mapping using DESS in a true standing position for the first time, and have shown preliminary evidence that there may be differences between loading the joint in the standing position versus the supine loaded and unloaded case. The volumetric DESS T2 maps were acquired with short acquisition time which is critical for imaging weightbearing postures, while maintaining a range of T2 values that were similar to gold-standard T2 maps generated by a multi-spin-echo sequence.

538 17:24

Texture analysis of T2 relaxation time maps reveals degenerative changes in articular cartilage: Oulu Knee Osteoarthritis study

Arttu Peuna[1,2,3], Joonas Hekkala[1,3], Marianne Haapea[1,2], Jana Podlipska[1,3], Ali Guermazi[4], Miika T Nieminen[1,2,3], Simo Saarakkala[1,2,3], and Eveliina Lammentausta[1,2]

[1]Medical Research Center, University of Oulu and Oulu University Hospital, Oulu, Finland, [2]Department of Diagnostic Radiology, Oulu University Hospital, Oulu, Finland, [3]Research group of Medical Imaging, Physics and Technology, University of Oulu, Oulu, Finland, [4]Department of Radiology, Boston University School of Medicine, Boston, MA, United States

Gray level co-occurrence matrix based texture analysis is a sensi ve image processing method that probes the spa al informa on from knee MR T2 maps and of the changes caused by osteoarthri s (OA). Texture analysis can dis nguish symptoma c pa ents from healthy control subjects more sensi vely than regional mean T2 analysis, and provides addi onal informa on also when compared to clinical evalua ons such as MOAKS. Advanced learning algorithms can be further u lized to classify asymptoma c and OA subjects.

539 17:36

Use of comprehensive MRI to assess cartilage composition in patients with acute cartilage injury

Didier Laurent[1], Stefan Zbyn[2], Vladimir Mlynarik[2], Markus Schreiner[2], Pavol Szomolanyi[2], Nicole Getzmann[1], Harry Haber[1], Joerg Goldhahn[1], Stefan Marlovits[3], and Siegfried Trattnig[2]

[1]Novartis Institutes fo Biomedical Research, Basel, Switzerland, [2]Department of Biomedical Imaging and Image-Guided Therapy, Medical University of Vienna, Vienna, Austria, [3]Department of Traumatology, Medical University of Vienna, Vienna, Austria

A comprehensive MRI approach was implemented to assess cartilage macromolecular composition in patients with acute cartilage injury. Differences in T2 relaxation and gagCEST asymmetry values were observed between the defective and adjacent regions in the tibio-femoral cartilage. Preliminary results indicate that the combination of T2 mapping with gagCEST scans at 7T may be reproducible and sensitive enough to monitor early cartilage degeneration, and thus may be considered as a good alternative to cartilage biopsies in future clinical trials on new therapies aimed at cartilage regeneration.

540 17:48

A New High-resolution 3D gagCEST Imaging method for In Vivo Human Knee Cartilage at 7T

Guruprasad Krishnamoorthy[1], Ravi Prakash Reddy Nanga[1], Puneet Bagga[1], Hari Hariharan[1], and Ravinder Reddy[1]

[1]Center for Magnetic Resonance and Optical Imaging, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States

Osteoarthritis (OA), one of the most prevalent musculoskeletal conditions, affects a large number of people around the world with an increased risk on an even larger number of people getting affected by it in the future [1]. GAG chemical exchange saturation transfer (gagCEST) is a promising MRI technique to non-invasively quantify GAG content present in the cartilages [2]. In this study, a new burst mode magnetization preparation 3D gagCEST technique was developed which provided high-resolution gagCEST maps of knee cartilages in practically achievable scan times at 7T with more than twice the sensitivity of the previously reported steady-state saturation 3D gagCEST study [5].

18:00 Adjournment & Meet the Teachers

Educational Course

MR Physics & Techniques for Clinicians

*Organizers:*Marcus T. Alley, Ph.D., Brian Hargreaves, Ph.D., Michael Markl, Ph.D., Bernd Jung, Ph.D. & Nicole Seiberlich, Ph.D.

Nicoll 3 | 16:00 - 18:00 | *Moderators:*Michael Markl & Pauline Worters

16:00 Spin Echo Imaging
Pauline Worters

Understand the basic physics and properties of pulse sequences based upon spin echoes

Describe fast spin-echo imaging and applications of basic MR pulse sequences

Design MRI protocols for diagnostic applications considering image contrast, spatial resolution, acquisition time, signal-to-noise ratio and artifacts

17:00 Gradient Echo Imaging
Oliver Bieri[1,2]

[1]Department of Radiology, Division of Radiological Physics, University Hospital Basel, Basel, Switzerland, [2]Department of Biomedical Engineering, University of Basel, Basel, Switzerland

The fundamental signal generation in magnetic resonance imaging (MRI) sequences is based on the principle of either spin echoes or gradient echoes or a combination of the two. This course elucidates concepts and basic properties of gradient echo methods with a special focus on fast gradient echo sequences.

18:00 Adjourment & Meet the Teachers

Educational Course

Game Show: What Artefacts-lah?

*Organizers:*Wally Block, Ph.D. & Nicole Seiberlich, Ph.D.

Nicoll 2 | 16:00 - 18:00

16:00 Artifact Identification & Elimination Game Show
Eric G Stinson[1]

[1]Mayo Clinic, Rochester, MN, United States

An educational and entertaining romp through common and uncommon MR artifacts with explanations by experts in the field.

17:00 Doctor! An Artifact!
Dominik von Elverfeldt[1]

[1]Uniklinik-Freiburg

The purpose of this course is to introduce the audience to image artifacts that may occur when using MRI, to explain what causes these artifacts, and to offer some ways to mitigate these artifacts. The course information will be presented in a light hearted “game show” format where “contestants” will be asked to answer a series of questions about the artifacts being presented. Audience participation through the audience response system will be encouraged. Following these short “game show” segments, experts in the field will offer brief presentations discussing the appearance of the artifacts, the physics causing the artifacts and practical methods to avoid or minimize them.

18:00 Adjournment & Meet the Teachers

Corporate Symposium

Gold Corporate Symposium Philips Healthcare

Plenary Hall | 12:15 - 13:15

Corporate Symposium

Silver Corporate Evening Symposium: Toshiba Medical Systems

Hall 606 | 18:30 - 20:30

Corporate Symposium

Bronze Corporate Evening Symposium: Bracco

Nicoll 1 | 18:30 - 20:30

Wednesday, May 11, 2016

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Sunrise Session

Multiparametric MR for Cancer

*Organizers:*Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 300-302 | 7:00 - 7:50 | *Moderators:*Jeong Min Lee & Taro Takahara

Tumor Diagnosis with Diffusion
Nandita deSouza

Multiparametric MRI Therapy Response in Bone
Anwar Padhani

Adjournment & Meet the Teachers

Sunrise Session

High-Throughput: The 5 Minute MR Scan

*Organizers:*Garry E. Gold, M.D. & Joshua D. Trzasko, Ph.D.

Room 324-326 | 7:00 - 7:50 | *Moderators:*Joshua Trzasko

High Throughput: The 5 minute MR Scan for Pediatric Imaging
Shreyas Vasanawala

Neuroimaging: Fast Brain MR Imaging
Kambiz Nael

Adjournment & Meet the Teachers

Sunrise Session

Addressing Clinical Challenges in the Body with MRI: Contrast Agents

Organizers: Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 | 7:00 - 7:50 | *Moderators:*Jeff Maki & Utaroh Motosugi

Addressing Clinical Challenges in the Body with MRI: Contrast Agents Hepatobiliary
Jeong Min Lee

Intravascular
Tim Leiner

Adjournment & Meet the Teachers

Sunrise Session

White Matter Changes Across the Lifespan

*Organizers:*Andrew Alexander, Ph.D. & Jennifer A McNab, Ph.D.

Room 334-336 | 7:00 - 7:50 | *Moderators:*Andrew Alexander & Shannon Kolind

White Matter Changes Across the Lifespan: Development & Maturation
Anqi Qiu

White Matter Changes Across the Lifespan: Aging
Hernan Jara

Adjournment & Meet the Speakers

Sunrise Session

Interventional MRI: Devices & Cardiovascular Applications

*Organizers:*Michael S. Hansen, Ph.D. & Viola Rieke, Ph.D.

Summit 1 | 7:00 - 7:50 | *Moderators:*Michael Hansen

Active & Passive Devices
Kevan Anderson

Cardiovascular Applications
Reza Razavi

Adjournment & Meet the Teachers

Sunrise Session

Susceptibility Quantitative Mapping

*Organizers:*Thomas K. F. Foo, Ph.D. & John F. Schenck, M.D., Ph.D.

Summit 2 | 7:00 - 7:50 | *Moderators:*Luke Xie

Susceptibility & Quantitative Mapping – Description, Overview and Method
Jürgen Reichenbach

Susceptibility & Quantitative Mapping - Clinical Potential & Relevance
Susan Gauthier

Adjournment & Meet the Teachers

Sunrise Session

Cardiovascular Image Processing

*Organizers:*Daniel Ennis, Ph.D. & Martin Graves, Ph.D.

Nicoll 1 | 7:00 - 7:50 | *Moderators:*Daniel Ennis & Martin Graves

Functional Analysis
Daniel Ennis

Perfusion Quantification
Michael Jerosch-Herold

2D/4D Flow Quantification
Alejandro Roldan-Alzate

Adjournment & Meet the Teachers

Sunrise Session

CEST Imaging: Techniques & Challenges

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 2 | 7:00 - 7:50 | *Moderators:*Ravinder Reddy & Siegfried Trattnig

CEST Imaging Techniques & Challenges
Gil Navon

MSK Applications (Cartilage, Disc , Muscle)
Benjamin Schmitt

Adjournment & Meet the Teachers

Sunrise Session

Controversies in Diffusion & Functional MRI

*Organizers:*Daniel C. Alexander, Ph.D., Jay J. Pillai, M.D. & Jonathan R. Polimeni, Ph.D.

Nicoll 3 | 7:00 - 7:50 | *Moderators:*Jay Pillai

Ultra-Fast fMRI of Task & Rest
Vesa Kiviniemi

Advanced Diffusion vs DTI Tractography for Surgical Planning
Alberto Bizzi

Adjournment & Meet the Teachers

Plenary Session

Advancing the Understanding, Diagnosis & Treatment of Cancer

*Organizers:*Daniel B. Ennis, Ph.D. & Linda Moy, M.D.

Plenary Hall | 8:10 - 9:10 | *Moderators:*Daniel Ennis & Linda Moy

The Essential Biology of Cancer Therapy
Sandro V Porceddu[1]

[1]*Radiation Oncology Department, Princess Alexandra Hospital, Queensland, Australia*
Sandro Porceddu

Advanced Multimodal MRI for Clinical Management of Brain Tumor Patients
Bejoy Thomas, MD[1]

[1]*Dept. of Imaging Sciences and Interventional Radiology, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivandrum, Kerala, India.*
Bejoy Thomas, MD

MRI Guided Radiotherapy
Jan J.W. Lagendijk[1], Bas W. Raaymakers[1], and Marco van Vulpen[1]

[1]*Radiotherapy, UMC Utrecht, Center for Image Sciences, Utrecht, Netherlands*
Jan Lagendijk

Plenary Session

NIBIB New Horizons Lecture

Plenary Hall 9:10 - 9:30

NIBIB New Horizons Lecture: A New Generation of Accelerated Imaging: Optimised Encoding in the Quest for Speed
Kawin Setsompop
Kawin Setsompop

Adjournment

Traditional Poster : Diffusion

Exhibition Hall 10:00 - 12:00 *(no CME credit)*

Electronic Poster : Molecular Imaging

Exhibition Hall 10:00 - 11:00 *(no CME credit)*

Electronic Poster : Functional MRI (Neuro)

Exhibition Hall 10:00 - 11:00 *(no CME credit)*

Study Groups

MR in Drug Research

Hall 405 E 10:00 - 12:00

Study Groups

Hyperpolarisation Methods & Equipment

Hall 406 D 10:00 - 12:00

Power Pitch

MR Engineering, Safety & Interventional

Power Pitch Theatre, Exhibition Hall 10:00 - 11:00 *Moderators:*Richard Bowtell

541 10:00 Porcine Imaging in a 10.5T Whole-Body Human MRI
Lance DelaBarre[1], Russell L. Lagore[1], Yigitcan Eryaman[1], Gregor Adriany[1], and J. Thomas Vaughan[1]

[1]Center for Magnetic Resonance Research - University of Minnesota, Minneapolis, MN, United States

542 10:03 The first demonstration of simultaneous transmit and receive MRI in vivo
Sung-Min Sohn[1], J. Thomas Vaughan[1], Michael Garwood[1], and Djaudat Idiyatullin[1]

[1]Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

543 10:06 Anatomically adaptive local coils for MR Imaging - Evaluation of stretchable antennas at 1.5T
Bernhard Gruber[1] and Stephan Zink[2]

[1]Medical Engineering - School of Applied Health and Social Sciences, University of Applied Sciences Upper Austria, Linz, Austria, [2]R&D HW LC, Siemens Healthcare GmbH, Erlangen, Germany

544 10:09 Gradient response harvesting for continuous system characterization during MR sequences
Bertram J. Wilm[1], Benjamin E. Dietrich[1], Jonas Reber[1], S. Johanna Vannesjo[1], and Klaas P. Pruessmann[1]

[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zurich, Switzerland

545 10:12 A Wireless MRI system using mm-Wave Transmission
Kamal Aggarwal[1], Kiran Raj Joshi[1], Yashar Rajavi[1,2], Mazhareddin Taghivand[1,2], Ada S. Y. Poon[1], John M. Pauly[1], and Greig Scott[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Qualcomm Atheros, San Jose, CA, United States

546 10:15

A Broadband Spectrometer for Simultaneous Multinuclear Magnetic Resonance Imaging and Spectroscopy

Stephen Ogier[1], John C Bosshard[1], and Steven M Wright[1]

[1]Electrical and Computer Engineering, Texas A&M University, College Station, TX, United States

547 10:18

MR Probe Design with On-Coil Digital Receiver

David Otto Brunner[1], Benjamin Sporrer[2], Christian Vogt[3], Jonas Reber[1], Josip Marjanovic[1], Luca Bettini[2], Lianbo Wu[2], Thomas Burger[2], Gerhard Troester[3], Qiuting Huang[2], and Klaas P Pruessmann[1]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Integrated Systems Laboratory, ETH Zurich, Zurich, Switzerland, [3]Electronics Laboratory and Wearable Computing Group, ETH Zurich, Zurich, Switzerland

548 10:21

summa cum laude

Ultra-fast MRI based transfer function determination for the assessment of implant safety.

Janot Tokaya[1], A.J.E. Raaijmakers[1], J.F. Bakker[2], P.R. Luijten[1], and C.A.T. van den Berg[1]

[1]Imaging Division, UMC Utrecht, Utrecht, Netherlands, [2]Medtronic, Eindhoven, Netherlands

549 10:24

summa cum laude

Improving Peak Local SAR Prediction in Parallel Transmit Using In-situ S-matrix Measurements

Matthew Restivo[1], Alexander Raaijmakers[1], Cornelis A.T. van den Berg[1], Pedro Crespo-Valero[2], Peter Luijten[1], and Hans Hoogduin[1]

[1]Center for Imaging Sciences, University Medical Center Utrecht, Utrecht, Netherlands, [2]Zurich Med Tech, Zurich, Switzerland

550 10:27

Percentage of change in the calculated SAR values in human head during 3T MRI of patients with deep brain stimulation implants: A computational study of realistic vs. simplified lead trajectories

Laleh Golestanirad[1], Maria Ida Iacono[2], Leonardo M Angelone[2], and Giorgio Bonmassar[1]

[1]Radiology, Massachusetts General Hospital, Charlestown, MA, United States, [2]Division of Biomedical Physics, Office of Science and Engineering Laboratories, Center for Devices and Radiological Health, US Food and Drug Administration, Silver Spring, MD, United States

551 10:30

magna cum laude

Accurate MR Thermometry by Hyperpolarized 129Xe

Le Zhang[1,2], Alex Burant[2,3], Andrew McCallister[2,3], Karl Koshlap[4], Simone Degan[5], Michael Antonacci[2,3], and Rosa Tamara Branca[2,3]

[1]Department of Applied Physical Sciences, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [2]Biomedical Research Imaging Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [3]Department of Physics and Astronomy, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [4]Eshelman School of Pharmacy, University of North Carolina at Chapel Hill, Chapel Hill, NC, United States, [5]Center for Molecular and Biomolecular Imaging, Duke University, Durham, NC, United States

552 10:33

MR Guided Focused Ultrasound Thalamotomy for Essential Tremor - Maryland Experience

Rao P Gullapalli[1], Jiachen Zhuo[1], Dheeraj Gandhi[1], Charlene Aldrich[2], Erma Owens[1], John Hebel[1], Paul Fishman[3], Howard Eisenberg[2], and Elias Melhem[1]

[1]Diagnostic Radiology & Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States, [2]Neurosurgery, University of Maryland School of Medicine, Baltimore, MD, United States, [3]Neurology, University of Maryland School of Medicine, Baltimore, MD, United States

553 10:36

Magnetic Resonance-Guided Focused Ultrasound Treatment of Extra-Abdominal Desmoid Tumors: A Retrospective Multicenter Study

Pejman Ghanouni[1], Andrew Dobrotwir[2], Alberto Bazzocchi[3], Matthew Bucknor[4], Rachelle Bitton[1], Jarrett Rosenberg[1], Kristen Telischak[5], Maurizio Busacca[3], Stefano Ferrari[6], Ugo Albisinni[3], Shannon Walters[1], Kristen Ganjoo[7], Alessandro Napoli[8], Kim Butts Pauly[1], and Raffi Avedian[9]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Radiology, The Royal Women's Hospital, Parkview, Australia, [3]Diagnostic and Interventional Radiology, The Rizzoli Orthopaedic Institute, Bologna, Italy, [4]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [5]Anesthesiology, Perioperative and Pain Medicine, Stanford University, Stanford, CA, United States, [6]Oncology, The Rizzoli Orthopaedic Institute, Bologna, Italy, [7]Medicine, Stanford University, Stanford, CA, United States, [8]Radiology, Sapienza University, Rome, Italy, [9]Orthopaedic Surgery, Stanford University, Stanford, CA, United States

554 10:39

White-Matter-Nulled MP-RAGE Predicts Clinical Outcome of Focused Ultrasound Thalamic Ablation for Essential Tremor

Jason Su[1], Christian Federau[2], Thomas Tourdias[3], Manojkumar Saranathan[4], Casey Halpern[5], Jaimie Henderson[5], Veronica Santini[6], Kim Butts-Pauly[2], Pejman Ghanouni[2], and Brian Rutt[2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Neuroradiology, Bordeaux University Hospital, Bordeaux, France, [4]Radiology, University of Arizona, Tucson, AZ, United States, [5]Neurosurgery, Stanford University, Stanford, CA, United States, [6]Neurology, Stanford University, Stanford, CA, United States

555 10:42 Evaluation of thermal ablation with a 230 kHz transcranial MRI-guided focused ultrasound system in a large animal model

Nathan McDannold[1], Jonathan Sutton[1], Natalia Vykhodtseva[1], and Margaret Livingstone[2]

[1]Radiology, Brigham and Women's Hospital, Boston, MA, United States, [2]Neurobiology, Harvard Medical School, Boston, MA, United States

556 10:45 MR safety screening - Is it really worth the time investment?

Derek K Jones[1], John Evans[1], and Richard G Wise[1]

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

Oral

Neurodevelopmental Imaging

Room 300-302 10:00 - 12:00 *Moderators:*Jeff Neil & Tetsu Niwa

557 10:00 Quantitative Determination of Pediatric Myelination Using Fast Bound-Pool Fraction Imaging

Hunter R Underhill[1,2] and Gary Hedlund[2]

[1]Pediatrics, University of Utah, Salt Lake City, UT, United States, [2]Radiology, University of Utah, Salt Lake City, UT, United States

Fast bound-pool fraction imaging (FBFI) is a quantitative MRI technique validated with histology to measure whole-brain, voxel-based myelin density. In this study, FBFI was translated to a whole-body 3T clinical scanner using only standard preset sequences without modifications to measure myelin density in the developing pediatric brain via a time-efficient methodology (<7 min). We found that FBFI effectively quantifies myelin density during normal development. Progressive myelination identified in the posterior white matter corresponded strongly to a bounded exponential growth curve. Quantification of myelin density with FBFI in pediatric patients may improve detection of delayed or altered myelination.

558 10:12 Longitudinal Probing Infant Brain Connectomes Using Graph Theory

Longchuan Li[1,2], Sarah Shultz[1], Xiaoping Hu[2], Ami Klin[1], and Warren Jones[1]

[1]Marcus Autism Center, Emory University, Atlanta, GA, United States, [2]Biomedical Imaging Technology Center, Emory University, Atlanta, GA, United States

We used diffusion tractography and network theory to examine the organizational development of the brain in typical infants in their first 6 months of life. Data were longitudinally sampled at randomized time points between birth and 6 months and collected on a Siemens 3T TIM Trio system with 32-channel coil using multiband techniques. We found that network-based metrics may reveal unique information in the organizational principles of the brain and its development that is impossible with conventional methods focusing on specific pathways and regions, demonstrating the usefulness of the approach in studying early typical brain development and its disruptions.

559 10:24 Toward routine assessment of cerebral blood flow in neonates and infants: a phase-contrast MRI study

Peiying Liu[1], Ying Qi[2], Zixuan Lin[1], Xuna Zhao[3], Qiyong Guo[2], Xiaoming Wang[2], and Hanzhang Lu[1]

[1]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Shengjing Hospital of China Medical University, Shenyang, China, People's Republic of, [3]Philips Healthcare, Beijing, China, People's Republic of

Knowledge of CBF in neonates or infants may provide valuable information in many pathological conditions. When applied to very young children, CBF mapping using arterial-spin-labeling (ASL) MRI suffers from low SNR and poor quantification, whereas phase-contrast (PC) MRI may provide reliable estimation of global CBF. Therefore, this study aim to 1) provide a set of age-specific PC-MRI protocols for CBF quantification in children under 1.5 years old; 2) establish typical arterial flow velocity in children at this age which could guide future ASL efforts in labeling pulse optimization; 3) report how CBF changes during this early stage of life.

560 10:36 Global and regional cortical connectivity maturation index (CCMI) of developmental human brain with quantification of short-range association tracts

magna cum laude

Minhui Ouyang[1], Tina Jeon[1], Jennifer Muller[1], Virendra Mishra[2], Haixiao Du[3], Yu Wang[3], Yun Peng[4], Bo Hong[5], and Hao Huang[1,6]

[1]Department of Radiology, Children's Hospital of Philadelphia, Philadelphia, PA, United States, [2]Cleveland Clinic Lou Ruvo Center for Brain Health, Las Vegas, NV, United States, [3]Department of Electronic Engineering, Tsinghua University, Beijing, China, People's Republic of,

[4]Department of Radiology, Beijing Children's Hospital, Capital Medical University, Beijing, China, People's Republic of, [5]Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of, [6]Department of Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, United States

Disturbance of precisely balanced strengthening of certain axons and pruning of others in developmental human brains is associated with mental disorders such as autism and schizophrenia. To characterize this balance, we defined a cortical connectivity maturation index (CCMI) derived from short-range association tracts traced with diffusion MRI tractography. The brain CCMI values were measured with diffusion MRI and T_1-weighted datasets of 21 healthy subjects with age of 2-25 years. CCMI in all cortical regions decreased in early developmental stage and increased later, yet with distinctive trajectories. The observed CCMI dynamics may be underlaid by heterogeneous pruning among cortical regions.

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561 10:48

Parental Education and Childhood Brain and Behavioral Development

Sean Deoni[1,2], Holly Dirks[2], Jonathan O'Muircheartaigh[3], and Douglas C Dean[4]

[1]CHILD Lab, Children's Hospital, Colorado, Aurora, CO, United States, [2]Advanced Baby Imaging Lab, Brown University, Providence, RI, United States, [3]Neuroimaging, King's College, London, London, United Kingdom, [4]Waisman Lab for Brain Imaging and Behavior, University of Wisconsin Madison, Madison, WI, United States

It is well established that family socioeconomic status (SES), related to parental education level, occupation, and income, is associated with differences in offspring educational outcomes and cognitive abilities. However, while brain imaging studies in older children have revealed altered brain structure associated with SES, the influence of SES on infant and childhood brain development remain unclear. Here we investigated longitudinal trajectories of brain and cognitive development in a large cohort of typically-developing children from 2 months to 6 years of age. Results reveal diverging developmental trends associated with parental education (PE) level even when controlling for common confounds.

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562 11:00

Age-related Magnetic Susceptibility in the Deep Gray Nuclei from 1 month to 6 Years: Comparison between Quantitative Susceptibility and R2* Mapping

Ning Ning[1], Peng Wu[2], Xianjun Li[3], Yajie Hu[3], Weishan Zhang[1], Lei Zhang[1], Sung-Min Gho[4], Dong-Hyun Kim[4], Hua Guo[2], and Jian Yang[1,3]

[1]Department of Diagnostic Radiology, the First Affiliated Hospital of Xi'an Jiaotong University, Xi'an, China, People's Republic of, [2]Department of Biomedical Engineering, Tsinghua University, Beijing, China, People's Republic of, [3]Department of Biomedical Engineering, School of Life Science and Technology, Xi'an Jiaotong University, Xi'an, China, People's Republic of, [4]Department of Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of

To observe the age-related susceptibility changes in the deep gray nuclei and assess the superiority of the quantitative susceptibility mapping(QSM) and effective transverse relaxation rate(R2*) for quantifying the iron deposits in children. 87 subjects(1M-6Y) were enrolled. The susceptibility in QSM and R2* values exhibited positive correlations with age and the reference iron concentrations calculated using an empirical equation. The correlation of the susceptibility with the iron is higher than the R2* with it. QSM may provide a more promising and reliable tool for assessment of iron content in children's deep gray nuclei, even in the regions with lower iron content.

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563 11:12

To smell or not to smell: does the newborn habituate to sustained odorant stimulation?

Frédéric Grouiller[1], Alexandra Adam-Darqué[2], Russia Ha-Vinh Leuchter[2], Petra S Hüppi[2], and François Lazeyras[1]

[1]Department of Radiology and Medical Informatics, University of Geneva, Geneva, Switzerland, [2]Division of Development and Growth, Department of Pediatrics, University of Geneva, Geneva, Switzerland

The aim of this study is to better characterize the habituation effect of sustained odorant stimulation and to investigate if this effect is already present in newborns. Olfactory fMRI was acquired in adults and newborns using a 20s block design. After modelling habituation, activations in the primary and secondary olfactory cortices were observed in adults and newborns. Habituation effect to sustained odorant stimulation was strong in adults but unseen in the newborns. This study shows that the olfactory cortex of newborns is highly functional soon after birth and that the habituation effect is not observed in newborns compared to adults.

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564 11:24

Structural neuroimages revealed limited parental care affect development of gray matter rather than white matter in left-behind children

Yuan Xiao[1,2], Lili Yang[2], Lu Liu[1], Xin Gao[1], Bo Tao[1], Min Wu[1], Yuchuan Fu[2], Meimei Du[2], Zhihan Yan[2], and Su Lui[1,2]

[1]Department of Radiology, HMRRC, West China Hospital of Sichuan University, Chengdu, China, People's Republic of, [2]Department of Radiology, The Second Affiliated Hospital & Yuying Children's Hospital of Wenzhou Medical University, Wenzhou, China, People's Republic of

This study provided the first empirical evidence of larger gray matter volume in left-behind children than comparison children who lived in the nuclear family, especially in emotional circuit, suggesting the early parental care would affect the brain development of gray matter rather than white matter.

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565 11:36

Local shape analysis of the thalamus in extremely preterm born young adults

Eliza Orasanu[1], Andrew Melbourne[1], Zach Eaton-Rosen[1], David Atkinson[2], Joshua Lawan[3], Joanne Beckmann[4], Neil Marlow[4], and Sebastien Ourselin[1]

[1]Translational Imaging Group, Centre for Medical Image Computing, University College London, London, United Kingdom, [2]University College London, London, United Kingdom, [3]University College Hospital, London, United Kingdom, [4]Institute for Women's Health, University College London, London, United Kingdom

Alterations of thalamic structures may cause disruptions in thalamic-cortical-thalamic circuitry and affect cognition. In this work we present a local shape analysis of the thalamus in extremely preterm born young adults when compared to their term born peers. We perform a groupwise shape analysis after spectral matching registration. After correcting for gender and thalamic volume, it resulted that the anterior and superior thalamic regions, connected to regions responsible for executive function, working memory, language and verbal memory, show most shape variations.

566 11:48

Segmentation of the fetal brain cortical plate using diffusion-weighted imaging cues

Rosita Shishegar[1,2], Shreya Rana[3], Mary Tolcos[3], David W. Walker[3], and Leigh A. Johnston[1,4]

[1]Dept. Electrical & Electronic Engineering, University of Melbourne, Melbourne, Australia, [2]NICTA Victoria Research Laboratory, Melbourne, Australia, [3]The Ritchie Centre, Hudson Institute of Medical Research, Monash University, Melbourne, Australia, [4]Florey Institute of Neuroscience and Mental Health, Melbourne, Australia

Segmentation of the developing cortical plate from MRI data of the fetal brain is highly challenging due to partial volume effects, low contrast and heterogeneous maturation caused by ongoing myelination processes. We present a new atlas-free method for segmenting the boundary between the cortical plate and subplate in fetal brains, by exploiting diffusion-weighted imaging cues. The accuracy of the segmentation algorithm is demonstrated by application to fetal sheep brain MRI data.

Oral

Fat/Water Imaging

Room 324-326 10:00 - 12:00 *Moderators:*Dimitrios Karampinos & Brian Welch

567 10:00

Resolving Uncertainties of IDEAL Fat-Water Imaging Using Magnetization Transfer Effect

Alexey Samsonov[1]

[1]Radiology, University of Wisconsin, Madison, WI, United States

IDEAL fat/water imaging often suffers from estimation errors such as fat/water swaps, which can't be removed even by sophisticated algorithms based on field map smoothness regularization. However, these errors may be minimized by supplying the algorithms with an adequate FM prior, which, however, is not generally available. We propose a new method to improve IDEAL robustness which exploits a phenomenon of absence of magnetization transfer (MT) effect in fat for estimation of sufficiently accurate IDEAL field map prior.

568 10:12

Simultaneous T2, T2' and PDFF mapping in the spine using an adiabatic T2-prepared time-interleaved multi-echo gradient echo acquisition

Stefan Ruschke[1], Dominik Weidlich[1], Maximilian Diefenbach[1], Holger Eggers[2], Hendrik Kooijman[3], Houchun H. Hu[4], Ernst J. Rummeny[1], Axel Haase[5], Jan S. Kirschke[6], Thomas Baum[1], and Dimitrios C. Karampinos[1]

[1]Department of Diagnostic and Interventional Radiology, Technische Universität München, Munich, Germany, [2]Philips Research, Hamburg, Germany, [3]Philips Healthcare, Hamburg, Germany, [4]Radiology, Phoenix Children's Hospital, Phoenix, AZ, United States, [5]Zentralinstitut für Medizintechnik, Technische Universität München, Garching, Germany, [6]Neuroradiology, Technische Universität München, Munich, Germany

Simultaneous T2 and T2' mapping is highly desirable in applications investigating changes in blood oxygenation, iron content and bone mineral density. Simultaneous T2 and T2' mapping is highly desirable in applications investigating blood oxygenation changes (in tumors), iron deposition (in patients with blood transfusions) and trabecular bone matrix weakening (in osteoporosis patients). Gradient echo imaging using adiabatic T2-preparation has enabled T2 mapping in the presence of inhomogeneous B1 fields. In addition, the presence of water and fat components has to be considered in the extraction of T2 and T2' parameters in many organs. The simultaneous quantification of the proton-density fat fraction (PDFF) can be also of particular interest (e.g. in the liver and in, fat fraction, bone marrow fat fraction). Multi-echo gradient echo imaging can separate water and fat components and quantify PDFF. Therefore, the purpose of the present work was to introduce a novel method for simultaneous T2, T2' and PDFF mapping, relying on an adiabatic T2-preparation combined with a time-interleaved multi-echo gradient echo acquisition scheme.

569 10:24

3D Whole-Heart Water Fat Coronary MRA at 3T with 100% Scan Efficiency

Gastao Cruz[1], René Botnar[1], and Claudia Prieto[1]

[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom

Fat suppression is required for visualization of coronary arteries with MRA. Studies have shown that cardiac fat may provide diagnostic information and thus water/fat coronary imaging is desirable. Respiratory motion is a major problem in whole-heart coronary imaging as respiratory gating leads to long and unpredictable scan times. Translational motion correction (TC) may be of limited value as it may introduce ghosting artefacts from static fat tissue. Here, we propose a 100% scan efficiency, two-step motion correction framework using translational and nonrigid correction for water/fat coronary MRA. The proposed approach outperforms TC, minimising ghosting artefacts from static tissues.

570 10:36

Free-breathing volumetric fat/water separation by combining radial sampling, compressed sensing, and parallel imaging
Thomas Benkert[1,2], Daniel K. Sodickson[1,2], Hersh Chandarana[1,2], and Kai Tobias Block[1,2]

[1]Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, New York University School of Medicine, New York, NY, United States

This work presents a model-based fat/water separation technique for radial sampling, which takes into account the off-resonant blurring of fat and integrates both compressed sensing and parallel imaging. By combining this reconstruction scheme with 3D radial stack-of-stars sampling, volumetric and motion-robust water and fat maps as well as in-phase/opposed-phase images can be generated under free-breathing. The approach is demonstrated at 1.5T and 3T, including volunteer and patient measurements.

571 10:48

Rapid Water-Fat Separation using 3D VFA GRASE with Phase-Independent Reconstruction
Hahnsung Kim[1] and Jaeseok Park[2]

[1]Center for Neuroscience Imaging Research, Institute for Basic Science, Suwon, Korea, Republic of, [2]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Korea, Republic of

Most water-fat separation methods based on chemical shift effect require multiple image acquisitions at different echo times, which prolong the total scanning time. Recently, to resolve aforementioned problems, variable-flip-angle (VFA) fast/turbo SE is developed. In addition, partial Fourier and/or parallel imaging techniques are incorporated with VFA fast/turbo SE imaging to speed up acquisition time but directly trade off with signal-to-noise ratio. To avoid multiple measurements and to tackle spatially variant noise amplification, we develop a novel water-fat separation method employing: 1) single-slab 3D VFA GRASE using phase-encoding blips for imaging time efficiency, 2) phase-independent reconstruction exploiting spatially complementary information along the echo direction, and 3) phase-corrected water-fat separation method using robust field distribution.

572 11:00

Silicone-specific imaging using a unipolar flexible fast triple echo Dixon technique
Jingfei Ma[1], Jong Bum Son[1], Ken-Pin Hwang[1], and Basak Dogan[1]

[1]The University of Texas MD Anderson Cancer Center, Houston, TX, United States

Silicone-specific imaging can be performed using various combinations of selective inversion, selective saturation, and Dixon methods. In this work, we propose and demonstrate a new silicone-specific imaging method with a unipolar flexible fast spin echo triple echo Dixon pulse sequence. The method treats the water and fat signals as a single component by acquiring images only when water and fat are in-phase, and to use Dixon processing with flexible echo times to separate the remaining silicone signal. Among its many advantages, the method maintains high SNR and scan efficiency, is insensitive to field inhomogeneity, and is not subject to chemical shift misregistration.

573 11:12

Robust abdominal imaging with uniform fat suppression using Dixon based single shot turbo spin echo
Xinzeng Wang[1], Joshua S. Greer[1,2], Ivan Pedrosa[1,3], Neil M. Rofsky[1,3], and Ananth J. Madhuranthakam[1,3]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Bioengineering, University of Texas at Dallas, Richardson, TX, United States, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States

Breath-held single shot TSE sequence is a widely used in abdominal imaging due to its speed combined with robustness to field inhomogeneities and motion. Fat suppression techniques, such as SPAIR and Dixon method are often used in SShTSE to increase the conspicuity of the anatomical details. However, SPAIR is sensitive to B0 inhomogeneity resulting in incomplete fat suppression and Dixon method requires prolonged acquisition times. In this work, we implement a dual-echo SShTSE acquisition acquiring the in-phase (IP) and out-of-phase (OP) echoes in the same repetition, providing a true single shot acquisition with robust fat/water separation.

574 11:24

Reproducibility of Brown Adipose Tissue Assessment in Healthy Volunteers based on Time-Resolved Dixon MRI
Vanessa Stahl[1], Armin M. Nagel[1,2], Martin T. Freitag[3], Ralf O. Floca[4], Moritz C. Berger [1], Reiner Umathum[1], Mauricio Berriel Diaz[5], Stephan Herzig[5], Marc-André Weber[6], Antonia Dimitrakopoulou-Strauss[7], Peter Bachert[1], Mark E. Ladd[1], and Florian Maier[1]

[1]Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany, [2]Department of Diagnostic and Interventional Radiology, University Medical Center Ulm, Ulm, Germany, [3]Department of Radiology, German Cancer Research Center, Heidelberg, Germany, [4]Medical and Biological Informatics, German Cancer Research Center, Heidelberg, Germany, [5]Institute for Diabetes and Cancer, Helmholtz Zentrum München German Research Center for Environmental Health, München, Germany, [6]Diagnostic and Interventional Radiology, University Hospital of Heidelberg, Heidelberg, Germany, [7]Clinical Cooperation Unit Nuclear Medicine, German Cancer Research Center, Heidelberg, Germany

Brown adipose tissue (BAT) is subject of ongoing metabolic and obesity research having the ability to dissipate energy through non-shivering thermogenesis. This study was performed to evaluate reproducibility of recently shown time-resolved fat-fraction (FF) MR measurements during cold exposure for BAT assessment. BAT mass and activity were compared to the previous results assessed in the interscapular BAT depots. Potential BAT depots were observed at reproducible anatomic positions, showing a reproducible FF evolution with a mean FF decrease of (-2.31±1.05)%/h during cold-activation.

575 11:36

A Free-breathing water/fat separation and T1, T2 quantification method using dual TR FISP in abdomen

Dongyeob Han[1], Min-Oh Kim[1], Honpyo Lee[1], Taehwa Hong[1], and Dong-Hyun Kim[1]

[1]*Yonsei University, Seoul, Korea, Republic of*

A simultaneous, free-breathing water/fat separation and T1, T2 quantification method was proposed. Dual TR (in-phase and out-phase TR) and varying sinusoidal flip angle was used with FISP acquisition. For motion robustness, random rotating golden angle trajectories were applied. T1, T2 and $\Delta\varphi_{fat}$ of fat were pre-determined using the fat dominant region mask, then water/fat signal combined dictionary was generated. The results show that the water/fraction maps from the proposed method were in good agreement with conventional breath-hold results. Furthermore, measured T1, T2 values were in good agreement with the values from the previous research.

576 11:48

Improving Chemical Shift-Encoded Water-Fat Separation Based On A Detailed Consideration Of Magnetic Field Contributions

Maximilian N. Diefenbach[1], Stefan Ruschke[1], Hendrik Kooijman[2], Anh T. Van[3], Ernst J. Rummeny[1], Axel Haase[3], and Dimitrios C. Karampinos[1]

[1]*Department of Diagnostic and Interventional Radiology, Technische Universität München, Munich, Germany,* [2]*Philips Healthcare, Hamburg, Germany,* [3]*Zentralinstitut für Medizintechnik, Technische Universität München, Munich, Germany*

To avoid swaps in water-fat imaging a pre-processing step to standard fieldmap estimation methods is proposed. Based on spherical harmonic expansion the shimfield and the inhomogeneities of the main magnetic field are calculated. Thereby obtained details of the field inside the empty scanner are used to calculate an object-based fieldmap based on the tissue geometry and the susceptibility of tissue and air. The superposition of these three contributions to the fieldmap serves as an initial estimate for the water-fat separation algorithm and can reduce swaps in cases of large FOVs and when shimming is used.

Oral

Prostate

Room 331-332 10:00 - 12:00 *Moderators:*Daniel Margolis & Susan Noworolski

577 10:00

High-resolution distortion-free diffusion imaging of the prostate using stimulated echo based turbo spin echo (DPsti-TSE) sequence

Qinwei Zhang[1], Bram F. Coolen[1], Gustav J. Strijkers[2], Laurens van Buuren[3], Uulke van der Heide[3], Oliver J. Gurney-Champion [1], Sónia I. Gonçalves[4], and Aart J. Nederveen[1]

[1]*Department of Radiology, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands,* [2]*Biomedical Engineering and Physics, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands,* [3]*Department of Radiation Oncology, The Netherlands Cancer Institute, Amsterdam, Netherlands,* [4]*Institute for Biomedical Imaging and Life Sciences, University of Coimbra, Coimbra, Portugal*

Diffusion imaging is part of the standard MR imaging protocol for prostate cancer diagnosis. Conventional echo planar imaging (EPI) diffusion sequence has limitation on image resolution and additionally suffers from image distortion. The present study introduces a new stimulated echo based 3D diffusion preparation turbo spin echo sequence (DPsti-TSE) to achieve high-resolution and distortion free image. The sequence is also proved to be immune to eddy currents.

578 10:12

Detection of Aggressive Prostate Cancer Using Extradomain-B Fibronectin Targeted MRI Contrast Agent

Zheng Han[1], Yajuan Li[1], and Zheng-Rong Lu[1]

[1]*Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States*

Prostate cancer (PCa) is the second most lethal cancer in American men with a high incidence rate. Current method of PCa screening is not specific to aggressive cancer type, which results in overtreatment with serious adverse effects. We developed a MRI contrast agent, ZD2-Gd(HP-DO3A), that targets to overexpressed extradomain-B in aggressive PCa. Our result showed an increased sensitivity for MRI detection of aggressive PCa using ZD2-Gd(HP-DO3A), compared with the clinical control agent ProHance®. This contrast agent can potentially facilitate accurate risk stratification and clinical management of PCa.

579 10:24

Short term Repeatability of Microstructural (VERDICT) MRI vs. ADC in Prostate Cancer

Edward William Johnston[1], Eleftheria Panagiotaki[2], Elisenda Bonet-Carne[2], Nicola Stevens[1], David Atkinson[1], Daniel Alexander[2], and Shonit Punwani[1]

[1]*UCL Centre for Medical Imaging, London, United Kingdom,* [2]*UCL Centre for Medical Image Computing, London, United Kingdom*

VERDICT (Vascular, Extracellular, and Restricted Diffusion for Cytometry in Tumours) is a microstructural imaging technique that has shown significant potential in preclinical and pilot studies. However, its technical repeatability is unknown and must be established for translational and clinical application.

5 patients underwent consecutive VERDICT acquisitions, and their quantitative parametric maps were compared in tumour and non-tumour regions. We found that cellularity was the most reliable parameter, with almost perfect repeatability in both normal and cancerous prostate tissue. Intra and extracellular volume fractions also performed well, with almost perfect repeatability in the normal prostate and excellent repeatability in cancerous tissue.

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580 10:36

The Impact of Arterial Input Function Determination Variation on Prostate Dynamic Contrast-Enhanced Magnetic Resonance Imaging Pharmacokinetic Modeling: A Multicenter Data Analysis Challenge

Wei Huang[1], Yiyi Chen[1], Andriy Fedorov[2], Xia Li[3], Guido Jajamovich[4], Dariya I Malyarenko[5], Madhava Aryal[5], Peter S LaViolette[6], Matthew J Oborski[7], Finbarr O'Sullivan[8], Richard G Abramson[9], Mark Muzi[10], Kourosh Jafari-Khouzani [11], Aneela Afzal[1], Alina Tudorica[1], Brendan Moloney[1], Cecilia Besa[4], Jayashree Kalpathy-Cramer[11], James M Mountz[7], Charles M Laymon[7], Kathleen Schmainda[6], Yue Cao[5], Thomas L Chenevert[5], Bachir Taouli[4], Thomas E Yankeelov[9], Fiona Fennessy[2], and Xin Li[1]

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Dynamic Contrast-Enhanced MRI (DCE-MRI) pharmacokinetic modeling is widely used to extract tissue specific quantitative parameters. However, the accuracy and precision of these parameters can be affected by many factors, with arterial input function (AIF) determination being a primary source of uncertainties. In this multicenter study, we sought to evaluate variations in DCE-MRI parameters estimated from shared prostate DCE-MRI data as a result of differences in AIFs.

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581 10:48

Using low dose prostate dynamic contrast enhanced MRI data to verify newly developed eight-parameter mathematical form of arterial input function

Xiaobing Fan[1], Shiyang Wang[1], Milica Medved [1], Tatjana Antic[2], Serkan Guneyli [1], Aytekin Oto [1], and Gregory S Karczmar [1]

[1]Radiology, University of Chicago, Chicago, IL, United States, [2]Pathology, University of Chicago, Chicago, IL, United States

Accurate measurements of the arterial input function (AIF) are needed in pharmacokinetic models to analyze dynamic contrast enhanced (DCE) MRI data. The AIF often cannot be accurately measured due to T2* and water exchange effects. Therefore, population AIFs are often employed in pharmacokinetic modeling. Here we report a new 8-parameter empirical mathematical model (EMM) that fits the AIF measured directly from the external femoral artery after a dose of contrast agent that was greatly reduced to minimize artifacts. The results showed that the EMM-AIF accurately models both 1st and 2nd passes of contrast agent circulations.

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582 11:00

Quantitative DCE and DWI Characterization of the Index Lesion in Multiparametric MRI of Prostate Cancer Patients

Qing Yuan[1], Daniel N Costa[1,2], Julien Sénégas[3], Yin Xi[1], Andrea J Wiethoff[2,4], Robert E Lenkinski[1,2], and Ivan Pedrosa[1,2]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [3]Philips Research Laboratories, Hamburg, Germany, [4]Philips Research North America, Cambridge, MA, United States

We investigated the use of quantitative DWI and DCE measurements in MRI-visible index lesions as a surrogate for aggressiveness in prostate cancer patients. Tissue diffusion coefficient from simplified intravoxel incoherent motion model from DWI, and initial area under the curve from DCE offered the best performance in discriminating low and intermediate-to-high risk tumors. Anatomic and functional multiparametric MRI may provide a more reliable assessment of the aggressiveness of prostate cancer in patients.

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583 11:12

Rad-Path correlation and machine learning generate epithelium density maps predictive of pathologically confirmed prostate cancer

Amy L. Kaczmarowski[1], Kenneth Iczkowski[2], William A. Hall[3], Ahmad M. El-Arabi[4], Kenneth Jacobsohn[4], Paul Knechtges[1], Mark Hohenwalter[1], William See[4], and Peter S. LaViolette[1]

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Radiological-pathological correlation is being used to validate prostate cancer imaging technology. This study combines these two modalities with machine learning to generate predictive maps of histological features (i.e. new contrasts) based on segmented histology. We find that epithelium density maps highlight regions pathologically confirmed as Gleason grade ≥3. This allowed the prediction of prostate cancer presence based solely on non-invasive imaging in 23 of 26 cases.

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584 11:24

Quantitative MRI-Driven Deep Learning for Detection of Clinical Significant Prostate Cancer

Shiwen Shen[1,2], Xinran Zhong[1,3], Willam Hsu[1], Alex Bui[1], Holden Wu[1], Michael Kuo[1], Steven Raman[1], Daniel Margolis[1], and Kyunghyun Sung[1]

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We present a novel automatic classification method to distinguish between indolent and clinically significant prostatic carcinoma using multi-parametric MRI (mp-MRI). The main contributions are 1) utilizing state-of-art deep learning method to characterize the lesion in mp-MRI through a pre-trained convolutional neural network model, OverFeat, 2) building a hybrid two-order classification model that combines deep learning and conventional statistical features, and 3) avoiding annotation of the lesion boundaries and anatomical-location-specific training. The proposed method was evaluated using 102 lesions of prostate cancer and achieved significantly higher accuracy than the method with traditional statistical features.

585 11:36

Dixon with view angle tilting for improved post-contrast MRI of the prostate

Silke Hey[1], Vijayasarathy Elanchezhian[2], and Marius van Meel[2]

[1]*Clinical Excellence & Research, Philips HealthTech, Best, Netherlands,* [2]*MR Clinical Applications, Philips HealthTech, Best, Netherlands*

A T1w TSE Dixon acquisition is combined with view angle tilting (VAT) in order to reduce susceptibility induced artifacts from orthopedic implants close to the prostate and at the same time improve fat suppression in the area of interest. The comparison with SPIR fat suppression shows clear improvement when using Dixon together with VAT by providing more homogeneous and complete fat suppression and reduced susceptibility artifacts thus allowing clear visualization of T1 based contrast changes in the prostate and the surrounding tissue. Those results have been proven at 1.5T and 3.0T on healthy volunteers with orthopedic hip implants.

586 11:48

Multiparametric Whole-body MRI vs 18FCH-PET-CT in the Primary Staging of Intermediate and High-Risk Prostate Cancer

Edward William Johnston[1], Arash Latifoltojar[1], Harbir Singh Sidhu[1], Navin Ramachandran[1], Magdalena Sokolska[2], Alan Bainbridge[2], Caroline Moore[3], Hashim Ahmed[3], and Shonit Punwani[1]

[1]*UCL Centre for Medical Imaging, London, United Kingdom,* [2]*Medical Physics, University College London Hospital, London, United Kingdom,* [3]*Department of Urology, University College Hospital, London, United Kingdom*

Whilst whole body MRI is gaining momentum in cancer staging for multiple tumour types, relatively few groups have focused on the primary staging of prostate cancer.

In this study, we evaluated the role of an extensive multiparametric MRI protocol, including diffusion-weighted imaging in 23 patients against an 18F-choline PET-CT/ expert panel based reference standard.

According to the reference standard, we found that whole body MRI provided an equivalently high diagnostic accuracy vs. PET-CT in lymph nodes, and outperformed PET-CT in the detection of bone lesions. However, higher technical error rates suggest MRI reporting experience needs to be developed first.

Oral

Myocardial Tissue Characterisation

Room 334-336 10:00 - 12:00 *Moderators:*Mehmet Akcakaya & Daniel Kim

587 10:00

A Joint Image Denoising Approach for Improved Precision and Accuracy in Myocardial T1 Mapping

Aurelien Bustin[1,2,3], Pauline Ferry[3], Andrei Codreanu[4], Anne Menini[2], and Freddy Odille[3,5,6]

[1]*Department of Computer Science, Technische Universität München, Munich, Germany,* [2]*GE Global Research, Munich, Germany,* [3]*Imagerie Adaptative Diagnostique et Interventionnelle, Universite de Lorraine, Nancy, France,* [4]*Centre Hospitalier de Luxembourg, Luxembourg, Luxembourg,* [5]*CIC-IT 1433, INSERM, Nancy, France,* [6]*U947, INSERM, Nancy, France*

To improve precision and accuracy in myocardial T_1 mapping by combining saturation-recovery acquisitions with a joint denoising method. The proposed method is shown to improve mapping techniques by exploiting the spatiotemporal correlations in the native T_1-weighted images, thus providing a promising tool for the measurement of myocardial and blood T_1 times.

588 10:12

Detecting diffuse cardiac fibrosis with T1ρ MRI

Joep van Oorschot[1], Fatih Guclu[2], Peter Luijten[1], Tim Leiner[1], and Jaco Zwanenburg[1]

[1]*Radiology, University Medical Center Utrecht, Utrecht, Netherlands,* [2]*Cardiology, University Medical Center Utrecht, Utrecht, Netherlands*

Native T1ρ-mapping is a promising non-contrast enhanced method for fibrosis detection, that would overcome problems associated with contrast agent use. In this work, we will evaluate the performance of T1ρ-mapping versus ECV-m and native T1 in DCM patients. Native T1, native T1ρ and Contrast enhanced T1-maps were acquired in twelve DCM patients, and 8 healthy volunteers. The T1ρ relaxation time was significantly higher in the DCM patients (55.6 ± 3.0 ms), compared to the healthy control subjects (51.5 ± 1.2 ms), $p<0.005$. A significant correlation was found between the T1ρ relaxation time and the Extracellular Volume fraction in patients.

589 10:24

Improved myocardial T1 mapping technique to eliminate device-induced image artefacts for patients with implanted cardiac devices

Jiaxin Shao[1], Shams Rashid[1], Kim-Lien Nguyen[2,3], and Peng Hu[1,4]

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Current cardiac T1 mapping techniques, including the modified Look-Locker inversion-recovery (MOLLI), cannot be used effectively in patients with implanted cardiac devices due to large off-resonance induced by the device. To eliminate the device-induced image artefacts, we developed a technique by modifying the MOLLI sequence to use spoiled gradient echo readout and a wideband inversion pulse, with a new acquisition scheme and T1 estimation algorithm. The feasibility of our new technique was tested in phantom studies and validated in eight healthy volunteers and ten patients with implanted cardiac devices at 1.5 Tesla.

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590 10:36

T2 mapping for non-invasive assessment of acute cardiac allograft rejection in a mouse model of heterotopic heart transplantation
Dagmar Hartung[1,2], Rongjun Chen[3], Marcel Gutberlet[1,2], Song Rong[3], Mi-Sun Jang[3], Jan Hinrich Braesen[4], Martin Meier[2,5], Hermann Haller[3], Frank Wacker[1,2], Faikah Gueler[3], and Hueper Katja[1,2]

[1]Institute for Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Rebirth, Hannover, Germany, [3]Clinic for Nephrology, Hannover Medical School, Hannover, Germany, [4]Institute for Pathology, Hannover Medical School, Hannover, Germany, [5]Imaging Center of the Central Animal Laboratory, Hannover Medical School, Hannover, Germany

Acute cardiac allograft rejection is a frequent and life-threatening complication during the first year after heart transplantation (HTx) and therefore early detection is most important. The standard of care for HTx recipients is periodic rejection surveillance by endomyocardial biopsy. We investigated whether T2 mapping allows non-invasive detection of acute cardiac allograft rejection in mice. We demonstrated that myocardial T2 is significantly increased in allogenic HTx compared to isogenic HTx mice on day 6 after transplantation likely reflecting myocardial edema and corresponds to the extent of T cell infiltration. Thus, non-invasive T2 mapping might enable early and non-invasive detection of acute cardiac allograft rejection.

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591 10:48

Slice accelerated Double-Inversion Radial Fast-Spin-Echo for myocardial black-blood MRI with T2 mapping
Mahesh Bharath Keerthivasan[1], Sagar Mandava[1], Kevin Johnson[2], Diego R Martin[3], Ali Bilgin[1,3,4], and Maria I Altbach[3]

[1]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [2]Siemens Healthcare, Tucson, AZ, United States, [3]Medical Imaging, University of Arizona, Tucson, AZ, United States, [4]Biomedical Engineering, University of Arizona, Tucson, AZ, United States

A technique to increase slice coverage in dark blood fast spin echo sequences by a multi-band excitation is presented. The proposed technique can acquire multiple slices at the exact null point of blood. The radial version of the single slice sequence can generate black blood images, TE images and T2 maps within a single breath-hold. In this work we present a model based reconstruction to generate TE images and T2 maps for upto 4 slices in a single breath-hold.

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592 11:00

MRI Assessment of Coronary Endothelial Function using Native T1 Mapping with Nitric Oxide Synthase (NOS) Inhibition
Sophia Xinyuan Cui[1] and Frederick H. Epstein[1,2]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Radiology, University of Virginia, Charlottesville, VA, United States

Endothelial nitric oxide synthase (eNOS)-mediated production of NO is an important system regulating the microvasculature, controlling both vessel diameter and permeability. We hypothesized that T1 mapping of the heart during NOS inhibition could detect increased water content resulting from increased microvascular permeability, providing a novel means to noninvasively probe eNOS regulation of the coronary microvasculature. T1-mapping in mice after intravenous NOS inhibition detected an increase in myocardial T1 of 113±15 ms compared to baseline ($p<0.05$). These methods are likely probing eNOS regulation of coronary microvascular permeability, which may represent a novel means of assessing the health of the coronary endothelium.

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593 11:12

Accuracy of cardiac magnetic resonance T1 mapping for detecting diffuse myocardial fibrosis: comprehensive comparison with the pathology in diabetic rabbits
Mu Zeng[1], Nan Zhang[1], Yi He[1], Jing An[2], Andreas Greiser[3], and Zhanming Fan[1]

[1]Radiology, Beijing Anzhen Hospital,Capital medical university, Beijing, China, People's Republic of, [2]MR Collaborations NE Asia, Siemens Healthcare, Beijing, China, Beijing, China, People's Republic of, [3]Siemens AG Healthcare Sector MR, Erlangen, Germany

In recent years, use of the MRI T1 mapping technique to detect diffuse myocardial fibrosis has received increasing attention. Although previous studies have verified the relationship between T1 mapping and pathological findings, our study is the first to show continuity during the observation of a single disease while avoiding interference caused by other diseases. In addition, the pathology can be fully verified in real time using animal experiments.

The main findings of this study were that (1) the ECV obtained from the MRI T1 mapping sequence was highly correlated with the CVF in terms of the degree of histologically diffuse interstitial fibrosis; (2) the correlation between the native T1 value and the CVF change was not strong; and (3) the rabbit is a suitable model for cardiac magnetic resonance research using clinical equipment.

594 11:24

Oxygen-enhanced T2* cardiac magnetic resonance imaging in cardiomyopathy
Satoshi Kawanami[1], Michinobu Nagao[1], Yuzo Yamasaki[2], Takeshi Kamitani[2], Torahiko Yamanouchi[2], Tomomi Ide[3], Ryohei Funatsu[4], Hidetake Yabuuchi[5], Yuji Watanabe[1], and Hiroshi Honda[2]

[1]Molecular Imaging & Diagnosis, Kyushu University, Graduate School of Medical Sciences, Fukuoka, Japan, [2]Clinical Radiology, Kyushu University, Graduate School of Medical Sciences, Fukuoka, Japan, [3]Cardiovascular Medicine, Kyushu University, Graduate School of Medical Sciences, Fukuoka, Japan, [4]Radiological Technology, Kyushu University Hospital, Fukuoka, Japan, [5]Health Sciences, Kyushu University, Graduate School of Medical Sciences, Fukuoka, Japan

In this study, we analyzed T2* value in the mid-left ventricular septum avid normoxia (T2*air) and hyperoxia (T2*oxy) in cases with normal, hypertrophic cardiomyopathy (HCM) and dilated cardiomyopathy (DCM). Oxygen-enhanced T2* cardiac magnetic resonance (CMR) showed the different delta T2* (T2*oxy – T2* air), reflecting myocardial blood-oxygen dependent (BOLD) effect. Oxygen-enhanced T2* CMR has potential to open up a new avenue for the study of the pathophysiology of cardiomyopathy. The ΔT2* was prolonged in DCM, stable in control and shortened in HCM, respectively. Oxygen-enhanced T2* CMR can assess the oxygen metabolism in the mid-left ventricular septum with various density of capillaries and myocardial cells. We also note the relationship between T2* value and late gadolinium enhancement (LGE) or left ventricular ejection fraction (LVEF).

595 11:36

Myocardial extracellular volume fraction (ECV) quantified by T1 mapping can detect diffuse myocardial fibrosis in dilated cardiomyopathy (DCM): Comparison with histological collagen volume fraction by endomyocardial biopsy (EMB)
Yoshiaki Morita[1], Naoaki Yamada[1], Emi Tateishi[2], Teruo Noguchi[2], Masahiro Higashi[1], and Hiroaki Naito[1]

[1]Department of Radiology, National Cerebral and Cardiovascular Center, Suita, Osaka, Japan, [2]Division of Cardiology, National Cerebral and Cardiovascular Center, Suita, Osaka, Japan

Diffuse interstitial fibrosis is frequently observed in dilated cardiomyopathy (DCM). A non-invasive method that could reliably quantify fibrosis would be preferable. In this study, we demonstrated that the T1-map-derived ECV reflects the myocardial collagen volume fraction in DCM. Therefore, the ECV could be a useful and practical biomarker for the detection of diffuse interstitial fibrosis that is difficult to evaluate using only conventional LGE images.

596 11:48

Assessment of Necrosis in the Ischemic Heart using Hyperpolarized [1,4-13C2]Fumarate
Damian J Tyler[1], Angus Lau[1], Ferdia Gallagher[2], and Marie A Schroeder[1]

[1]DPAG, University of Oxford, Oxford, United Kingdom, [2]Radiology, University of Cambridge, Cambridge, United Kingdom

The aim of this study was to evaluate the potential of hyperpolarised [1, 4-13C2]fumarate, coupled with MRS, to measure cardiac necrosis during ischemia and reperfusion. Hyperpolarised [1, 4-13C2]fumarate was infused into rat hearts at three time points, corresponding with the healthy heart, early reperfusion after a 20 min ischemic period, and late reperfusion. The amount of [1, 4-13C2]malate production was measured using MRS and quantified to reflect degree of cardiomyocyte necrosis. We observed a 3.8-fold increase in [1,4-13C2]malate during the late reperfusion period but no change in early reperfusion, suggesting that necrotic cell death takes place during reperfusion only. This technique shows potential to evaluate therapies targeting necrosis to prevent cardiac remodeling into failure.

Oral

Neurovascular Disease & Stroke

Hall 606 10:00 - 12:00 *Moderators:*Rao Gullapalli & Masaaki Hori

597 10:00

Transient Oxygen Extraction Fraction as a Measure of Cerebrovascular Reserve
Charles G Cantrell[1], Parmede Vakil[1,2], Donald R Cantrell[3], Yong Jeong[1], Sameer A Ansari[3], and Timothy J Carroll[1,3]

[1]Biomedical Engineering, Northwestern, Chicago, IL, United States, [2]College of Medicine, University of Illinois, Chicago, IL, United States, [3]Radiology, Northwestern, Chicago, IL, United States

We have found that MR-PARSE has detectable sensitivity to frequency shifts induced by transient alterations in de-oxyhemoglobin through the cardiac cycle. Our initial studies have shown, through the use of ICA, a statistically significant hemispheric difference between healthy and compromised regions. Our approach to quantifying cerebrovascular reactivity represents a new and simple, non contrast approach to stratifying patients toward therapies to prevent stroke.

598 10:12

Ex-vivo Quantitative Imaging and Qualitative Plaque Type Classification of Intracranial Atherosclerotic Plaque using High Resolution MRI
Yuanliang Jiang[1], Chengcheng Zhu[2], Andrew J Degnan[3], Wenjia Peng[1], Luguang Chen[1], Xinrui Wang[1], Qi Liu[1], Yang Wang[4], Zhenzhen Xiang[4], Zhongzhao Teng[5], David Saloner[2], and Jianping Lu[1]

[1]Radiology, Changhai Hospital, Shanghai, China, People's Republic of, [2]Radiology, University of California, San Francisco, San Francisco, CA, United States, [3]Radilogy, University of Pittsburgh, Pittsburgh, PA, United States, [4]Pathology, Changhai Hospital, Shanghai, China, People's Republic of, [5]Radiology, University of Cambridge, Cambridge, United Kingdom

The first ex vivo measurement of T1, T2, and T2* relaxation times of intracranial plaque components at 3T is reported. The ability of multi-contrast MRI to characterize plaque type was evaluated with histological validation. Plaque components could be differentiated based on relaxation times. Specifically, lipid core had significantly lower T2 values than fibrous cap. MRI and histology correlation was consistent across specimens and locations, and MRI showed a high sensitivity and specificity for identifying plaque features previously associated with high-risk. Therefore, MRI has the potential to characterize intracranial plaque composition and improve patient risk stratification.

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599 10:24

Acceleration-selective Arterial Spin Labeling (AccASL) MR Angiography for Visualization of Distal Cerebral Arteries in Moyamoya Disease
Osamu Togao[1], Akio Hiwatashi[1], Makoto Obara[2], Koji Yamashita[1], Kazufumi Kikuchi[1], and Hiroshi Honda[1]

[1]Department of Clinical Radiology, Graduate School of Medical Sciences, Kyushu University, Fukuoka, Japan, [2]Philips Electronics Japan, Tokyo, Japan

In this study, we demonstrated the utility of intracranial MR angiography (MRA) using acceleration-selective arterial spin labeling (AccASL) technique in Moyamoya disease. The AccASL-MRA markedly improved the visualization of arteries distal to the steno-occlusive site reflecting collateral flow via LMA in Moyamoya disease in comparison with time-of-flight (TOF)-MRA.

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600 10:36

summa cum laude

Serial Quantification of Brain Oxygenation using Streamlined-qBOLD in Acute Stroke Patients
Alan J Stone[1], George WJ Harston[2], Davide Carone[2], Mmua Ngwako[2], Radim Licenik[2], James Kennedy [2], and Nicholas P Blockley[1]

[1]FMRIB, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [2]Acute Stroke Programme, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom

Streamlined-qBOLD is applied to an exploratory cohort of acute stroke patients in a serial imaging study to map brain oxygen metabolism. Quantitative brain oxygenation parameters are demonstrated to vary between regions with different tissue outcomes and this imaging approach is shown to have the potential to refine the identification of the ischemic penumbra.

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601 10:48

Relationship between Cerebrovascular Reserve and Brain Temperature following Acetazolamide Challenge in Patients with Chronic Steno-Occlusive Disease
Seena Dehkharghani[1], Candace C. Fleischer[2], Deqiang Qiu[1], Sang-Eon Park[2], Junjie Wu[1], and Fadi Nahab[3]

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

Methods for characterizing *misery perfusion* to predict stroke are largely limited to positron emission tomography, which suffers from high radiation exposure. Magnetic resonance imaging (MRI) and spectroscopy (MRS) offer non-invasive alternatives to explore cerebral hemodynamics and brain temperature regulation, a poorly understood physiologic variable at the intersection of perfusion and metabolism. We detail the first reported use of MRI/MRS to relate cerebrovascular reserve with temperature in patients following acetazolamide challenge, observing significant correlation between temperature changes and cerebrovascular reserve. These findings will be used to inform future MRI studies of perfusion and brain temperature among patients with chronic steno-occlusive disease.

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602 11:00

summa cum laude

Stroke Volume Evolution Following Endovascular Therapy on DWI and FLAIR
Christian Federau[1], Soren Christensen[1], Michael Mlynash[1], Jenny Tsai[1], Sun Kim[1], Greg Zaharchuk[1], Matus Straka[1], Nishant Mishra[1], Maarten Lansberg[1], and Greg Albers[1]

[1]Stanford University, Stanford, CA, United States

We studied the evolution of the infarct volume between an early post-revascularization scan (within 24 h of symptom onset) and day 5 in patients of the CRISP and DEFUSE 2 cohort studies. On the early post-revascularization scan, FLAIR lesions were smaller compared to DWI, but were larger at day 5. The early post-revascularization stroke volume on DWI, compared to FLAIR, was closer, and correlated better with the day 5 DWI and FLAIR lesion volumes. Together, our findings suggest that DWI is a better early surrogate marker of stroke volume.

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603 11:12

summa cum laude

Quantitative Susceptibility Mapping (QSM) based Cerebral Metabolic Rate of Oxygen (CMRO2) Mapping: Eliminating Blood Flow Challenge with Minimal Local Variance (MLV)
Jingwei Zhang[1,2], Dong Zhou[2], Sarah Eskreis-Winkler[2], Thanh Nguyen[2], Pascal Spincemaille[2], Ajay Gupta[2], and Yi Wang[1,2]

[1]Biomedical Engineering, Cornell University, New York, NY, United States, [2]Radiology, Weill Cornell Medical College, New York, NY, United States

We propose a cerebral metabolic rate of oxygen consumption (CMRO2) mapping method without blood flow challenge using quantitative susceptibility mapping, cerebral blood flow and a regularization of minimal local variance (MLV) within the same type of tissue. Getting rid of blood flow challenge would vastly increase the clinical utility of MRI CMRO2. The MNV CMRO2 maps were very similar to CMRO2 maps using caffeine as challenge, with no significant bias in value.

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604 11:24

Flow dynamics in a 3D printed brain aneurysm model assessed by magnetic particle imaging, magnetic resonance imaging and dynamic subtraction angiography
Jan Sedlacik[1], Andreas M. Frölich[1], Johanna Spallek[2], Nils D. Forkert[3], Tobias D. Faizy[1], Franziska Werner[4,5], Tobias Knopp[4,5], Dieter

Krause[2], Jens Fiehler[1], and Jan-Hendrik Buhk[1]

[1]Neuroradiology, UKE, Hamburg, Germany, [2]Product Development and Mechanical Engineering Design, TUHH, Hamburg, Germany, [3]University of Calgary, Calgary, AB, Canada, [4]Biomedical Imaging, UKE, Hamburg, Germany, [5]Biomedical Imaging, TUHH, Hamburg, Germany

Magnetic particle imaging (MPI) was compared with dynamic magnetic resonance imaging (MRI) and dynamic subtraction angiography (DSA) in a realistic 3D printed aneurysm model. All three methods clearly depicted a distinct pulsatile flow pattern and a delayed contrast agent outflow from the aneurysm. Despite the disadvantages of a much lower temporal resolution of the dynamic MRI and the 2D projection of the DSA, all three methods are valid tools for characterizing the hemodynamics of aneurysms. Especially the radiation free, 3D, high temporal resolution MPI method seems to be a very promising tool for imaging and characterization of hemodynamics.

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605 11:36

Microstructure Parameters in Acute Stroke: A Bayesian Approach to diffusion-weighted MRI

Elias Kellner[1], Karl Egger[2], Valerij G Kiselev[2], Horst Urbach[2], and Marco Reisert[1]

[1]Department of Radiology, Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]Department of Neuroradiology, University Medical Center Freiburg, Freiburg, Germany

In a recent study, we proposed a method for fast estimation of microstructural tissue parameters such as intra/extraaxonal volume fraction and diffusivities based on a Bayesian approach and machine learning. In this study, we report the application to cases of acute ischemic stroke. We show that the parameters are able to outline the infarct core qualitatively better than standard DTI. The results are in line with the currently accepted picture of axonal beading.

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606 11:48

Chronological evaluation of Cerebral Hemodynamics by Dynamic Susceptibility Contrast Magnetic Resonance Imaging after Indirect Bypass Surgery for Moyamoya Disease

Yosuke Ishii[1,2], Tadashi Nariai[1], Yoji Tanaka[1], HIroshi Aihara[2], Yoshio Suyama[2], Shinichi Wakabayashi[2], and Taketoshi Maehara[1]

[1]Neurosurgery, Tokyo Medial and Dental University, Tokyo, Japan, [2]Neurosurgery, Suiseikai Kajikawa Hospital, Hiroshima, Japan

We used dynamic susceptibility contrast (DSC)-MRI to evaluate the chronological changes in hemodynamics after indirect bypass surgery for moyamoya disease. Twenty five patients who underwent indirect bypass surgery and repeated DSC–MRI measurement within the first 6 postoperative months were included. We analyzed mean transit time (MTT) delay using the cerebellum as control. Mean MTT delay in the anterior circulation area gradually decreased soon after surgery and stabilized after 3 postoperative months. Postoperative MTT delay values were significantly decreased compared with preoperative values from 1 to 2 weeks onwards. These results suggested DSC–MRI detected angiogenesis during the early postoperative stages.

Oral

Simultaneous Multi-Slice

Summit 1 10:00 - 12:00 *Moderators:*Justin Haldar & Benedikt A Poser

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607 10:00

Generalized SLIce Dithered Enhanced Resolution Simultaneous MultiSlice (gSlider-SMS) to increase volume encoding, SNR and partition profile fidelity in high-resolution diffusion imaging.

Kawin Setsompop[1], Jason Stockmann[1], Qiuyun Fan[1], Thomas Witzel[1], and Lawrence L. Wald[1]

[1]A.A. Martinos Center for Biomedical Imaging, charlestown, MA, United States

In this work, we propose generalized Slider (gSlider) method which utilizes RF encoding to markedly improve the ability of slice super-resolution in acquiring a large number of imaging slices simultaneously in diffusion imaging, to increase volume encoding and SNR. In particular, we show that gSlider can be use to acquire 5 slices simultaneously to provide close to the theoretical √5 SNR gain, while retaining sharp slice/partition resolution, comparable to that of conventional 2-D slice-selective imaging. Through a combined gSlider-SMS acquisition (5x-gSlider and MB-2), we demonstrate a highly efficient 10 simultaneous slice acquisition for high quality whole-brain 660μm isotropic diffusion imaging.

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608 10:12

Online Radial Multiband Magnetic Resonance Fingerprinting

Martijn A Cloos[1,2], Tiejun Zhao[3], Florian Knoll[1,2], and Daniel K Sodickson[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [3]Siemens Medical Solutions USA Inc., Malvern, PA, United States

Magnetic resonance fingerprinting (MRF) is a promising new approach for rapid quantitative imaging. So far, multi-slice acceleration (MSA) for MRF has been based on a gradient t-Blipped multi-slice scheme. However, for traditional MR sequences using thick slices, it has been shown that radiofrequency based phase encoding works better than the gradient blipped implementation. In this work we demonstrate an RF based MSA approach for radial sampled MRF experiments such as PnP-PTX including a fully integrated online image reconstruction pipeline that creates both quantitative maps (T1, T2, PD and B_1^+) and synthesized contras weighted images (MP-RAGE, T1-TSE and T2-TSE).

609 10:24

Analytical G-factor for Cartesian Simultaneous Multi-Slice Imaging

Kangrong Zhu[1], Hua Wu[2], Robert F. Dougherty[2], Matthew J. Middione[3], John M. Pauly[1], and Adam B. Kerr[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Center for Cognitive and Neurobiological Imaging, Stanford University, Stanford, CA, United States, [3]Applied Sciences Laboratory West, GE Healthcare, Menlo Park, CA, United States

In simultaneous multi-slice (SMS) imaging, a commonly used method to compute the g-factor is the pseudo multiple replica method, whose accuracy depends on the number of simulated replicas. In this work, we derive analytical g-factor maps for SMS acquisitions with arbitrary Cartesian undersampling patterns basing on a hybrid-space SENSE reconstruction. Brain images demonstrate that the analytical g-factor maps agree with those calculated by the pseudo multiple replica method, but require less computation time for high quality maps. The analytical maps enable a fair comparison between coherent and incoherent Cartesian SMS undersampling patterns.

610 10:36

Correction of Chemical-Shift Ghost Artifact in Blipped Controlled Aliasing Parallel Imaging

JaeJin Cho[1], Dongchan Kim[1], Hyunseok Seo[1], Kinam Kwon[1], Seohee So[1], and HyunWook Park[1]

[1]Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Korea, Republic of

Blipped-CAIPI imaging is widely used for fast imaging, which is one of the simultaneous multi-slice imaging methods. Conventional water-fat separation methods can be combined with the blipped-CAIPI technique. However, it results in the chemical-shift ghost artifact because fat signal on slightly shifted position is exited in the slice-selection process. This geometric error in slice-selection generates additional phase cycling, which causes the ghost artifacts on each slice's fat image. In this abstract, a SENSE-based water-fat separation method is proposed, which considers the additional phase cycling on fat signal and obtains more accurate water-fat separated images.

611 10:48

Simultaneous Multislice AcquisitioN G-noise reduction & Reshifted CAIPI In Angiography (SANGRIA)

Zahra Fazal[1], Jennifer Schulz[1], Jose P Marques[1], and David G Norris [1,2]

[1]Donders Center for Cognitive Neuroimaging, Radboud university, Nijmegen, Netherlands, [2]Erwin L.Hahn institute for Magnetic Resonance Imaging, Essen, Germany

To reconstruct blood vessel in 2D and 3D MB TOF MRA without using coil sensitivity profile to reduce g-factor noise. The idea is to use CAIPRINHA on sparse angiographic data that first shift each slice/slab differently and then apply CAIPI reshift to shift each slab to its original position to form a continuous vessel tree. Results showed that the vessel reconstruction in 2D and 3D MB is comparable to standard single band MS TOF. Vessel reconstruction in MB angiography without using coil sensitivity profile can lead to high MB factors reducing the aquistion time and high sensitivity in detecting small vessels

612 11:00

Optimized CS-Wave imaging with tailored sampling and efficient reconstruction

Berkin Bilgic[1], Huihui Ye[1], Lawrence L Wald[1], and Kawin Setsompop[1]

[1]Martinos Center for Biomedical Imaging, Charlestown, MA, United States

Wave-CAIPI utilizes additional gradients during the readout to improve controlled aliasing and fully harness coil sensitivity encoding. Recently proposed CS-Wave extended Wave-encoding with Poisson sampling and wavelet regularization. This work proposes optimized CS-Wave with i) tailored data-sampling and ii) highly efficient reconstruction. At 15-fold acceleration, proposed CS-Wave provides 20% RMSE improvement over Wave-CAIPI, which nearly doubles the improvement achieved with previously proposed CS-Wave. This permits single head-orientation Quantitative Susceptibility Mapping at 1×1×2mm^3 resolution in 25s. Combining CS-Wave with SMS Echo-Shift strategy further increases the acceleration to 30-fold, thus enabling multi-orientation QSM at long-TE from three head-rotations at 1.5mm isotropic in 72s.

613 11:12

Multiband and Multishot EPI Using Hadamard Encoding for Functional MRI at 7T

Alexander D. Cohen[1], Andrew S. Nencka[1,2], and Yang Wang[1,2]

[1]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

In this study a novel technique was tested combining multiband and multishot imaging for functional MRI at 7T. Hadamard and segmented multi-shot encoding were applied to yield short TR, reduced distortion fMRI images without the need for parallel imaging reconstruction techniques. Furthermore, acquiring segmented data allows for datasets to be reconstructed with effective in-plane accelerations up to the number of segments. Thus, one can reconstruct a dataset with higher SNR and the reduced geometric distortion of a highly accelerated acquisition.

614 11:24

SMS-HSL: Simultaneous Multi-Slice Aliasing Separation Exploiting Hankel Subspace Learning

Suhyung Park[1] and Jaeseok Park[2]

[1]Center for Neuroscience Imaging Research, Institute for Basic Science (IBS), Suwon, Korea, Republic of, [2]Department of Biomedical Engineering, Sungkyunkwan University, Suwon, Korea, Republic of

Simultaneous multi-slice (SMS) acquisition has recently gained attention in clinical and research applications. However, since the spatial variation of coil sensitivity along the slice direction is typically insufficient and thus SMS reconstruction including SENSE/GRAPPA and

slice-GRAPPA is potentially ill-conditioned, it is challenging to separate the aliased slices in the presence of noise with increasing multi-band factors (MB). In this work, we propose a novel, SMS reconstruction method that exploits Hankel subspace learning (SMS-HSL) for aliasing separation in the slice direction, in which SMS signals are projected onto an individual subspace specific to each slice by incorporating the proposed SMS model into a constrained optimization with low rank and magnitude priors. Simulation and experiments were performed at high MB factors to demonstrate the effectiveness of the proposed SMS-HSL over conventional SMS methods.

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615 11:36

High resolution simultaneous multi-slice GRE at 9.4T using 16-channel SMS-pTX spokes excitations for slice-by-slice flip-angle homogenisation

Desmond H Y Tse[1], Christopher J Wiggins[2], and Benedikt A Poser[1]

[1]Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands, [2]Scannexus, Maastricht, Netherlands

RF inhomogeneity at ultra-high field MRI leads to unwanted variations in image contrast and SNR. RF homogenisation at 9.4T was achieved with parallel transmission (pTx) of slice-specific spokes pulses designed offline using acquired B0 and B1+ maps. These spokes pulses were combined on-the-fly on the scanner to form simultaneous multi-slice (SMS) excitations, with optimised inter-slice phases to minimise the SMS pulse amplitude. The pTx spokes SMS pulse allowed a time efficient high resolution 2D GRE T2*-weighted imaging at 9.4T with whole brain coverage and minimal artefacts caused by RF inhomogeneity.

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616 11:48

Phase-cycled simultaneous multi-slice balanced SSFP imaging with CAIPIRINHA for efficient banding reduction

Yi Wang[1], Xingfeng Shao[1], Thomas Martin[1], Steen Moeller[2], Essa Yacoub[2], and Danny JJ Wang[1]

[1]Neurology, UCLA, Los Angeles, CA, United States, [2]Center of Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States

The application of balanced SSFP (bSSFP) is limited by the banding artifact resulting from its sensitivity to field inhomogeneity. A common approach for band reduction involves multiple measurements with different RF phase cycling, at the cost of lengthened total imaging time. In this work, we present a novel time-efficient bSSFP banding reduction technique by utilizing simultaneous multi-slice (SMS) imaging with CAIPIRINHA to acquire multiple phase-cycled images within the same imaging time of a single-band bSSFP scan. Effective band reduction is demonstrated in phantom, abdominal and brain imaging with SMS factor up to four.

Oral

Abdominal Technique & Pulse Sequences

Summit 2 10:00 - 12:00 *Moderators:*Lorenzo Mannelli

617 10:00

Improving Respiratory Phase-resolved 3D Body Imaging Using Iterative Motion Correction and Average (MoCoAve)

Xiaoming Bi[1], Jianing Pang[2], Wensha Yang[2], Matthias Fenchel[3], Zixin Deng[2], Yuhua Chen[4], Richard Tuli[2], Debiao Li[2], Gerhard Laub[1], and Zhaoyang Fan[2]

[1]Siemens Healthcare, Los Angeles, CA, United States, [2]Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Siemens Healthcare GmbH, Erlangen, Germany, [4]University of Pennsylvania, Philadelphia, PA, United States

4D (respiratory phase-resolved 3D) MRI has been increasingly used for the planning of radiotherapy and minimally invasive surgery. Recently developed self-gating methods showed great potential in 4D MRI by providing high imaging efficiency and isotropic spatial resolution. However, images of individual phases may suffer from decreased SNR and increased streaking artifact since only a subset of data were used for reconstruction. A motion correction and average (MoCoAve) framework was developed in this work to address such limitations. Preliminary results from patients showed that the proposed method can significantly improve SNR and image quality without compromising motion information.

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618 10:12

Variable Density Compressed Sensing Single Shot Fast Spin Echo

Valentina Taviani[1], Daniel V. Litwiller[2], Jonathan I. Tamir[3], Andreas M. Loening[1], Brian A. Hargreaves[1], and Shreyas S. Vasanawala[1]

[1]Stanford University, Stanford, CA, United States, [2]Global MR Applications and Workflow, GE Healthcare, New York, NY, United States, [3]University of California Berkeley, Berkeley, CA, United States

Variable density (VD) sampling was implemented into an extended echo train single shot fast spin echo (SSFSE) pulse sequence. Compressed sensing (CS) reconstuction was used. With respect to regular undersampling and ARC (Autocalibrated Reconstruction for Cartesian imaging), VD CS SSFSE allows higher acceleration factors, which translates in increased flexibility in the choice of echo times for full-Fourier imaging (shorter minimum TEs) and faster acquisitions (shorter breath-holds).

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619 10:24

Free-breathing non-contrast enhanced 3D radial respiratory-motion resolved pancreatic MRI at 3T using sparse iterative reconstruction

Jessica AM Bastiaansen[1], Jerome Yerly[1,2], Jean-Baptiste Ledoux[2], Ruud B van Heeswijk[1,2], Davide Piccini[3], and Matthias Stuber[1,2]

[1]Department of Radiology, University hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Center for Biomedical Imaging, Lausanne, Switzerland, [3]Advanced Clinical Imaging Technology, Siemens Healthcare, Lausanne, Switzerland

Pancreatic MRI is commonly performed during breath-held or navigator-gated acquisitions. The long breath-holds needed for high spatial resolution are not always feasible in patients and residual respiratory motion may still occur. Additionally, in some implementations, the navigator leads to a local signal void that may obscure parts of the anatomy of interest. Here we used a free-breathing self-navigated 3D radial gradient-recalled-echo (GRE) imaging sequence, and compared the 1D motion correction as performed on the scanner versus a motion-resolved 4D sparse iterative reconstruction. We show that non-contrast enhanced pancreatic MRI can be performed at 3T during free-breathing, while motion-resolved sparse reconstruction can efficiently minimize the adverse effects of respiratory motion.

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620 10:36

Radial Volumetric Interpolated Breath-hold Examination of the Liver: Clinical Impact of Self-gated 3D Isotropic Contrast-enhanced Late-Phase MR Imaging

Jakob Weiss[1], Jana Taron[1], Ahmed E. Othman[1], Robert Grimm[2], Petros Martirosian[1], Christina Schraml[1], Konstantin Nikolaou[1], and Mike Notohamiprodjo[1]

[1]Diagnostic and Interventional Radiology, University of Tuebingen, Tuebingen, Germany, [2]Siemens Healthcare, Erlangen, Germany

To evaluate clinical performance of contrast-enhanced 3D-isotropic radial volumetric interpolated breath-hold examination (VIBE) for late-phase MR imaging of the liver. A prototype retrospective self-gating algorithm for more motion-robust data acquisition was implemented and compared to standard Cartesian VIBE. Utilization of self-gating VIBE provides significantly improved image quality, especially in coronal reformations and Gd-EOB-DTPA-enhanced late-phase scans. Moreover, in 11% only radial VIBE provided diagnostic image quality, thus having a direct implication on patient care. Therefore, self-gated radial VIBE seems a valuable approach to improve diagnostic accuracy in late-phase MR imaging of the liver.

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621 10:48

Improved detection of capsular enhancement in hepatocellular carcinoma using multiphasic hepatic arterial imaging and DIfferential Sub-sampling with Cartesian Ordering (DISCO) in gadoxetic acid-enhanced magnetic resonance imaging

Shintaro Ichikawa[1], Utaroh Motosugi[1], Tetsuya Wakayama[2], Takashi Kakegawa[1], Hiroshi Kumagai[1], and Hiroshi Onishi[1]

[1]University of Yamanashi, Yamanashi, Japan, [2]GE Healthcare Japan, Tokyo, Japan

DIfferential Subsampling with Cartesian Ordering (DISCO) is a new high spatiotemporal resolution, dynamic contrast-enhanced magnetic resonance imaging (MRI) technique. We evaluated the usefulness of multiple (n=6) hepatic arterial phases (HAPs) with DISCO in gadoxetic acid-enhanced dynamic MRI for detecting capsular enhancement in hepatocellular carcinoma (HCC). Such capsular enhancement is detected more frequently by combining portal venous phase (PVP) images and multiphasic hepatic arterial images with DISCO. Combining DISCO with PVP improved the liver imaging reporting and data system (LI-RADS) v2014 score from LR4 to LR5.

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622 11:00

Multispectral Body Diffusion-Weighted Imaging

Valentina Taviani[1], Shreyas S. Vasanawala[1], and Brian A. Hargreaves[1]

[1]Stanford University, Stanford, CA, United States

A diffusion-weighted (DW) imaging method was developed to mitigate off-resonance-induced distortion and signal loss, which are problematic for body applications. A 2D RF pulse is used in place of the conventional spectral-spatial excitation used for DW spin echo echo-planar imaging. In the presence of off-resonance, a narrow band of frequencies is excited due to the different bandwidths between excitation and refocusing pulses. By progressively shifting the center frequency, the whole range of off-resonance can be excited and a composite image, corrected for off-resonance-induced distortion, can be reconstructed by estimating the field map from the spectral information.

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623 11:12

3D whole liver black blood imaging: a 3 min solution consisting of respiratory triggering and free breathing imaging techniques

Li Jiang[1], Chenguang Zhao[1], Andy Jiang[1], Ming Yang[1], Wengu Su[1], Allan Jin[1], Ping Yang[1], Stephon Xu[1], and Feng Huang[1]

[1]Philips Healthcare (Suzhou), Suzhou, Jiangsu, China, People's Republic of

Liver black blood imaging helps to detect and characterize focal liver lesions and thus is highly desirable clinically. The commonly used low b-value DWI sequence is limited due to inherent limitations of EPI, such as low spatial resolution and motion artifacts including blurring and ghosting. We proposed a 3D whole liver black blood imaging solution within 3 min. By combining with existing black blood preparation, a respiratory triggered VISTA sequence and a free breathing imaging technique utilizing GROWL reconstruction were proposed. Six healthy volunteers with stable and irregular respiration were scanned to further validate the feasibility of our proposed solution.

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624 11:24

magna cum laude

Potential Improvement in Apparent Diffusion Coefficient (ADC) Measurement by Respiratory Correlated Four Dimensional Diffusion-Weighted MRI (4D-DWI): Initial Investigation on Digital Phantoms and Human Subjects

Yilin Liu[1], Fang-Fang Yin[2], Brian Gary Czito[2], Mustafa R. Bashir [3], Manisha Palta [2], Xiaodong Zhong [4], Brian M. Dale [5], and Jing Cai[2]

[1]Medical Physics Graduate Program, Duke University Medical Center, Durham, NC, United States, [2]Radiation Oncology, Duke University Medical Center, Durham, NC, United States, [3]Department of Radiology, Center for Advanced Magnetic Resonance Development, Duke University Medical Center, Durham, NC, United States, [4]MR R&D Collaborations, Siemens Healthcare, Atlanta, GA, United States, [5]MR R&D Collaborations, Siemens Healthcare, Cary, NC, United States

Diffusion-weighted imaging (DWI) has been shown to have superior tumor-to-tissue contrast for cancer detection in abdominal region. However, the respiratory motion may induce severe imaging errors or artifacts for DWI images. This study aims at developing and evaluating a respiratory correlated 4D-DWI technique using a retrospective sorting method for imaging respiratory motion on human subjects. Comparing to free breathing DWI, 4D-DWI can lead to more accurate measurement of ADC. This has a great potential to improve the visualization and delineation of cancer tumors for radiotherapy.

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625 11:36

Simultaneous multislice accelerated diffusion-weighted imaging of the liver: comparison of different breathing schemes with standard sequences as reference

Christina Schraml[1], Jana Taron[1], Nina F Schwenzer[1], Holger Schmidt[1], Thomas Kuestner[2], Michael Erb[3], Mike Notohamiprodjo[1], Konstantin Nikolaou[1], Fritz Schick[4], and Petros Martirosian[4]

[1]Diagnostic and Interventional Radiology, Department of Radiology, University Hospital Tuebingen, Tuebingen, Germany, [2]Institute of Signal Processing and System Theory, University of Stuttgart, Stuttgart, Germany, [3]Department of Biomedical Magnetic Resonance, University Hospital Tuebingen, Tuebingen, Germany, [4]Section on Experimental Radiology, Department of Radiology, University Hospital Tuebingen, Tuebingen, Germany

SMS-acceleration allows for considerable scan time reduction in hepatic DWI without substantial drawbacks in image quality both using respiratory-triggering and free-breathing acquisitions. In the present study set-up, ADC measured in SMS-DWI were lower than in standard DWI which should be considered when using absolute ADC for clinical reading. The demonstrated high image quality of SMS-DWI obtained in FB indicates great potential for scan time reduction in DWI for abdominal and whole-body applications.

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626 11:48

Intravoxel incoherent motion diffusion-weighted imaging of hepatocellular carcinoma: is there a correlation with flow and perfusion metrics obtained with dynamic contrast-enhanced MRI?

Stefanie Hectors[1], Mathilde Wagner[1], Cecilia Besa[1], Hadrien Dyvorne[1], Octavia Bane[1], M. Isabel Fiel[2], Hongfa Zhu[2], and Bachir Taouli[1,3]

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

We assessed the correlation between intravoxel incoherent diffusion-weighted imaging (IVIM-DWI) and dynamic contrast-enhanced MRI (DCE-MRI) in hepatocellular carcinoma (HCC) and liver parenchyma. DCE-MRI-derived arterial fraction and arterial flow were significantly negatively correlated with IVIM-DWI-derived perfusion fraction and pseudodiffusion in the liver, while IVIM-DWI parameters did not correlate with DCE-MRI parameters in HCC. These results indicate that IVIM-DWI and DCE-MRI provide non-redundant information in HCC.

Educational Course

Muscle Diseases

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 10:00 - 12:00 *Moderators:*Jenny Bencardino & Eric Sigmund

10:00

Update on MR Techniques for Assessment of skeletal Muscle : illustration of a potential application in neuromuscular disorders

David Bendahan[1]

[1]AIx-Marseille University, CRMBM - CNRS, France

The purpose of this presentation is to give an overview of MRI investigations of skeletal muscle both in terms of acquisitions schemes and post-processing mainly related to segmentation.

10:30

Inflammatory and Ischemic Myopathies

Christopher J. Hanrahan[1]

[1]Department of Radiology and Imaging Sciences, University of Utah School of Medicine, Salt Lake City, UT, United States

This presentation will review clinical and MR imaging features of inflammatory and ischemic myopathies.

11:00

Denervation Muscle Syndromes

Gustav Andreisek

Muscle denervation syndromes have a broad variety of peripheral nerve disorders where MR imaging can be a helpful adjunct in clinical diagnosis, therapy planning and follow-up.

11:30

Traumatic Muscle Injuries

Christoph Rehnitz[1]

[1]*Heidelberg University Hospital*

During this talk MRI patterns of traumatic muscle injuries in elite athletes will be covered with a special focus on soccer injuries. The main topics will be: to give background information about the frequency and relevance of muscle injuries (m.i.) in professional players; to understand the mechanism of m.i. to discuss the MR imaging protocol needed to diagnose m.i. including the role of new sequence developments and techniques in daily practice; to discuss classification or grading systems and imaging predictors regarding "time to return to play"; to demonstrate exercise induced changes and differential diagnoses as well as complications.

12:00 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Alzheimer's Disease

*Organizers:*Andrew L. Alexander, Ph.D. & Kelvin Lim, M.D.

Nicoll 2 10:00 - 12:00 *Moderators:*Michael Zeineh & Flavio Dell'Acqua

10:00 Alzheimer's Disease
Tammie Benzinger[1]

[1]*Washington University in Saint Louis, School of Medicine; Mallinckrodt Institute of Radiology*

627 10:30 Neurodegeneration simulation in the connectome: a heuristic approach to unfold the key white matter pathways in Alzheimer's disease
Matteo Mancini[1], Marcel A. de Reus[2], Laura Serra[3], Marco Bozzali[3], Martijn van den Heuvel[2], Mara Cercignani[3,4], and Silvia Conforto[1]

magna cum laude

[1]*Department of Engineering, University of Rome "Roma Tre", Rome, Italy,* [2]*Department of Psychiatry, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands,* [3]*Neuroimaging Laboratory, IRCSS Santa Lucia Foundation, Rome, Italy,* [4]*Brighton & Sussex Medical School, Clinical Imaging Sciences Centre, University of Sussex, Brighton, United Kingdom*

In order to identify the white matter impairment that could lead to Alzheimer's disease (AD), we combined computational simulations with a graph theoretical approach. We reconstructed the structural connectome of AD patients and healthy controls by means of diffusion tensor imaging, and characterized the differences between the two groups using graph theoretical measures. We then simulated neurodegeneration processes in the controls using two different heuristic algorithms. We were able to reproduce the AD disruption pattern in the controls, and we observed a relevant role of the connections between hubs and peripheral regions in the simulated damaging process.

628 10:45 A New Biomarker for Neuroinflammation in Preclinical Alzheimer's disease Progression
Yong Wang[1,2,3], Qing Wang[2,4], Joshua S Shimony[2], Anne M Fagan[4,5], John C Morris[5,6], and Tammie L.S. Benzinger[2,6,7]

[1]*Obstetrics and Gynecology, Washington University in St. Louis, St. Louis, MO, United States,* [2]*Mallinckrodt Institute of Radiology, Washington University in St. Louis, St. Louis, MO, United States,* [3]*Biomedical Engineering, Washington University in St. Louis, St. Louis, MO, United States,* [4]*Knight Alzheimer's Disease Research Center, St. Louis, MO, United States,* [5]*Neurology, Washington University in St. Louis, St. Louis, MO, United States,* [6]*Knight Alzheimer's Disease Research Center, St. Louis, MO, United States,* [7]*Neurosurgery, Washington University in St. Louis, St. Louis, MO, United States*

The preclinical pathophysiology of Alzheimer's disease (AD) is not limited to the neuronal compartments. Neuroinflammation characterized by activation of microglia and astrocytes may contribute as much to AD disease pathogenesis as do amyloid plaques and neurofibrillary tangles. We demonstrated that a novel magnetic resonance imaging technique, diffusion basis spectrum imaging (DBSI), can accurately image neuroinflammation changes that occur in preclinical AD patients. DBSI neuroinflammation biomarker can be used to identify asymptomatic subjects at highest risk of developing dementia, and lead to effective new AD disease-modifying therapies targeting neuroinflammation.

11:00 Network-sensitive structural and functional MR imaging methods
Juan Zhou

Each neurodegenerative disease is defined by selectively vulnerable neurons, regions, networks, and functions, as well as genetic risk factors. In the past decade, new network-sensitive neuroimaging methods have made it possible to test the notion of network-based degeneration in living humans. In this talk, the basic theory/preprocessing/data analyses of these methods including structural covariance networks (MRI), functional connectivity (fMRI-BOLD) and structural connectivity (Diffusion MRI) will be introduced. We will focus on applications of these network-sensitive methods on two common causes of dementia, Alzheimer's disease (AD) and frontotemporal dementia. Lastly, important frontiers in the field of network-based neurodegeneration will be reviewed.

629 11:30 Changed Brain Connectivity in Elderly APOE ε4 Carriers: a Whole-brain Voxel-wise Functional Connectivity Strength Analysis
Kai Liu[1], Teng Zhang[1], Yanjia Deng[1], Lin Shi[2,3], Defeng Wang[4,5], and ADNI Alzheimer's Disease Neuroimaging Initiative [6]

[1]*Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [2]*Department of Medicine and Therapeutics, The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [3]*Chow Yuk Ho Technology Centre for Innovative Medicine, The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [4]*Research Center for Medical Image Computing, Department of Imaging and Interventional Radiology, The Chinese University of Hong Kong, Hong Kong, Hong Kong,* [5]*Shenzhen Research Institute, The Chinese University of Hong Kong, Shenzhen, China, People's Republic of,* [6]*Los Angeles, SC, United States*

Apolipoprotein E epsilon 4 allele (APOE-4) is considered as the strongest genetic risk factor for late-onset Alzheimer's disease, and investigation of its neuropathological effect in normal elderly using advanced neuroimaging connectivity probes has brought much research curiosity. In this study, the underlying abnormal brain connectivity in APOE-4 carriers was analyzed using the functional connectivity strength (FCS), which provides a voxel-wise method to explore the significant connectivity changes at whole-brain level. The results identified APOE-4 related significant connectivity decrease in the bilateral insular and left temporal lobe. We hope these findings could help to shed light on the APOE-4's neuropathological mechanism.

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630 11:45 Who will develop Alzheimer's disease? New insights from multimodal neuroimaging

Letizia Casiraghi[1,2], Fulvia Palesi[2,3], Gloria Castellazzi[2,4], Andrea De Rinaldis[2,4], Elena Sinforiani[5], Claudia Angela Michela Gandini Wheeler-Kingshott [2,6], Egidio D'Angelo[1,2], and Carol Di Perri[2]

[1]*Department of Brain and Behavioral Sciences, University of Pavia, Pavia, Italy,* [2]*Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy,* [3]*Department of Physics, University of Pavia, Pavia, Italy,* [4]*Department of Electrical, Computer and Biomedical Engineering, University of Pavia, Pavia, Italy,* [5]*Neurology Unit, C. Mondino National Neurological Institute, Pavia, Italy,* [6]*NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, University College London, London, United Kingdom*

Mild cognitive impairment (MCI) is considered a transitional state between healthy controls (HC) and Alzheimer's disease (AD). This study compares the predictive value of neuropsychological evaluation, structural magnetic resonance imaging, diffusion tensor imaging and resting state functional MRI indices able to identify MCI conversion. AD versus HC and converted MCI (cMCI) versus non-converted MCI (ncMCI) presented different features of differentiation. This result suggests adopting advanced MRI techniques to investigate early alterations. Due to the clinical heterogeneity of MCI patients, considering cMCI as AD-like and ncMCI as HC might be inappropriate when attempting to distinguishing between cMCI and non-converted MCI.

12:00 Adjournment & Meet the Teachers

Educational Course

Portable MRI

*Organizers:*Guoying Liu, Ph.D. & Greg Zaharchuk, M.D., Ph.D.

Nicoll 3 10:00 - 12:00 *Moderators:*Michael Garwood & Lawrence Wald

10:00 A Brief History of Portable MRI

John M. Pauly[1]

[1]*Electrical Engineering, Stanford University, Stanford, CA, United States*

Many different methods have been explored over the years for using NMR for imaging and characterizing materials. Some of these have carried forward into MRI, but there are many other interesting variations that can make MRI more portable and flexible. This presentation will outline some of these ideas, and describe where they may have a place in the future of MRI systems.

10:30 Portable Imaging with Rotating Inhomogeneous Magnetic Fields

Clarissa Zimmerman Cooley[1]

[1]*A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States*

As the premiere modality for brain imaging, MRI could find wider applicability if lightweight, portable systems were available for siting in unconventional locations. We construct and validate a truly portable (<100kg) and silent proof-of-concept scanner which replaces conventional gradient encoding with a rotating inhomogeneous low-field magnet. When rotated about the object, the inhomogeneous field pattern is used to create generalized projections. The system is validated with experimental 2D images, and extended to 3D imaging with the addition of Transmit Array Spatial Encoding (TRASE). This new scanner architecture demonstrates the potential for portability by simultaneously relaxing the magnet homogeneity criteria and eliminating the gradient coil.

11:00 Imaging the Brain using Ultra-low Field MRI with SQUIDs

Fa-Hsuan Lin[1]

[1]*National Taiwan University*

Recent progress has demonstrated the feasibility of using the SQUID sensor arrays in MEG helmets to record MRI data. Here we describe the basic principles of MRI as well as the special requirements and solutions needed to perform ultra-low-field MRI concurrently with MEG. We consider it is feasible to build practical MEG-MRI instruments for scientific experimentation and for clinical

use. An MRI with 2 mm spatial resolution, sufficient signal-to-noise ratio and contrast appears achievable without essentially lengthening the normal MEG measurement time.

11:30 Millitesla MRI: Brain and Beyond

Matthew S Rosen[1,2,3]

[1]MGH/Martinos Center, Charlestown, MA, United States, [2]Department of Radiology, Harvard Medical School, Boston, MA, United States, [3]Department of Physics, Harvard University, Cambridge, MA, United States

MRI is unparalleled in its ability to visualize anatomical structure and function non-invasively. To overcome the low sensitivity inherent in inductive detection of weakly polarized nuclear spins, the vast majority of clinical MRI scanners employ massive superconducting Tesla-scale magnets with strict infrastructure demands that preclude truly portable operation. We describe here a simple, non-cryogenic approach to high-performance human MRI at ultra-low magnetic field using undersampled b-SSFP at 6.5 mT. We contend that practical ultra-low magnetic-field implementations of MRI (< 10 mT) will complement traditional MRI, providing clinically relevant images and setting new standards for affordable and robust portable devices.

12:00 Adjournment & Meet the Teachers

Traditional Poster : Interventional

Exhibition Hall 13:30 - 15:30 *(no CME credit)*

Traditional Poster : Engineering

Exhibition Hall 13:30 - 15:30 *(no CME credit)*

Traditional Poster : MR Safety: Safety & Bioeffects

Exhibition Hall 13:30 - 15:30 *(no CME credit)*

Traditional Poster : MSK

Exhibition Hall 16:00 - 18:00 *(no CME credit)*

Traditional Poster : Molecular Imaging

Exhibition Hall 16:00 - 18:00 *(no CME credit)*

Traditional Poster : - Spectroscopy

Exhibition Hall 16:00 - 18:00 *(no CME credit)*

Electronic Poster : Body

Exhibition Hall 13:30 - 14:30 *(no CME credit)*

Electronic Poster : - Spectroscopy

Exhibition Hall 14:30 - 15:30 *(no CME credit)*

Electronic Poster : Neuro

Exhibition Hall 16:00 - 17:00 *(no CME credit)*

Study Groups

Cardiac MR

Hall 405 E 13:30 - 15:30

Study Groups

MR Elastography

Hall 406 D 13:30 - 15:30

Study Groups

Perfusion

Hall 405 E 16:00 - 18:00

Study Groups

Psychiatric MR Spectroscopy & Imaging

Hall 406 D 16:00 - 18:00

Power Pitch

Controversies in fMRI

Power Pitch Theatre, Exhibition Hall 13:30 - 14:30 *Moderators:*Molly Bright & Raisim Boyacioglu

631 13:30 summa cum laude

The sensitivity of diffusion MRI in direct detection neuronal activity: an in-vitro assessment
Ruiliang Bai[1,2], Craig Stewart[3], Dietmar Plenz[3], and Peter J Basser[1]

[1]Section on Quantitative Imaging and Tissue Science, DIBGI, NICHD, National Institutes of Health, Bethesda, MD, United States, [2]Biophysics Program, Institute for Physical Science and Technology, University of Maryland, College Park, MD, United States, [3]Section on Critical Brain Dynamics, LSN, NIMH, National Institutes of Health, Bethesda, MD, United States

632 13:33

Apparent diffusion coefficient correlates with gamma oscillation of local field potentials
Tomokazu Tsurugizawa[1], Yoshifumi Abe[1], and Denis Le Bihan[1]

[1]NeuroSpin, Bât 145, Commissariat à l'Energie Atomique-Saclay Center, 91191, France, Gif-sur-Yvette, France

633 13:36 summa cum laude

Fast Dynamic Measurement of Functional T1 and Grey Matter Thickness Changes During Brain Activation at 7T
Laurentius Huber[1], Sean Marrett[1], Daniel A Handwerker[1], Adam Thomas[1], Benjamin Gutierrez[1], Dimo Ivanov[2], Benedikt A Poser[2], and Peter A Bandettini[1]

[1]Section of Functional Imaging Methods, National Institute of Mental Health, Bethesda, MD, United States, [2]MBIC, Maastricht University, Maastricht, Netherlands

634 13:39 summa cum laude

Cognitive Application of Multi-Phase Passband Balanced SSFP fMRI with 50ms Sampling rate at 7 Tesla
Zhongwei Chen[1,2], Rong Xue[1], Jing An[3], Kaibao Sun[1,2], Zhentao Zuo[1], Peng Zhang[1], and Danny JJ Wang[4]

[1]State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences, Beijing, China, People's Republic of, [2]Graduate School, University of Chinese Academy of Sciences, Beijing, China, People's Republic of, [3]Siemens Shenzhen Magnetic Resonance Ltd, Shenzhen, China, People's Republic of, [4]Laboratory of FMRI Technology (LOFT), Department of Neurology, University of California Los Angeles, Los Angeles, CA, United States

635 13:42

Depth-Dependence of Visual Signals in the Human Superior Colliculus at 9.4T: Comparison with 3T
Joana Alves Loureiro[1,2], Gisela Hagberg[1], Thomas Ethofer[2], Michael Erb[2], Klaus Scheffler[1], and Marc Himmelbach[3]

[1]High-Field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]BMMR, University Hospital Tuebingen, Tuebingen, Germany, [3]Division of Neuropsychology, Centre for neurology, Tuebingen, Germany

636 13:45 summa cum laude

Resting State Functional Connectivity is Sensitive to Layer-specific Connectional Architecture in Cortical Columns
Yun Wang[1], Jennifer Robinson[1,2,3], and Gopikrishna Deshpande[1,2,3]

[1]AU MRI Research Center, Department of Electrical and Computer Engineering, Auburn University, Auburn, AL, United States, [2]Department of Psychology, Auburn University, Auburn, AL, United States, [3]Alabama Advanced Imaging Consortium,Auburn University and University of Alabama Birmingham, Birmingham, AL, United States

637 13:48

Deconvolving the laminar gradient echo activation profiles with the spatial PSF: an approach to revealing underlying activation patterns
Irati Markuerkiaga[1] and David G. Norris[1]

[1]Donders Institute, Nijmegen, Netherlands

638 13:51

Effects of Anesthesia on White Matter BOLD Signals in Monkeys
Tung-Lin Wu[1,2], Feng Wang[1,3], Li Min Chen[1,3], Adam W. Anderson[1,2,3], Zhaohua Ding[1,3], and John C. Gore[1,2,3]

[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States, [2]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [3]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States

639 13:54

Cerebral vascular reactivity and baseline cerebral blood volume contributions to the slow fluctuating baseline BOLD signal.

Jeroen C.W. Siero[1], Jill B. de Vis[1], and Jeroen Hendrikse[1]

[1]*Radiology, University Medical Center Utrecht, Utrecht, Netherlands*

640 13:57

Frequency specificity of functional connectivity in rat brain networks

Li-Ming Hsu[1], Gu Hong[1], Hanbing Lu[1], Elisabeth C. Caparelli[1], Elliot A. Stein[1], and Yihong Yang[1]

[1]*Neuroimaging Research Branch, National institute on drug abuse, Baltimore, MD, United States*

641 14:00

The resting state fMRI global signal is negatively correlated with time-varying EEG vigilance

Maryam Falahpour[1], Chi Wah Wong[1], and Thomas T. Liu[1]

[1]*Center for Functional Magnetic Resonance Imaging, University of California San Diego, San Diego, CA, United States*

642 14:03

Detection of epileptic networks using wavelet coherence analysis of dynamic local fMRI connectivity and simultaneous scalp EEG

Amir Omidvarnia[1], David Vaughan[1,2], Mangor Pedersen[1], Mira Semmelroch[1], David Abbott[1], and Graeme Jackson[1,2,3]

[1]*Epilepsy Imaging, The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia,* [2]*Department of Neurology, Austin Health, Melbourne, Australia,* [3]*Department of Medicine, The University of Melbourne, Melbourne, Australia*

643 14:06

Large-scale Brain Activation upon Strong Low Frequency Visual Stimulation

Leon C. Ho[1,2], Russell W. Chan[1,2], Patrick P. Gao[1,2], Alex T.L. Leong[1,2], Celia M. Dong[1,2], and Ed X. Wu[1,2]

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

644 14:09

Relative latency and temporal variability of BOLD fMRI signal within human visual cortex

Jo-Fu Lotus Lin[1], Jonathan R Polimeni[2], Wen-Jui Kuo[3], and Fa-Hsuan Lin[1]

[1]*Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan,* [2]*Athinoula A. Martinos Center, Department of Radiology, Harvard Medical School, Massachusetts General Hospital, Charlestown, MA, United States,* [3]*Institute of Neuroscience, National Yang Ming University, Taipei, Taiwan*

645 14:12

Globally conditioned multivariate causal influence estimates in whole-brain functional connectivity

Andrea Duggento[1], Luca Passamonti[2,3], Maria Guerrisi[1], and Nicola Toschi[1,4]

[1]*Department of biomedicine and prevention, University of Rome "Tor Vergata", Rome, Italy,* [2]*Institute of Bioimaging and Molecular Physiology, National Research Council, Catanzaro, Italy,* [3]*Department of Clinical Neurosciences, University of Cambridge, Cambridge, United Kingdom,* [4]*Department of Radiology, Martinos Center for Biomedical Imaging and Harvard Medical School, Boston, MA, United States*

Power Pitch

Body MRI

Power Pitch Theatre, Exhibition Hall 16:00 - 17:00 *Moderators:*Masoom Haider & Edwin van Beek

715 16:00

Abdominal and Body Imaging Using a 16 Channel Dipole RF Array at 7.0 T

Celal Oezerdem[1], Till Huelnhagen[1], Lukas Winter[1], and Thoralf Niendorf[1,2]

[1]*Berlin Ultrahigh Field Facility (B.U.F.F), Max Delbrück Center for Molecular Medicine in the Helmholtz Association (MDC), Berlin, Germany,* [2]*Experimental and Clinical Research Center, a joint cooperation between the Charité Medical Faculty and the Max Delbrück Center for Molecular Medicine in the Helmholtz Association, Berlin, Germany*

716 16:03

Free-Breathing 3D Abdominal Magnetic Resonance Fingerprinting Using Navigators

Yong Chen[1], Bhairav Mehta[1], Jesse Hamilton[2], Dan Ma[1], Nicole Seiberlich[2], Mark Griswold[1], and Vikas Gulani[1]

[1]*Department of Radiology, Case Western Reserve University, Cleveland, OH, United States,* [2]*Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States*

717 16:06

magna cum laude

Multiple Linear Regression for Predicting Fibrosis in the Kidney using T1 Mapping and 'RESOLVE' Diffusion-Weighted MRI

Iris FRIEDLI[1], Lindsey Alexandra CROWE[1], Lena BERCHTOLD[2], Solange MOLL[3], Karine HADAYA[2], Thomas DE PERROT[1], Pierre-Yves MARTIN[2], Sophie DE SEIGNEUX[2], and Jean-Paul VALLEE[1]

[1]Department of Radiology, Geneva University Hospitals, Geneva, Switzerland, [2]Department of Nephrology, Geneva University Hospitals, Geneva, Switzerland, [3]Department of Pathology, Geneva University Hospitals, Geneva, Switzerland

718 16:09

Towards Quantitative Renal MR Blood Oximetry by Combined Monitoring of T2*, T2 and Blood Volume Fraction

Andreas Pohlmann[1], Karen Arakelyan[1,2], Leili Riazy[1], Till Huelnhagen[1], Stefanie Kox[1], Kathleen Cantow[2], Sonia Waiczies[1], Bert Flemming[2], Erdmann Seeliger[2], and Thoralf Niendorf[1]

[1]Berlin Ultrahigh Field Facility, Max Delbrueck Center for Molecular Medicine, Berlin, Germany, [2]Institute of Physiology, Charite Universitaetsmedizin, Berlin, Germany

719 16:12

magna cum laude

BOLD MRI of human placenta and fetuses under maternal hyperoxygenation in growth restricted twin pregnancies

Jie Luo[1,2], Esra Abaci Turk[1,2], Carolina Bibbo[3], Borjan Gagoski[1], Mark Vangel[4], Clare M Tempany-Afdhal[5], Norberto Malpica[6], Arvind Palanisamy[7], Elfar Adalsteinsson[2,8,9], Julian N Robinson[3], and Patricia Ellen Grant[1]

[1]Fetal-Neonatal Neuroimaging & Developmental Science Center, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [2]Madrid-MIT M+Vision Consortium in RLE, Massachusetts Institute of Technology, Cambridge, MA, United States, [3]Maternal and Fetal Medicine, Brigham and Women's Hospital, Boston, MA, United States, [4]Department of Radiology, Harvard Medical School, Boston, MA, United States, [5]Department of Radiology, Brigham and Women's Hospital, Boston, MA, United States, [6]Medical Image Analysis and Biometry Laboratory, Universidad Rey Juan Carlos, Madrid, Spain, [7]Division of Obstetric Anesthesia, Brigham and Women's Hospital, Boston, MA, United States, [8]Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA, United States, [9]Harvard-MIT Health Sciences and Technology, Massachusetts Institute of Technology, Cambridge, MA, United States

720 16:15

summa cum laude

Ingestion of carbohydrate solutions of glucose-fructose versus glucose-alone during a prolonged exercise in individuals with type 1 diabetes

Tania Buehler[1], Lia Bally[2], Ayse Sila Dokumaci[1], Christoph Stettler[2], and Chris Boesch[1]

[1]Depts. Radiology and Clinical Research, University of Bern, Bern, Switzerland, [2]Division of Endocrinology, Diabetes and Clinical Nutrition, Inselspital Bern, Bern, Switzerland

721 16:18

Pancreatic disease in obesity: observations on fat content, diffusion, T2* relaxometric and mechanical properties in the rat ex vivo

Philippe Garteiser[1], Sabrina Doblas[1], Jean-Baptiste Cavin[1], André Bado[1], Vinciane Rebours[1,2], Maude Le Gall[1], Anne Couvelard[1,3], and Bernard E Van Beers[1,4]

[1]Center For Research on Inflammation, Inserm U1149, Paris, France, [2]Pancreatology Unit, AP-HP, Beaujon Hospital, Clichy, France, [3]Pathology department, AP-HP, Bichat Hospital, Paris, France, [4]Radiology department, AP-HP, Beaujon Hospital, Clichy, France

722 16:21

magna cum laude

MR of hyperpolarized Xe-129 dissolved in the human brain at 1.5 T and 3.0 T

Madhwesha Rao[1], Neil J Stewart[1], Graham Norquay[1], Paul D Griffiths[1], and Jim M Wild[1]

[1]Academic unit of Radiology, University of Sheffield, Sheffield, United Kingdom

723 16:24

Pulmonary Thin-Section MRI with Ultrashort TE: Capability for Lung Nodule Screening and Subtype Classification as Compared with Low- and Standard-Dose CTs

Yoshiharu Ohno[1,2], Yuji Kishida[2], Shinichiro Seki[2], Hisanobu Koyama[2], Takeshi Yoshikawa[1,2], Daisuke Takenaka[3], Masao Yui[4], Aiming Lu[5], Mitsue Miyazaki[5], Katsusuke Kyotani[6], and Kazuro Sugimura[2]

[1]Advanced Biomedical Imaging Research Center, Kobe University Graduate School of Medicine, Kobe, Japan, [2]Radiology, Kobe University Graduate School of Medicine, Kobe, Japan, [3]Radiology, Hyogo Cancer Center, Akashi, Japan, [4]Toshiba Medical Systems Corporation, Otawara, Japan, [5]Toshiba Medical Research Institute USA, Vernon Hills, IL, United States, [6]Center for Radiology and Radiation Oncology, Kobe University Hospital, Kobe, Japan

724 16:27

Quantitative Assessment of Pulmonary Blood Flow in Infants with Congenital Diaphragmatic Hernia by CINE Phase Contrast MRI

Jean A Tkach[1], Ryan A Moore[2], Nara S Higano[1,3,4], Laura L Walkup[1,3], Mantosh S Rattan[5], Paul S Kingma[6], Michael D Taylor[2], and Jason C Woods[1,3,4]

[1]Imaging Research Center, Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [2]The Heart Institute, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [3]Center for Pulmonary Imaging Research, Division of Pulmonary Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [4]Department of Physics, Washington University, St. Louis, MO, United States, [5]Department of Radiology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [6]Division of Neonatology and Pulmonary Biology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States

725 16:30 Pretreatment intravoxel incoherent motion diffusion-weighted imaging for predicting the response of locally advanced rectal cancer to neoadjuvant chemoradiation therapy

Hongliang Sun[1], Yanyan Xu[1], Kaining Shi[2], and Wu Wang[1]

[1]Radiology, China-Japan Friendship hospital, Beijing, China, People's Republic of, [2]Philips Healthcare China, Beijing, China, People's Republic of

726 16:33 Prostate cancer detection with multi-parametric MRI : PI-RADS version 1 versus version 2

Zhaoyan Feng[1], Xiangde Min[1], and Liang Wang[1]

[1]Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan, China, People's Republic of

727 16:36 Radiomic features on T2w MRI to predict tumor invasiveness for pre-operative planning in colorectal cancer: preliminary results

Jacob Antunes[1], Scott Steele[2], Conor Delaney[2], Joseph Willis[3], Justin Brady[4], Rajmohan Paspulati[5], Anant Madabhushi[1], and Satish Viswanath[1]

[1]Department of Biomedical Engineering, Case Western Reserve University, Cleveland, OH, United States, [2]Department of Colon and Rectal Surgery, University Hospitals Case Medical Center, Cleveland, OH, United States, [3]Department of Anatomic Pathology, University Hospitals Case Medical Center, Cleveland, OH, United States, [4]Department of General Surgery, University Hospitals Case Medical Center, Cleveland, OH, United States, [5]Department of Radiology, University Hospitals Case Medical Center, Cleveland, OH, United States

728 16:39 Motion Compensated Diffusion-Weighted MRI in the Liver with Convex Optimized Diffusion Encoding (CODE)

Eric Aliotta[1,2], Holden H Wu[1,2], and Daniel B Ennis[1,2]

[1]Radiological Sciences, UCLA, Los Angeles, CA, United States, [2]Biomedical Physics IDP, UCLA, Los Angeles, CA, United States

729 16:42 Quantitative Analysis of Arterial Phase Transient Respiratory Motions Induced by Two Contrast Agents for Dynamic Liver MR Imaging

Yuxi Pang[1], Dariya Malyarenko[1], Matthew Davenport[1], Hero Hussain[1], and Thomas Chenevert[1]

[1]Department of Radiology, UNIVERSITY OF MICHIGAN, ANN ARBOR, MI, United States

Oral

Perfusion & Permeability Contrast Agent Methods

Room 300-302 13:30 - 15:30 *Moderators:*Greg Cron & Thomas Christen

646 13:30 A 3-Dimensional Microvascular Phantom for Perfusion Imaging

Thomas Gaass[1,2], Moritz Schneider[1], Michael Ingrisch[1], Julia Herzen[3], and Julien Dinkel[1,2]

[1]Institute for Clinical Radiology, Ludwig-Maximilians University, Munich, Germany, [2]Comprehensive Pneumology Center, German Center for Lung Research, Munich, Germany, [3]Department of Physics, Technische Universität München, Munich, Germany

The presented work demonstrates the applicability of a dedicated 3-dimensional phantom as a realistic MR- and CT-compatible phantom for microvascular perfusion simulation. The device constructed using resin-embedded, melt-spun, sacrificial sugar structures was examined using dynamic contrast enhanced MRI. Parameters, such as flow and volume fraction gained from deconvolving the signal enhancement curve showed very good agreement with the pre-set perfusion parameters. The presented phantom showed great potential in realistically simulating the capillary bed and can potentially serve as a quality insurance device for quantitative dynamic contrast enhanced MRI in the future.

647 13:42 Bézier Curve Deconvolution for Model-Free Quantification of Cerebral Perfusion

André Ahlgren[1], Ronnie Wirestam[1], Freddy Ståhlberg[1,2,3], and Linda Knutsson[1]

[1]Department of Medical Radiation Physics, Lund University, Lund, Sweden, [2]Department of Diagnostic Radiology, Lund University, Lund, Sweden, [3]Lund University Bioimaging Center, Lund University, Lund, Sweden

Deconvolution is an ill-posed and ill-conditioned inverse problem that often yields non-physiological residue functions in perfusion MRI. Deconvolution methods based on Fourier transform or matrix decomposition often yield solutions with spurious oscillations. Although the perfusion value, estimated from the peak of the tissue impulse response function, may still be useful, any estimate that depends on the actual shape of the residue function will be prone to errors. To obtain physiologically reasonable residue functions in perfusion MRI, we propose the use of Bézier curves, and demonstrate initial experiences from the application to DSC-MRI in vivo data.

648 13:54

Simultaneous perfusion and permeability assessments using multi-band multi-echo EPI (M2-EPI)

Deqiang Qiu[1], Junjie Wu[1], Seena Dehkharghani[1], and Amit Saindane[1]

[1]*Department of Radiology and Imaging Sciences, Emory University, Atlanta, GA, United States*

We proposed a novel multi-band multi-echo DSC perfusion imaging method to estimate leakage-corrected perfusion parameters and additional vascular permeability parameters. Simulations were performed and showed that higher temporal resolution provided by the novel sequence improves the accuracy in the calculation of perfusion parameters.

649 14:06

Unveiling the Dispersion Kernel in DSC-MRI by Means of Dispersion-Compliant Bases and Control Point Interpolation Techniques

Marco Pizzolato[1], Rutger Fick[1], Timothé Boutelier[2], and Rachid Deriche[1]

[1]*Athena Project-Team, Inria Sophia Antipolis - Méditerranée, Sophia Antipolis, France,* [2]*Olea Medical, La Ciotat, France*

In DSC-MRI the presence of dispersion affects the estimation, via deconvolution, of the residue function that characterizes the perfusion in each voxel. Dispersion is described by a Vascular Transport Function (VTF) which knowledge is essential to recover a dispersion-free residue function. State-of-the-art techniques aim at characterizing the VTF but assume a specific shape for it, which in reality is unknown. We propose to estimate the residue function without assumptions by means of Dispersion-Compliant Bases (DCB). We use these results to find which VTF model better describes the in-vivo data for each tissue type by means of control point interpolation approaches.

650 14:18

Arterial transit time (ATT) heterogeneity in calf muscle: how DCE studies reveal a critical challenge for arterial spin labeling (ASL) acquisition

Jeff L. Zhang[1], Christopher Hanrahan[1], Christopher C. Conlin[1], Corey Hart[2], Gwenael Layec[2], Kristi Carlston[1], Daniel Kim[1], Michelle Mueller[3], and Vivian S. Lee[1]

[1]*Radiology, University of Utah, Salt Lake City, UT, United States,* [2]*Internal Medicine, University of Utah, Salt Lake City, UT, United States,* [3]*Vascular surgery, University of Utah, Salt Lake City, UT, United States*

One major challenge for measuring exercise perfusion of skeletal muscle with ASL is the potential heterogeneity of arterial transit time (ATT) across the muscle. In this study, we used reliable DCE MRI technique to measure ATT of calf muscle in both healthy controls and peripheral artery disease patients and after plantar flexion of different loads. Our study showed that ATT of calf muscle varied with multiple factors, including muscle group, exercise load and healthy status, and had a wide range of 0~4 sec. The result suggests the necessity of performing calf-muscle ASL with multiple different post-labeling delays.

651 14:30

Accelerated brain DCE-MRI using Contrast Agent Kinetic Models as Temporal Constraints

Sajan Goud Lingala[1], Yi Guo[1], Yinghua Zhu[1], Naren Nallapareddy[1], R. Marc Lebel[2], Meng Law[3], and Krishna Nayak[1]

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We propose a novel tracer-kinetic model based constrained reconstruction scheme to enable highly accelerated DCE-MRI. The proposed approach efficiently leverages information of the contrast agent kinetic modeling into the reconstruction, and provides a novel alternative to current constraints that are blind to tracer kinetic modeling. We develop the frame-work to include constraints derived from the extended-Tofts (e-Tofts) model. We perform noise sensitivity analysis to determine the accuracy and precision of parameter mapping with the proposed e-Tofts derived temporal bases. We demonstrate its utility in retrospectively accelerating brain tumor DCE datasets with different tumor characteristics.

652 14:42

High temporal resolution DCE MRI of breast cancer treated with neo-adjuvant chemotherapy and analyzed with both distributed parameter and modified Tofts tracer kinetics models

Dennis Lai-Hong Cheong[1], Bo Zhang[1], Bingwen Zheng[1], Limiao Jiang[1], Eugene Wai Mun Ong[2], Soo Chin Lee[3,4], and Thian C Ng[1]

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Higher resolution DCE-MRI is readily attainable and should allow for more realistic distributed parameter tracer kinetics models to be used. However, simpler, faster and lesser parameters compartmental models such as the modified Tofts model are still preferred by many researchers. We present here how we have implemented a distributed parameter model to analyze 2.4sec/frame DCE MRI data in a clinical trial of neo-adjuvant chemotherapy with or without short-course anti-angiogenic therapy in breast cancer patients. The results from modified Tofts and the distributed parameter model differ. More realistic distributed parameter models might be better in analyzing high temporal resolution DCE-MRI data.

653 14:54

Motion Correction in DCE-MRI by Tracer-Kinetic Model-Driven Registration: Beyond the Tofts models

Dimitra Flouri[1,2], Daniel Lesnic[2], and Steven P Sourbron [1]

[1]*Division of Biomedical Imaging, University of Leeds, Leeds, United Kingdom,* [2]*Department of Applied Mathematics, University of Leeds, Leeds, United Kingdom*

Tracer-kinetic model-driven motion correction is an attractive solution for DCE-MRI, but previous studies only use the extended Tofts model. We propose a generalisation based on a 4-parameter 2-compartment tracer-kinetic model, and evaluate it in simulated and patient kidney data. Results show a significantly improved alignment of the data and removal of the motion-induced parameter error at a wide range of noise levels. With improvement in calculation time this is viable method for motion correction in arbitrary DCE-MRI data.

654 15:06

Impact of fitting strategy on DCE parameter estimates and performance : a simulation study in image space

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The two-compartment exchange model is a tracer-kinetic model that is defined by two coupled first-order differential equations. These can be solved analytically or by direct integration. In this simulation study, we compared both strategies for different parameter scenarios in synthetic 4D images. The sum of squared residuals was calculated either by numeric integration with the Runge-Kutta method or by numeric convolution. The resulting parameter estimates were evaluated in terms of accuracy, precision and computational speed. Both approaches yield similar results in parameter determination, the convolution excelled in computational speed.

655 15:18

A Novel Prostate DCE-MRI Flow Phantom for the Quantitative Evaluation of Pharmacokinetic Parameters

Silvin P. Knight[1], Jacinta E. Browne[2], James F. Meaney[1], David S. Smith[3], and Andrew J. Fagan[1]

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A method is lacking to comprehensively validate and optimise the ability of prostate DCE-MRI techniques to accurately measure pharmacokinetic (PK) parameters. We present a novel flow phantom capable of simultaneously producing two measurable, reproducible, and known arbitrarily-shaped contrast time-intensity curves, from which PK parameters can be derived. K^{trans} values were derived from MR data acquired at different temporal resolutions (2.3-20.3s) and were found to differ by -8.1% to -44.6%, when compared to calibrated 'truth estimate' values, with the lowest variance measured at a temporal resolution of 6.8s. The phantom can be used to help establish robust DCE-MRI prostate protocols.

Oral

Diffusion: Probing Microstructure

Room 324-326 13:30 - 15:30 *Moderators:*Julien Cohen-Adad & Benoit Scherrer

656 13:30

What dominates the diffusivity time dependence transverse to axons: Intra- or extra-axonal water?

Hong-Hsi Lee[1], Jelle Veraart[1,2], Dmitry S. Novikov[1], and Els Fieremans[1]

[1]New York University, Center for Biomedical Imaging, New York, NY, United States, [2]iMinds-Vision Lab, University of Antwerp, Antwerp, Belgium

Diffusion MRI enables to evaluate microstructure at the mesoscopic scale. In particular, tuning the diffusion time over a wide range could increase the sensitivity for acquiring useful biomarkers, such as the axonal diameter or density. However, it is unclear whether either intra-, or extra-axonal water attribute most to the observed changes of diffusion signal with diffusion time. Here, we evaluate the dependence of the diffusion coefficient (obtained from the diffusion signal at low $$$b$$$-value) on $$$\delta$$$ and $$$\Delta$$$ in the direction perpendicular to axons in the human brain, and explain these dependencies by diffusion of water in the extra-axonal space.

657 13:42

Impact of transcytolemmal water exchange on quantitative characterization of tissue microstructure using diffusion MRI

Hua Li[1], Xiaoyu Jiang[1], Jingping Xie[1], John C Gore[1], and Junzhong Xu[1]

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Current diffusion MRI methods that quantitatively characterize tissue microstructure usually assume a zero transcytolemmal water exchange rate $$$\tau_{in}$$$ between intra- and extracellular spaces. This assumption may not be true in many cases of interest. The present work used both computer simulations and cell culture in vitro to investigate the influence of $$$\tau_{in}$$$ on the accuracy of fitted microstructural parameters such as mean cell size $$$d$$$, intracellular water fraction $$$f_{in}$$$ and diffusion coefficient $$$D_{in}$$$. Results indicate $$$d$$$ is relatively insensitive to $$$\tau_{in}$$$, while $$$f_{in}$$$ is always underestimated with finite $$$\tau_{in}$$$. $$$D_{in}$$$ can be fit reliably only when short diffusion times are used.

658 13:54

Low frequency oscillating gradient spin-echo sequences improves sensitivity to axon diameter – an experimental validation study in live nerve tissue

Lebina Shrestha Kakkar[1], Oscar Bennett[1], David Atkinson[2], Bernard Siow[3], James Phillips[4], Simon Richardson[3], Enrico Kaden[1], and Ivana

Drobnjak[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]Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom, [4]Department of Biomaterials & Tissue Engineering, University College London, London, United Kingdom

In a recent simulation study, Drobnjak ***et al*** demonstrates that low-frequency oscillating gradient spin-echo (OGSE) sequence is more sensitive to axon diameter than conventional pulsed gradient spin-echo (PGSE) sequence when fibre orientation is unknown or when fibre dispersion exists. Here, we experimentally validate this claim. We image a live rat sciatic nerve tissue using both sequences and compare its agreement with histology. Our results confirm that OGSE provides more accurate and precise diameter estimates compared to PGSE. Additionally, OGSE parameter estimates are less affected by reduced number of diffusion gradient directions, suggesting their use could translate into faster scan times.

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659 14:06

Asymmetries of the dendrite density in cortical areas assessed by diffusion MR microscopy using NODDI

Achille Teillac[1,2,3], Sandrine Lefranc[2,3,4], Edouard Duchesnay[2,3,4,5], Fabrice Poupon[2,3,4], Maite Alaitz Ripoll Fuster[1,2,3], Denis Le Bihan[1,2,3], Jean François Mangin[2,3,4,5], and Cyril Poupon[1,2,3,5]

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In this study, we investigated the dendrite density in cortical areas with diffusion MR microscopy using the NODDI model and showed, on a population of healthy volunteers, significant differences between left and right hemisphere, correlated with their supported brain functions.

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660 14:18

Diffusion-Relaxation Correlation Spectroscopic Imaging (DR-CSI): An Enhanced Approach to Imaging Microstructure

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[1]Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Department of Neurology, Washington University, St. Louis, MO, United States

We propose a new MR experiment called diffusion-relaxation correlation spectroscopic imaging (DR-CSI). DR-CSI acquires imaging data across a range of different b-value and echo time combinations, and then performs regularized reconstruction to generate a 2D diffusion-relaxation correlation spectrum for every voxel. The peaks of this spectrum correspond to the different tissue microenvironments that are present within each macroscopic imaging voxel, which provides powerful insight into the tissue microstructure. Compared to standard relaxometry or diffusion imaging, DR-CSI provides unique capabilities to resolve tissue compartments that have similar relaxation or diffusion parameters. DR-CSI is demonstrated with spinal cord traumatic injury MRI data.

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661 14:30

Linear Multi-scale Modeling of diffusion MRI data: A framework for characterization of orientational structures across length scales

Barbara Wichtmann[1,2], Susie Huang[1], Qiuyun Fan[1], Thomas Witzel[1], Elizabeth Gerstner[3], Bruce Rosen[1], Lothar Schad[2], Lawrence Wald[1,4], and Aapo Nummenmaa[1]

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We propose a new analysis technique called Linear Multi-scale Modeling (LMM) for diffusion MRI data that enables detailed microstructural tissue characterization by separating orientation distributions of restricted and hindered diffusion water compartments over a range of length scales. We demonstrate the ability of LMM to estimate volume fractions, compartment sizes and orientation distributions utilizing both simulations as well as empirical data from one healthy subject and one tumor patient acquired using a human 3T MRI scanner equipped with a 300mT/m gradient system. Possible applications of our modeling framework include characterization of diffusion microstructural signatures of pathological vs. healthy tissue.

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662 14:42

Microscopic Interpretation and Generalization of the Bloch-Torrey Equations for Diffusion MR

Inbar Seroussi[1], Ofer Pasternak[1,2], and Nir Sochen [1]

[1]Tel-Aviv university, Tel Aviv, Israel, [2]Psychiatry and Radiology, Harvard Medical School, Boston, MA, United States

How to bridge microscopic molecular motion with macroscopic diffusion MR signal? We suggest a simple stochastic microscopic model for molecular motion within a magnetic field. We derive the Fokker-Planck equation of this model, which is an analytic expression of the probability density function describing the magnetic diffusion propagator. This propagator is a crucial quantity and provides the link between the microscopic equations and the measured MR signal. Using the propagator we derive a generalized version for the macroscopic Bloch-Torrey equation. The advantage of this derivation is that it does not require assumptions such as constant diffusion coefficient, or ad-hoc selection of a propagator. In fact, we show that the generalized Bloch-Torrey equations have an additional term that was previously neglected and accounts for spatial varying diffusion coefficient. Including this term better predicts MR signal in complex microstructures, such as those expected in most biological experiments.

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663 14:54

Estimating the axon diameter from intra-axonal water diffusion with arbitrary gradient waveforms: Resolution limit in parallel and

dispersed fibers

Markus Nilsson[1], Samo Lasic[2], Daniel Topgaard[3], and Carl-Fredrik Westin[4]

[1]Lund University Bioimaging Center, Lund University, Lund, Sweden, [2]CR Development AB, Lund, Sweden, [3]Physical Chemistry, Lund University, Lund, Sweden, [4]Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

The use of non-conventional gradient waveforms has brought renewed interest in non-invasive estimation of the axon diameter from diffusion MRI. Using conventional single diffusion encoding (SDE) at clinical MRI scanners, axons smaller than the resolution limit (4-5 microns) were indistinguishable from each other. We here predict the resolution limit for arbitrary gradient waveforms in systems with (i) parallel axons and (ii) orientation dispersion. Results show that SDE is optimal for parallel fibers, but that multiple diffusion encodings (MDE) are preferred where there is orientation dispersion. With 300 mT/m and MDE, the resolution limit was 2.8 microns for dispersed fibers.

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664 15:06

Quantification of anisotropy and directionality in three-dimensional electron microscopy images and diffusion tensor imaging of injured rat brain

Raimo A. Salo[1], Ilya Belevich[2], Eppu Manninen[1], Eija Jokitalo[2], Olli Gröhn[1], and Alejandra Sierra[1]

[1]Department of Neurobiology, A. I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland, [2]Institute of Biotechnology, University of Helsinki, Helsinki, Finland

Diffusion tensor imaging (DTI) is a widely used tool, however, the contribution of brain tissue microstructure into DTI contrast is not fully understood. In this work, we propose using serial block-face scanning electron microscopy (SBEM) and Fourier analysis to gain insight into this contribution. We calculated anisotropy and orientation from SBEM stacks and compare the values to fractional anisotropy and orientation from *in vivo* and *ex vivo* DTI. This work will give new insights to the contribution of microstructure to DTI contrast in normal brain and during pathology.

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665 15:18

A new paradigm to assess brain cell microstructure by diffusion-weighted magnetic resonance spectroscopy: proof of concept and initial results in the macaque brain

Marco Palombo[1,2], Clémence Ligneul[1,2], Chloé Najac[1,2], Juliette Le Douce[1,2], Julien Flament[1,2], Carole Escartin[1,2], Philippe Hantraye[1,2], Emmanuel Brouillet[1,2], Gilles Bonvento[1,2], and Julien Valette[1,2]

[1]CEA/DSV/I2BM/MIRCen, Fontenay-aux-Roses, France, [2]CNRS Université Paris-Saclay UMR 9199, Fontenay-aux-Roses, France

We introduce a novel paradigm for non-invasive brain microstructure quantification, where original diffusion modeling is merged with cutting-edge diffusion-weighted spectroscopy (DW-MRS) experiments to capture features of cellular morphology that have remained largely ignored by DW-MRI. A compact description of long-range cellular morphology is used to randomly generate large collections of synthetic cells where particles diffusion is simulated. After investigating model robustness, we apply it on metabolite ADC measured in vivo in the monkey brain up to t_d=2 seconds. The new paradigm introduced here opens new possibilities to non-invasively extract quantitative information about cell size, complexity and heterogeneity in the brain.

Oral

Hyperpolarised MR & Metabolism

Room 331-332 13:30 - 15:30 *Moderators:*Christoffer Laustsen & Yi-Fen Yen

13:30 Introduction

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666 13:42

Hyperpolarized 13C-Urea MRI for the assessment of the urea gradient in the porcine kidney

Esben Søvsø Szocska Hansen[1,2], Neil James Stewart[3], Jim Michael Wild[3], Hans Stødkilde-Jørgensen[1], and Christoffer Laustsen[1]

[1]MR Research Centre, Aarhus University, Aarhus N, Denmark, [2]Danish Diabetes Academy, Odense, Denmark, [3]Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom

Renal anatomical and pathophysiological alterations are directly associated with the fluid and electrolyte balance in the kidney, which is regulated by the extracellular corticomedullary osmolality gradient. We introduce a novel magnetic resonance imaging (MRI) approach to monitor the corticomedullary osmolality gradient changes using hyperpolarized ^{13}C-urea in a healthy porcine model. A corticomedullary urea gradient was observed with an intra-medullary accumulation after 75s of hyperpolarized ^{13}C-urea injection, while earlier time points were dominated by cortical perfusion. Furosemide treatment resulted in an increased urea accumulation in the cortical space. This work demonstrates intra-renal functional assessment with hyperpolarized ^{13}C-urea MRI in multi-papillary kidneys.

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667 13:54

In vivo measurement of Renal Redox Capacity in a Model of Chronic Kidney Disease using by hyperpolarized 13C dehydroascorbate (DHA) MRS

Celine A.J. Baligand[1], David H. Lovett[2], Lalita Uttarwar[2], Jeremy Gordon[1], John Kurhanewicz[1], David M. Wilson[1], and Zhen Jane Wang[1]

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Limited biomarkers are available for early diagnosis and monitoring of chronic kidney disease (CKD). Renal oxidative stress is a key initiator of CKD. Therefore, in vivo assessment of kidney redox capacity may provide a clinically relevant and early marker of kidney injury. The N-terminal truncated matrix metalo-protease isoform (NTT-MMP-2) transgenic mouse is a model mimicking human progressive kidney disease that is triggered by oxidative stress. Using this model, we show that hyperpolarized ^{13}C-dehydroascobic acid MRS imaging can detect *in vivo* the altered redox capacity preceding any functional and histological changes, thus potentially providing an early marker of susceptibility to CKD.

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668 14:06

magna cum laude

Maternal-fetal exchanges characterized by dynamic hyperpolarized 13C imaging on pregnant rats

Anne Fages[1], Tangi Roussel[1], Marina Lysenko[2], Ron Hadas[2], Michal Neeman[2], and Lucio Frydman[1]

[1]*Chemical Physics, Weizmann Institute of Science, Rehovot, Israel,* [2]*Biological Regulation, Weizmann Institute of Science, Rehovot, Israel*

Dynamic nuclear polarization (DNP) enhanced ^{13}C MRI of hyperpolarized (HP) urea and bicarbonate has been applied to monitor metabolic fluxes from the maternal blood pool to the fetuses, in pregnant rats at late gestation stage. This use of HP metabolites offers a non-invasive way to observe details of active and passive maternal-fetal exchanges.

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669 14:18

magna cum laude

Metabolic imaging of energy metabolism in traumatic brain injury using hyperpolarized [1-13C]pyruvate

Stephen J DeVience[1], Xin Lu[1], Julie Proctor[2], Parisa Rangghran[2], Rao Gullapalli[1], Gary M Fiskum[2,3,4], and Dirk Mayer[1]

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We investigated the use of hyperpolarized ^{13}C-pyruvate imaging as a direct, non-invasive method for identifying traumatic brain injury and studying its effects on energy metabolism. Rats were injured with a controlled cortical impact device and then injected with [1-^{13}C]pyruvate. Spectrally-resolved imaging was performed on the brain to quantify the resulting pyruvate, lactate, and bicarbonate signals. The ratio of lactate to bicarbonate signal was found to be sensitive to traumatic brain injury, with the relative increase in lactate signal and decrease in bicarbonate (formed from CO_2) at the injury site suggesting a transition to anaerobic respiration.

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670 14:30

In Vivo pH and Metabolite MR Imaging Using Hyperpolarized 13C-Pyruvate

Nicholas Drachman[1], Stephen J. Kadlecek[1], Mehrdad Pourfathi[1,2], Yi Xin[1], Harrilla Profka[1], and Rahim R. Rizi[1]

[1]*Radiology, University of Pennsylvania, Philadelphia, PA, United States,* [2]*Electrical and Systems Engineering, University of Pennsylvania, Philadelphia, PA, United States*

In this study, we investigate the possibility of simultaneously imaging pH and lactate to pyruvate ratio in vivo in the lungs. We produce hyperpolarized ^{13}C-bicarbonate by rapidly decarboxylating hyperpolarized [1-^{13}C]pyruvate with hydrogen peroxide. By tuning the reaction rate by altering the pH, we produce roughly equal amounts of pyruvate and bicarbonate, which allows us to image both metabolic processes simultaneously.

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671 14:42

magna cum laude

Tumor Progression, Regression, and Recurrence Monitoring using Hyperpolarized [1-^{13}C]Pyruvate Metabolic Imaging in a Murine Breast Cancer Model

Peter jinwoo Shin[1], Zihan Zhu[1], Roman Camarda[2], Robert Bok[1], Alicia Zhou[2], Andrei Goga[2], and Daniel B Vigneron[1]

[1]*Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States,* [2]*Biomedical Science Program, University of California, San Francisco, San Francisco, CA, United States*

We used hyperpolarized [1-^{13}C]pyruvate imaging to monitor tumor progression and regression in a murine breast cancer model that conditionally expresses the human *c-MYC* transgene in a doxycycline switchable manner. Previously, it was shown that this model could develop a secondary tumor even after the primary tumor regresses nearly fully following c-MYC deinduction. Hence, the purpose of this project was to monitor altered glycolytic metabolism by hyperpolarized metabolic MRI in this multi-stage mammary tumorigenesis animal model.

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672 14:54

Metabolism of hyperpolarized 13C-acetoacetate/β-hydroxybutyrate reveals mitochondrial redox state in perfused rat hearts

Wei Chen[1], Chalermchai Khemtong[1], Weina Jiang[1], Craig R. Malloy[1], and A. Dean Sherry[1]

[1]*Advanced Imaging Research Center, University of Texas Southwestern Medical Center, Dallas, TX, United States*

A large prior literature on inter-conversion of β-hydroxybutyrate (β-HB) and acetoacetate (AcAc) indicates that the process is mitochondrial and the ratio reflects specifically mitochondrial redox state. Therefore the conversion of [1,3-^{13}C]AcAc to [1,3-^{13}C]β-HB is expected to be sensitive to redox. In this study, we explored the utility of using hyperpolarized [1,3-^{13}C]AcAc to study the mitochondrial redox state in perfused rat hearts. Our results show that the production of HP β-HB from HP-AcAc was much higher in ischemic hearts, reflecting the increased concentration of NADH under this reduced state. The redox-dependent conversion between this metabolic pair in mitochondria may lead to the development of an imaging tool for redox imaging of the heart by hyperpolarized ^{13}C MRI.

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673 15:06

Detection of inflammatory cell function using 13C MRS of hyperpolarized 13C-labeled arginine

Chloe Najac[1], Myriam M Chaumeil[1], Gary Kohanbash[2], Caroline Guglielmetti[3], Jeremy Gordon[1], Hideho Okada[2], and Sabrina M Ronen[1]

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Myeloid-derived suppressor cells (MDSCs) are inflammatory cells in the tumor microenvironment that inhibit T-cell-mediated immunosuppression by expressing high levels of arginase. Arginase catalyzes the breakdown of arginine into urea. To monitor the enzymatic conversion, we developed a new hyperpolarized (HP) probe, namely [guanido-^{13}C]-arginine. We first characterized the probe and confirmed the production of HP ^{13}C urea in solution with different arginase concentrations. Then, we demonstrated its potential to probe the increase in arginase activity in MDSCs. This new HP probe could serve as a readout of MDSC function in tumor and its inhibition following MDSC-targeted immunotherapies.

674 15:18 Initial experiences of simultaneous in vivo metabolic imaging using MRI, PET, and hyperpolarized 13C MRSI from rat glioma models

JAE MO PARK[1], Shie-Chau Liu[1], Milton Merchant[2], Taichang Jang[2], Keshav Datta[1], Praveen Gulaka[1], Zachary Corbin[2], Ralph E Hurd[3], Lawrence Recht[2], and Daniel M Spielman[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]Neurology and Neurological Sciences, Stanford University, Stanford, CA, United States, [3]Applied Sciences Laboratory, GE Healthcare, Menlo Park, CA, United States

We demonstrated the feasibility of simultaneous investigation of *in vivo* metabolism using ^{1}H MRI, time-of-flight ^{18}F-FDG PET, and hyperpolarized ^{13}C-pyruvate MRSI in C6 xenograft and ENU-induced brain tumor models. Volumetric images were acquired, and metabolic kinetics of FDG and pyruvate metabolism was investigated in the study.

Oral

Imaging of Osseous Structure & Function

Room 334-336 13:30 - 15:30 *Moderators:*Xeni Deligianni & Tiffany Ting-Fang Shih

675 13:30 Whole Body Skeletal Imaging Using Zero TE

Florian Wiesinger[1], Sandeep Kaushik[2], Anne Menini[1], Sangtae Ahn[3], Lishui Cheng[3], Cristina Cozzini[1], Thomas Hope[4], Jaewon Yang[4], Peder Larson[4], and Dattesh Shanbhag[2]

[1]GE Global Research, Munich, Germany, [2]GE Global Research, Bangalore, India, [3]GE Global Research, Schenectady, NY, United States, [4]University of California San Francisco, San Francisco, CA, United States

Recently we presented a method for zero TE MR bone imaging in the head. In this abstract, we describe the extension of this work towards whole body skeletal imaging as required for applications like PET/MR Attenuation Correction, or MR-based Radiation Therapy Planning.

676 13:42 30-Second Bound- and Pore-Water Maps of Cortical Bone

Mary Kate Manhard[1], Kevin D Harkins[2], Daniel F Gochberg[2], Jeffry S Nyman[3], and Mark D Does[1]

[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [3]Department of Orthopaedics & Rehabilitation, Vanderbilt University, Nashville, TN, United States

Imaging bound and pore water concentrations in cortical bone using UTE MRI has shown potential for evaluating fracture risk, but 3D methods require a relatively long scan time (~30 minutes total). 2D UTE with optimized half-pulses was implemented to acquire both bound and pore water maps in ~30 seconds and results were compared to 3D UTE, both ex vivo and in vivo. Mean differences in bound/pore water concentration were less than 10%. Applying these fast sequences in 2D has the potential to greatly increase the utility of these methods in clinical settings for evaluating fracture risk in patient populations.

677 13:54 On the Feasibility of Quantitative Susceptibility Mapping For Trabecular Bone Volume Density Mapping at 3 T

Maximilian Nikolaus Diefenbach[1], Anh T. Van[2], Jakob Meineke[3], Hendrik Kooijman[4], Axel Haase[2], Ernst J. Rummeny[5], Jan S. Kirschke[6], Thomas Baum[1], and Dimitrios C. Karampinos[5]

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Trabecular bone imaging has a high clinical significance for predicting fracture risk in patients with osteoporosis. Quantitative susceptibility mapping (QSM) has been recently emerging for mapping diamagnetic and paramagnetic substances. Recent reports attempted to use QSM combined with ultra-short echo time imaging for mapping the susceptibility of cortical bone. However, it remains unknown whether QSM is feasible for measuring bone volume density in trabecular bone, where the bone density is much lower than cortical bone. The purpose of the present work is to study the feasibility of QSM for trabecular bone density mapping, using numerical simulations, specimen measurements and preliminary in vivo measurements.

678 14:06

High-Resolution MRI to Assess Trabecular Bone Microstructure in the Proximal Femur of HIV-Infected Men

Roland Krug[1], Andrew Lai[1], Lorenzo Nardo[1], Luca Facchetti[1], Misung Han[1], Galateia Kazakia[1], and Julio Carballido-Gamio[1]

[1]*University of California, UCSF, San Francisco, CA, United States*

MRI is currently the only modality to assess trabecular bone structure with high-resolution in the proximal femur in-vivo. We have optimized image acquisition and image analysis techniques to assess microstructural bone parameters in HIV-infected individuals compared to healthy controls. We have found significant differences in the femoral head, neck and trochanteric regions between patients and controls. We conclude that MRI can be an important tool to assess bone structure in the central skeleton at important fracture sites such as the proximal femur with very high resolution.

679 14:18

Age-related loss of bound water in human trabecular bone

Mathilde Granke[1], Kuniko Hunter[2], Sasidhar Uppuganti[1], Jeffry S Nyman[1,3], and Mark D Does[1]

[1]*Vanderbilt University, Nashville, TN, United States,* [2]*Rensselaer Polytechnic Institute, Troy, NY, United States,* [3]*VA Tennessee Valley Healthcare System, Nashville, TN, United States*

^{1}H NMR- derived bound water measurements in cadaveric human trabecular bone are sensitive to age-related changes in the quality of bone tissue, and therefore could be predictive of fracture risk in trabecular sites prone to fracture.

680 14:30

magna cum laude

Fast volumetric mapping of bound and pore water content in cortical bone in vivo using 3D Cones sequences

Jun Chen[1], Michael Carl[2], Hongda Shao[1], Eric Chang[1], Graeme Bydder[1], and Jiang Du[1]

[1]*Radiology, University of California, San Diego, San Diego, CA, United States,* [2]*GE Healthcare, San Diego, CA, United States*

Bone water exists in the form of free water in the Haversian canals or lacunar-canalicular system, as well as bound water either loosely bound to collagen or more tightly bound to mineral. Ultrashort echo time (UTE) sequences with TEs as short as 8 μs can potentially detect signal from pore water and loosely bound water. In this study, we introduce an approach for fast volumetric mapping of bound and pore water content in vivo using a clinical 3T MR scanner.

681 14:42

Quantitative and Functional Assessment of Red and Yellow Bone Marrow Using PET-MR Imaging

Chuan Huang[1,2], Anuradha Janardhanan[1,3], and Mark Schweitzer[1]

[1]*Radiology, Stony Brook Medicine, Stony Brook, NY, United States,* [2]*Psychiatry, Stony Brook Medicine, Stony Brook, NY, United States,* [3]*Diagnostic Imaging, Kuala Lumpur Hospital, Kuala Lumpur, Malaysia*

Understanding the distribution of red marrow is important for various hematopoetic diseases and especially osseous metastases as areas of red marrow are the primary sites for hematogenous seeding of tumor cells, accounting for approximately 90% of skeletal metastases. Using a simultaneous PET-MR we sought to evaluate voxel of red marrow in the femora and pelvis using fat/water sequences correlated with FDG PET uptake. This quantitative assessment of red and yellow marrow was done in specific anatomic subregions. The bone marrow composition and metabolism were found to be symmetric in each individual. Good correlation between SUV and %red were found for each ROI among all subjects. The metabolism (FDG uptake) was found to be different for the ROIs with the same amount of red marrow. Further research will study whether this leads to higher chance of tumor seeding.

682 14:54

magna cum laude

Novel Approach in Detection of Bone Marrow Changes Related to Osteoporosis, Using a Stray Field NMR Scanner

Inbar Hillel[1], Yifat Sarda[1], Elad Bergman[1], Itzhak Binderman[2], and Uri Nevo[1]

[1]*Department of Biomedical Engineering, Tel-Aviv University, Tel Aviv, Israel,* [2]*School of Dental Medicine, Tel-Aviv University, Tel Aviv, Israel*

Osteoporosis is a disease characterized by loss of bone mineral density, caused by loss of the equilibrium between osteogenesis and adipogenesis. In this work T2, T1 and ADC were measured using a low-field NMR scanner, for the detection of bone marrow changes related to osteoporosis. Results showed that this method is capable of significantly classifying between bones of rats that were ovariectomized, ovariectomized and treated with parathyroid hormone, and sham-operated rats.

683 15:06

magna cum laude

A Method to Quantitatively Compare Bone and Cartilage Changes Post Knee Injury: Initial Results

Uchechukwuka Monu[1], Feliks Kogan[2], Emily McWalter[2], Brian Hargreaves[2], and Garry Gold[2]

[1]*Electrical Engineering, Stanford University, Stanford, CA, United States,* [2]*Radiology, Stanford University, Stanford, CA, United States*

New PET/MR systems have made the simultaneous acquisition and quantitative assessment of bone and cartilage possible. Using projection maps and cluster analysis, the comprehensive visualization and quantification of PET ^{18}F-NaF uptake within an injured and contralateral knee are determined and compared with corresponding T2 and T1rho relaxation times within the cartilage. Significant increase in PET uptake is observed in the injured knee compared to the contralateral knee and some areas of high PET uptake correspond with elevated T2 and T1rho relaxation times. This developed tool shows promise in assessing bone metabolic activity and its relationship with quantitative MR parameters.

684 15:18

Validation of MRI-based Assessment of Mechanical Competence of Distal Tibia using Cadaveric Human Bone.

Chamith S. Rajapakse[1], Benjamin T. Newman[1], Wenli Sun[1], Michael Ispiryan[1], Michelle Slinger[2], Elizabeth A. Kobe[2], Kelly Borges[1], Karyll Davis[2], Keren De Jesus[2], Jeremy Magland[1], and Felix W. Wehrli[1]

[1]Laboratory for Structural NMR Imaging, Department of Radiology, University of Pennsylvania, Philadelphia, PA, United States, [2]University of Pennsylvania School of Engineering and Applied Science, University of Pennsylvania, Philadelphia, PA, United States

High-resolution MRI-derived finite element analysis allows for the *in vivo* estimation of bone strength. This information is useful for planning treatments and interventions in individuals suffering from conditions that affect bone mineral homeostasis. However these methods have not been previously validated. This study subjected distal tibia specimens to both MRI-based finite element analysis and mechanical testing *ex vivo*. Estimated bone stiffness was strongly correlated to the experimental values (R2=0.84) supporting usefulness of MRI-based bone strength assessment in human subjects.

Oral

Neurodegeneration: Non AD

Hall 606 | 13:30 - 15:30 | *Moderators:*David Abbott & Rik Achten

685 | 13:30

magna cum laude

Quantitative Susceptibility Mapping for the Evaluation of Subcortical Iron Abnormality in Parkinson's Disease with Dementia

Darrell Ting Hung Li[1], Edward Sai Kam Hui[1], Queenie Chan[2], Nailin Yao[3], Siew-eng Chua[4], Grainne M. McAlonan[4,5], Shu Leong Ho[6], and Henry Ka Fung Mak[1]

[1]Department of Diagnostic Radiology, The University of Hong Kong, Hong Kong, Hong Kong, [2]Philips Healthcare, Hong Kong, Hong Kong, [3]Department of Psychiatry, Yale University, New Haven, CT, United States, [4]Department of Psychiatry, The University of Hong Kong, Hong Kong, Hong Kong, [5]Department of Forensic and Neurodevelopmental Science, King's College London, London, United Kingdom, [6]Department of Medicine, The University of Hong Kong, Hong Kong, Hong Kong

Parkinson's disease (PD) patients may develop other non-motor comorbidities when the disease progress. While increased nigral iron was considered as a biomarker of the disease, it was also believed that iron deposition is associated with the development of other non-motor symptoms. In this study, magnetic susceptibility as a surrogate of iron concentration was measured in six major subcortical brain regions on the QSM images. Increased magnetic susceptibilities were observed in hippocampus and amygdala of the PD patients with dementia, suggesting a possible association of iron with the development of dementia symptom in late stage of PD.

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686 | 13:42

summa cum laude

Mapping temporal order of whole brain volumetric changes using change point analysis in premanifest Hungtington Disease

Dan Wu[1], Laurent Younes[2,3,4], Andreia V Faria[1], Christopher A Ross[5], Susumu Mori[1,6], and Michael I Miller[3,4,7]

[1]Radiology, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [2]Applied Mathematics and Statistics, Johns Hopkins University, Baltimore, MD, United States, [3]Center for Imaging Science, Johns Hopkins University, Baltimore, MD, United States, [4]Institute for Computational Medicine, Johns Hopkins University, Baltimore, MD, United States, [5]Departments of Psychiatry, Neurology, Neuroscience and Pharmacology, and Program in Cellular and Molecular Medicine, Johns Hopkins University School of Medicine, BALTIMORE, MD, United States, [6]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [7]Biomedical Engineering, Johns Hopkins University, Baltimore, MD, United States

In order to understand the temporal and spatial order of brain atrophy in Huntington's disease (HD), we aim to characterize the whole brain volumetric changes based on T1-weighted whole brain segmentation. We adapted a novel multi-variant linear statistical model to capture the change points of volumetric changing courses from 412 control and HD subjects. The change point analysis revealed that the brain atrophy initiated in the deep gray matter structures and progressed to the peripheral white matter and cortical regions, and it also suggested the posterior brain atrophy proceeded the anterior brain.

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687 | 13:54

Connectivity Patterns of Deep Brain Stimulation of the Subthalamic Nucleus in Parkinson's Disease

Silvina G Horovitz[1], Nora Vanegas-Arroyave[1,2], Ling Huang[2], Peter M Lauro[2], Paul A Taylor[3,4,5], Mark Hallett[1], Kareem A Zaghloul[6], and Codrin Lungu[2]

[1]Human Motor Control Section, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD, United States, [2]Office of the Clinical Director, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD, United States, [3]Scientific and Statistical Computing Core, National Institutes of Health, Bethesda, MD, United States, [4]Department of Human Biology, Faculty of Health Sciences, University of Cape Town, MRC/UCT Medical Imaging Research Unit, Cape Town, South Africa, [5]African Institute for Mathematical Sciences, Muizenberg, South Africa, [6]Surgical Neurology Branch, National Institute of Neurological Disorders and Stroke, NIH, Bethesda, MD, United States

Deep brain stimulation (DBS) of the subthalamic nucleus (STN) is an effective surgical treatment for Parkinson's Disease (PD). However, its mechanism is unclear. We have developed a pipeline for processing diffusion tensor imaging (DTI) data in DBS patients, and applied it to analyze 22 PD patients implanted with bilateral STN-DBS. With this approach, we have identified the motor nuclei of the thalamus and the superior frontal cortex as the most common targets and predictors of clinical benefits.

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688 | 14:06

Simultaneous electrical stimulation of DBS electrodes and fMRI in movement disorders.

Stephen Edward Jones[1], Hyun-Joo Park[2], Pallab Bhattacharyya[1], and Andre Machado[2]

[1]Imaging Institute, Cleveland Clinic, Cleveland, OH, United States, [2]Neurologic Institute, Cleveland Clinic, Cleveland, OH, United States

We present a new intra-operative MRI technique for evaluating placement of DBS electrodes in patients with movement disorders, using simultaneous electrical stimulation and fMRI. This technique can elicit a strong BOLD effect whose pattern can reflect underlying networks. There is strong spatial sensitivity of these patterns to electrode position, which is important for clinical utility in predicting clinical response and unwanted side-effects.

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689 14:18

Regional iron accumulation is associated with motor impairments in Parkinson's disease as measured by quantitative susceptibility mapping

Xiaojun Guan[1], Min Xuan[1], Quanquan Gu[1], Xiaojun Xu[1], Chunlei Liu[2,3], Peiyu Huang[1], Nian Wang[2], Yong Zhang[4], Wei Luo[5], and Minming Zhang[1]

[1]Radiology, The Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China, People's Republic of, [2]Brain Imaging and Analysis Center, Duke University School of Medicine, Durham, NC, American Samoa, [3]Department of Radiology, Duke University School of Medicine, Durham, American Samoa, [4]MR Research, GE Healthcare, Shanghai, China, People's Republic of, [5]Neurology, The Second Affiliated Hospital of Zhejiang University School of Medicine, Hangzhou, China, People's Republic of

We explored the relationships between cerebral iron and the motor impairments in PD. Quantitative susceptibility mapping was used to quantify the iron content in vivo.

Iron content in dentate and red nuclei had close associations with tremor symptom.

Caudate and nigral iron content significantly correlated with akinetic/rigid symptom.

These might support the idea that regional iron is related to the motor impairments.

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690 14:30

magna cum laude

Nigral Iron Distribution in Brain of Parkinson's Disease: A Combined Structural Voxel-wise and ROI-based Study with Quantitative Susceptibility Mapping

Darrell Ting Hung Li[1], Edward Sai Kam Hui[1], Queenie Chan[2], Nailin Yao[3], Siew-eng Chua[4], Grainne M. McAlonan[4,5], Shu Leong Ho[6], and Henry Ka Fung Mak[1]

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Abstract

Abnormal nigral iron deposition is considered one of the major biomarkers in Parkinson's disease (PD). Extensive studies had been performed to evaluate iron concentration in substantia nigra using different *in vivo* imaging methods. Whole structure ROI-based analysis of basal nuclei is a majority approach in similar studies. In this study, we investigated the distribution of iron in substantia nigra with both voxel-wise and split ROI methods. Location of significant higher iron concentration was identified to be around pars compacta of the substantia nigra in PD brain. The two methods adopted in this study agreed with each other.

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691 14:42

Delayed morphological phenotype in R6/2 mice carrying longer fragments of the human Huntington's disease gene shown by in vivo MR imaging and spectroscopy

Stephen J Sawiak[1], Nigel I Wood[1], T Adrian Carpenter[1], and A Jennifer Morton[1]

[1]University of Cambridge, Cambridge, United Kingdom

Huntington's disease is caused by an unstable gene carrying excessive polyglutamine CAG repeats. Patients with genes carrying more CAG repeats have a less favourable outcome. The R6/2 mouse has a fragment of the human HD gene with 100 CAG repeats. We compared mice carrying longer CAG repeats (250 and 350) with wildtype controls using high-resolution in vivo longitudinal MRI and spectroscopy. Paradoxically, the 350CAG mice live longer, with ultimately similar but much slower atrophy and metabolic changes than 250CAG mice. They may, therefore, be a more useful model of HD with a longer window to evaluate pathology and treatments.

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692 14:54

Can NODDI provide a better characterisation of microstructural changes in ALS than DTI?

Matt Gabel[1], Rebecca Broad[2], Daniel C. Alexander[3], Hui Zhang[3], Nicholas G. Dowell[1], Peter Nigel Leigh[2], and Mara Cercignani[1]

[1]Clinical Imaging Sciences Centre, Brighton & Sussex Medical School, Falmer, United Kingdom, [2]Trafford Centre for Medical Research, Brighton & Sussex Medical School, Falmer, United Kingdom, [3]Centre for Medical Image Computing, Department of Computer Science, University College London, London, United Kingdom

NODDI is a multi-compartment model of diffusion MRI that overcomes some of the limitations of DTI. Our aim was to assess whether voxelwise analysis of NODDI parameters could provide a more comprehensive picture than DTI in assessing the microstructural changes associated with ALS. We analysed NODDI and DTI parameters for 17 patients with ALS and 19 healthy controls using Advanced Normalization Tools (ANTs) 2.1.0 and SPM12, with age included as a covariate. Both NODDI and DTI indices are sensitive to pathological changes in ALS, but NODDI provides more specific tissue microstructure characterisation.

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693 15:06

Cortical Glutathione Deficit in Patients with the "MELAS" A3243G Mitochondrial DNA Mutation Measured with 1H MRS Documents Oxidative Stress in the Disorder In Vivo

Dikoma C. Shungu[1], Kristin Engelstadt[2], Xiangling Mao[1], Guoxin Kang[1], Aya Goji[1], Robert H. Fryer[2], Savalatore DiMauro[2], and Darryl C. De Vivo[2]

[1]Radiology, Weill Cornell Medical College, New York, NY, United States, [2]Neurology, College of Physicians and Surgeons of Columbia University, New York, NY, United States

Although mitochondrial dysfunction has been associated with redox dysregulation, in vivo human brain evidence of such an association is currently lacking. This study aimed to use ^{1}H MRS to measure brain levels of the primary tissue antioxidant glutathione (GSH) in patients with MELAS – a primary mitochondrial disorder – as an objective marker of CNS oxidative stress in such disorders. Compared to healthy control subjects, patients with MELAS showed a 31% lower cortical GSH levels, thereby directly implicating CNS oxidative stress as a player in the disorder and pointing to potential therapeutic interventions based on elevating the levels of cerebral antioxidants.

694 15:18

CORTICO-SPINAL TRACT AND CEREBELLAR PEDUNCLES PROBABILISTIC TRACTOGRAPHY IN PARKINSONIAN SYNDROMES

Stefano Zanigni[1,2], Stefania Evangelisti[1,2], Claudia Testa[1,2], David Neil Manners[1,2], Giovanna Calandra-Buonaura[1,3], Maria Guarino[4], Anna Gabellini[3,5], Luisa Sambati[1,3], Pietro Cortelli[1,3], Raffaele Lodi[1,2], and Caterina Tonon[1,2]

[1]Department of Biomedical and Neuromotor Sciences, University of Bologna, Bologna, Italy, [2]Policlinico S.Orsola-Malpighi, Functional MR Unit, Bologna, Italy, [3]IRCCS Istituto delle Scienze Neurologiche di Bologna, Bologna, Italy, [4]Policlinico S.Orsola-Malpighi, Neurology Unit, Bologna, Italy, [5]Ospedale Maggiore, Neurology Unit, Bologna, Italy

We applied a probabilistic tractography FSL-based method to evaluate alterations in the cortico-spinal tract (CST), middle and superior cerebellar peduncles (MCP and SCP, respectively) in 90 patients with neurodegenerative parkinsonisms (Progressive Supranuclear Palsy, Multiple System Atrophy, and Parkinson's disease). Patients and healthy controls were evaluated on a 1.5T GE scanner. DTI metrics were evaluated in the whole CST, MCP and SCP tracts, and in addition, an along tract analysis for CST has been performed. We found that specific patterns of neurodegeneration within these specific tracts are evident and that they reflect the neuropathological and clinical profile of each syndrome.

Oral

New Techniques: It's Time to See How it Works!

Summit 1 13:30 - 15:30 *Moderators:*Hans Hoogduin & Stephen Riederer

695 13:30

Accurate T1 and T2 mapping by direct least-squares ellipse fitting to phase-cycled bSSFP data

Yulia Shcherbakova[1], Cornelis A.T. van den Berg[2], Jan J.W. Lagendijk[3], Chrit T.W. Moonen[4], and Lambertus W. Bartels[5]

[1]Center for Imaging Sciences/Imaging Division, UMC Utrecht, Utrecht, Netherlands, [2]Dept. of Radiotherapy/Imaging Division, UMC Utrecht, Utrecht, Netherlands, [3]Department of Radiotherapy/Centre for Image Sciences, UMC Utrecht, Utrecht, Netherlands, [4]Center for Imaging Sciences/ Imaging Division, UMC Utrecht, Utrecht, Netherlands, [5]Image Sciences Institute/Department of Radiology, UMC Utrecht, Utrecht, Netherlands

Björk et al. proposed to use the balanced steady-state free precession (bSSFP) pulse sequence with multiple phase-cycled acquisitions to estimate the values of T_1 and T_2 using a non-linear fitting approach. Unfortunately, they found that this non-linear approach would face large uncertainties for realistic SNRs. The purpose of our work was to demonstrate that by reformulating the signal model in the complex plane, an elliptical model can be fitted to the data points using a linear least squares method , allowing for more robust, accurate and simultaneous estimation of T_1 and T_2 values.

696 13:42

Influence of pulse length and shape on variable flip angle T1 mapping of the human brain

Yosef Al-Abasse[1] and Gunther Helms[1]

[1]Medical Radiation Physics, Lund University, Lund, Sweden

Effects of the macromolecular pool are usually neglected in T_1 mapping using the variable flip angle (VFA) method. To demonstrate the influence of magnetization transfer (MT) on the estimated T_1, VFA experiments were performed using sinc and rect pulses of different pulse lengths (0.5 ms ≤ TRF ≤ 2.0 ms). Substantial variations in T_1 (11-21 %) were observed. Longer rect pulses yielded lower T_1 values than those obtained by inversion recovery. This can be explained by varying saturation of macromolecules and inherent MT. A simplified model for the influence of T_{RF} on the T_1 estimates is suggested for low-power rect pulses.

697 13:54

B0 and B1 Insensitive Robust Fat Suppression using Frequency Offset Corrected Inversion (FOCI)

Xinzeng Wang[1], Joshua S. Greer[1,2], Ivan E. Dimitrov[3,4], and Ananth J. Madhuranthakam[1,3]

[1]Radiology, UT Southwestern Medical Center, Dallas, TX, United States, [2]Bioengineering, University of Texas at Dallas, Richardson, TX, United States, [3]Advanced Imaging Research Center, UT Southwestern Medical Center, Dallas, TX, United States, [4]Philips Medical Systems, Cleveland, OH, United States

STIR uses adiabatic non-selective hyperbolic secant (HS) inversion pulse to achieve uniform fat suppression even in the presence of B1 inhomogeneities. However, in the regions of increased B0 and B1 inhomogeneities, particularly at 3T and higher field strengths, the increased bandwidth of the HS pulse comes at the expense of higher adiabatic threshold. In this work, we evaluated C-FOCI pulse to

achieve robust fat suppression with broader bandwidth and increased robustness to B1 variations compared to HS pulse. We also derived an analytical expression for the adiabatic threshold of C-FOCI pulse and show robust performance against B0 and B1 inhomogeneities.

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698 14:06

magna cum laude

Real-time multi-slice MRI during CPAP reveals dynamic changes in upper airway in response to pressure change
Weiyi Chen[1], Ziyue Wu[2], Sally L. Davidson Ward[3], Michael C.K. Khoo[4], and Krishna S. Nayak[1]

[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Alltech Medical Systems USA, Solon, OH, United States, [3]Children's Hospital Los Angeles, Los Angeles, CA, United States, [4]Biomedical Engineering, University of Southern California, Los Angeles, CA, United States

We demonstrate a novel experiment that captures the upper airway's instantaneous response to changes in air pressure. We apply rapid changes in continuous positive airway pressure (CPAP) during real-time simultaneous multi-slice MRI. This reveals the airway area does NOT only depend on pressure level but also different airway sections and previous muscle tone status. This technique also enables characterization of airway collapsibility, and is relevant to the assessment of obstructive sleep apnea (OSA) and treatment planning.

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699 14:18

magna cum laude

Imaging myelin with ultrashort-echo time (UTE) in a Multiple Sclerosis model on a clinical 7T system
Caroline Guglielmetti[1], Tanguy Boucneau[2], Peng Cao[2], Annemie Van der Linden[3], Peder Larson[2], and Myriam M Chaumeil[1]

[1]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]University of Antwerp, Antwerp, Belgium

Many advances in neuroimaging have improved diagnosis and care of Multiple Sclerosis (MS) patients. However, current clinical methods fail to detect the majority of cortical lesions. In this work, we used the well characterized cuprizone mouse model for brain demyelination to evaluate the sensitivity of in vivo ultra-short echo time (UTE) measurements for the non-invasive detection of grey and white matter alterations. We showed that UTE enabled the detection of cortical lesions and the assessment of myelin integrity in the white matter following demyelination and spontaneous remyelination.

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700 14:30

Simultaneous DESS imaging and T2 mapping, for knee osteoarthritis studies
Cheng-Chieh Cheng[1], Lena Franziska Schaefer[1], Jeffrey Duryea[1], and Bruno Madore[1]

[1]Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States

The 'dual-echo in the steady state' (DESS) sequence is often the method of choice for assessing cartilage damage. A modified DESS method was developed that provides images of similar quality to regular DESS while also providing T_2 values, a proven biomarker for the early stages of osteoarthritis. The method exploits the fact that the two signal pathways sampled in a DESS sequence decay differently during the TR period, allowing T_2 and T_2* to be quantified. The resulting method can assess cartilage volume seemingly as well as regular DESS, while also providing relevant T_2 information, without increasing scan time.

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701 14:42

Quality evaluation scheme for no-reference MR images using pre-scanned MR big data
Jinseong Jang[1], Taejoon Eo[1], and Dosik Hwang[1]

[1]Electrical and Electronic Engineering, Yonsei University, Seoul, Korea, Republic of

This study demonstrated the feasibility of no reference (NR) image quality assessment (IQA) for magnetic resonance imaging. Especially, this method used pre-scanned images from other subjects. So by using prior big data, MRI can be evaluated in no reference environments.

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702 14:54

magna cum laude

Multiresolution imaging using golden angle stack-of-stars and compressed sensing
Abhishek Pandey[1,2], Umit Yoruk[3], Puneet Sharma[1], Diego R. Martin[1], Maria Altbach[1], Ali Bilgin[1,2,4], and Manojkumar Saranathan[1,4]

[1]Department of Medical Imaging, University of Arizona, Tucson, AZ, United States, [2]Electrical and Computer Engineering, University of Arizona, Tucson, AZ, United States, [3]Electrical Engineering, Stanford University, Stanford, CA, United States, [4]Biomedical Engineering, University of Arizona, Tucson, AZ, United States

Dynamic contrast enhanced MRI requires measurement of arterial input function with great accuracy while maintaining high spatial resolution. Golden angle stack-of-stars radial acquisition was used to get reconstructions at multiple temporal resolutions. A multiresolution reconstruction scheme is used to generate AIFs using a very small temporal window. The accuracy of the reconstruction method was checked on a realistic phantom and then applied to an in vivo data. Results show that compressed sensing reconstruction works best with high temporal resolution (HTR) AIF giving both diagnostic image quality and accurate GFR estimate.

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703 15:06

Ultra-short echo time sequence for electrode locations in simultaneous EEG-FMRI
Russell Butler[1], Guillaume Gilbert[2], and Kevin Whittingstall[3]

[1]University of Sherbrooke, Sherbrooke, QC, Canada, [2]MR Clinical Science - Philips Healthcare, Markham, ON, Canada, [3]Diagnostic Radiology,

University of Sherbrooke, Sherbrooke, QC, Canada

Precise and accurate knowledge of EEG sensors relative to underlying cortical tissue enhances simultaneous EEG-FMRI studies, but to date no specialized sequence for providing these locations exists. We propose an ultra-short echo time sequence (UTE) to highlight the plastic casing and wiring of a 64 channel MR compatible EEG cap. We show that the UTE resolves electrode components up to 6mm from the surface of the scalp, allowing to locate the precise contact point of electrode with skin and direction of wire leading away from the electrode in all subjects (n=8).

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704 15:18

Can Zero TE imaging be a viable alternative to micro CT in dentistry imaging : application in tooth implanting and extraction ?

Yu Kang[1], Bing Wu[2], Shikuo Fu[2], and Nan Hong[1]

[1]Peking University people's hospital, Beijing, China, People's Republic of, [2]GE healthcare MR Research China, Beijing, China, People's Republic of

Micro CT is currently used for dentistry imaging. Not only it is associated with radiation, it also offers poor contrast of the mandible canal, whose position needs to be precisely known during tooth implantation and extraction. Conventional MRI fails for this case due to the short T2 time of the teeth as well as the susceptibility in the oral cavity. Zero TE imaging, due to its technical uniqueness, seems to be a viable solution to this. In this work, imaging of the the jaw of a patient with both CT, conventional MR and zTE imaging was performed.

Oral

Renal/Adrenal/Male Pelvis

Summit 2 13:30 - 15:30 *Moderators:*Sooah Kim & Riccardo Lattanzi

705 13:30

Frequency tensor imaging (FTI) at a single orientation by vector projection

Luke Xie[1], Russell Dibb[2], Chunlei Liu[2], and Vivian S. Lee[1]

[1]Utah Center for Advanced Imaging Research, Radiology, University of Utah, Salt Lake City, UT, United States, [2]Brain Imaging Analysis Center, Radiology, Duke University Medical Center, Durham, NC, United States

STI is sensitive to tissue microstructure and can detect subtle changes in disease states. However, STI remains a challenging protocol due to the physical reorientation with respect to the magnetic field. Current studies of the heart and kidney are limited to *ex-vivo* imaging. In this study, we present frequency tensor imaging (FTI) at a single image acquisition without rotating the object. FTI takes advantage of tissue structure already pointing in multiple directions with respect to the magnetic field in a single orientation dataset. This technique offers the potential for susceptibility-based tensor imaging of the abdomen in the clinic.

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706 13:42

Automatic Renal Cortex Segmentation Using Machine Learning for MR Urography

Umit Yoruk[1,2], Brian Hargreaves[2], and Shreyas Vasanawala[2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States

Glomerular filtration rate (GFR) estimation can be achieved using dynamic contrast enhanced MRI (DCE-MRI) and pharmacokinetic models. The segmentation of kidneys is essential for obtaining the time intensity curves needed by these models. Manual segmentation of kidneys is one of the most time consuming and labor-intensive steps of GFR analysis as it can take several hours and require trained personnel. Here, we introduce a novel method for automatic renal segmentation based on morphological segmentation and machine learning, and assess the performance of the method.

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707 13:54

Magnetic Resonance Elastography (MRE) for the assessment of renal allograft function

Jing Guo[1], Stephan Marticorena[1], Florian Dittmann[1], Andreas Fehlner[1], Sebastian Hirsch[1], Thomas Fischer[1], Jürgen Braun[2], and Ingolf Sack[1]

[1]Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [2]Department of Medical Informatics, Charité - Universitätsmedizin Berlin, Berlin, Germany

In vivo assessment of the renal allograft function post kidney transplantation is challenging. We here demonstrate that multifrequency MR elastography (MMRE) can detect renal allograft dysfunction with good diagnostic accuracy (AUROC:0.91 [95% CI 0.80-1.02; $p < 0.001$]). Renal stiffness is significantly lower in dysfunctional transplant kidney and correlates moderately with glomerular filtration rate and resistive index. MMRE may serve as a non-invasive imaging maker to detect renal allograft dysfunction in an early stage and to monitor renal allograft function longitudinally.

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708 14:06

3D Printed Renal Cancer Models Derived from MRI data: Application in Pre-surgical Planning

Nicole Wake[1], Temitope Rude[2], William C Huang[2], Michael D Stifelman[2], James F Borin[2], Daniel K Sodickson[1], and Hersh Chandarana[1]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, Center for Advanced Imaging Innovation and Research, Department of Radiology, New York University School of Medicine, New York, NY, United States, [2]Department of Urology, New York University School of Medicine, New York, NY, United States

The objective of this study was to determine how patient-specific 3D printed renal tumor models derived from MRI data can influence pre-surgical planning. These 3D printed models may alter the surgical plan, especially for trainees and young surgeons. Future, outcome based studies may help to determine the impact of these 3D printed models on surgical outcomes and patient care.

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709 14:18

Diurnal Variation of Renal Blood Flow using 4D Flow MRI

Sylvana García-Rodríguez[1], Alejandro Roldán-Alzate[1,2], Camilo A. Campo[1], Scott B. Reeder[1], Oliver Wieben[1,3], and Christopher J. François[1]

[1]Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Mechanical Engineering, University of Wisconsin-Madison, Madison, WI, United States, [3]Medical Physics, Univerisity of Wisconsin-Madison, Madison, WI, United States

This study inves gated the diurnal changes in renal blood flow in healthy volunteers using 4D flow MRI, to determine the op mal me of day to perform renal blood flow measurements. Five 4D flow MRI acquisi ons were performed throughout the day in seven healthy subjects to mimic poten al imaging scheduling me points. Significant differences in renal blood flow were observed depending upon me of day and prandial status. This study confirms the importance of ming of renal MRI studies assessing kidney func on.

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710 14:30

Reduced susceptibility anisotropy in ischemia reperfusion kidneys: evidence of cellular organization as a source of contrast

Luke Xie[1], Vivian Lee[1], Russell Dibb[2], Yi Qi[2], Nian Wang[3], G. Allan Johnson[2], and Chunlei Liu[3]

[1]Radiology, University of Utah, Salt Lake City, UT, United States, [2]Center for In Vivo Microscopy, Radiology, Duke University Medical Center, Durham, NC, United States, [3]Brain Imaging Analysis Center, Radiology, Duke University Medical Center, Durham, NC, United States

Diffusion tensor imaging (DTI) and susceptibility tensor imaging (STI) can assess the integrity of the nephron where STI provides additional molecular information. STI has demonstrated sensitivity to changes in kidney disease models. The source of susceptibility anisotropy is hypothesized to be the organized tubules, basement membrane, and the organized lipids. Ischemia reperfusion is one particular disease model with well known cellular disorganization in specific nephron segments. In the present study, we applied STI in a model of ischemia perfusion to demonstrate changes in susceptibility anisotropy and to provide additional evidence that the cellular organization is a major contributor.

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711 14:42

Prospective Image Alignment for Time-Resolved Renal BOLD MRI

Inge Manuela Kalis[1], David Pilutti[1], Axel Joachim Krafft[1,2,3], and Michael Bock[1]

[1]Dept. of Radiology - Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]German Cancer Consortium (DKTK), Heidelberg, Germany, [3]German Cancer Research Center (DKFZ), Heidelberg, Germany

Renal function can be analyzed by time-resolved BOLD MRI before, during and after a functional challenge. Inconsistent kidney positions from one measurement to another hamper the analysis of renal parenchyma and medulla over time. Here, a new method, Kidney ALIgnment for BOLD Renal Imaging (KALIBRI), with prospective rigid image registration of each kidney is proposed.

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712 14:54

MR Elastography of The Prostate with A Mode-Conversion Endourethral Driver: Feasibility at 3.0 T

Jin Wang[1], Kevin J. Glaser[2], Bingjun He[1], Tianhui Zhang[1], Jun Pang[3], Ziying Yin[2], Zhuang Kang[1], Qungang Shan[1], Meng Yin[2], Forghanian-Arani Arvin[2], and Richard L. Ehman[2]

[1]Department of Radiology, The Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China, People's Republic of, [2]Department of Radiology, Mayo Clinic, Rochester, MN, United States, [3]Department of Urology, The Third Affiliated Hospital of Sun Yat-Sen University, Guangzhou, China, People's Republic of

Prostate cancer(PCa) is one of the leading causes of cancer-related deaths in men. Detection of clinically significant PCa is a major challenge. We evaluated the feasibility of a novel approach for quantitatively imaging the stiffness of prostate gland, using a conventional urinary catheter as a source of shear waves for MR elastography. Results in 19 examinations showed that the approach, which uses conventional commercially-available MRE drivers can generate shear wave fields in the prostate that are suitable processing. Measurements of regional prostate stiffness in patients with benign prostatic hypertrophy and PCa reveal trends that provide motivation for further evaluation of prostatic MRE.

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713 15:06

Adrenal gland iron measurement using MRI-R2* in patients with iron overload: a feasibility Study

Sarah Keller[1], Bjoern Schoennagel[1], Zhiyue Jerry Wang[2], Hendrick Kooijman[3], Gerhard Adam[1], Roland Fischer[4,5], and Jin Yamamura[1]

[1]Diagnostic and Interventional Radiology, University Medical Center Hamburg-Eppendorf, Hamburg, Germany, [2]Radiology, University of Texas Southwestern Medical Center, Dallas, TX, United States, [3]Philips Medical Care, Hamburg, Germany, [4]Radiology, Children's Hospital & Research Center Oakland, Oakland, CA, United States, [5]Biochemistry, University Medical Center Hamburg-Eppendorf, Hamburg, Germany

In recent years, hepatic, cardiac, and even pancreatic iron deposition has been studied in detail. However, the presence and incidence of iron disposition of normal-sized adrenal glands has not been adequately reported. The purpose of this study was to evaluate the levels of iron deposition in the adrenal glands in patients with iron overload.

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714 15:18

Improving the accuracy of renal perfusion measurements from ASL by using multiple TIs: Validation with DCE MRI

Christopher Charles Conlin[1,2], Yangyang Zhao[2], and Jeff Lei Zhang[1,3]

[1]Utah Center for Advanced Imaging Research, University of Utah, Salt Lake City, UT, United States, [2]Bioengineering, University of Utah, Salt Lake City, UT, United States, [3]Radiology, University of Utah School of Medicine, Salt Lake City, UT, United States

This study presents an approach for measuring renal perfusion from multi-TI ASL data and examines the impact of TI-sampling density on perfusion estimation. Our approach incorporates a tracer-kinetic model of the ASL difference signal and a correction for inversion-efficiency artifacts. It was used to measure renal perfusion in human subjects from ASL data sampled at different numbers of TIs and validated against an established DCE-MRI technique. For ASL data sampled at more than two TIs, our approach showed good agreement and correlation with DCE-MRI, demonstrating robust modeling of the ASL difference signal and accurate measurement of renal perfusion.

Oral

Imaging of Pediatric Neuropathology

Room 300-302 16:00 - 18:00 *Moderators:*Petra Huppi Petra & Duan Xu

730 16:00

Complex congenital heart defects in infants produce lasting decreases in functional network segregation

Vincent Jerome Schmithorst[1], Jodie Votava-Smith[2], Vince Lee[1], Vidya Rajagopalan[2], Shaheda Suleiman[1], Lisa Paquette[2], and Ashok Panigrahy[1]

[1]Radiology, Children's Hospital of Pittsburgh of UPMC, Pittsburgh, PA, United States, [2]Children's Hospital of Los Angeles, Los Angeles, CA, United States

We used functional connectivity MRI and graph analysis to investigate the impact of congenital heart disease (CHD) on functional network topology in neonates. Cost-dependent and cost-independent analyses both showed decreases in global segregation (transitivity). The cost-dependent analysis showed a decrease in clustering coefficient (reflective of nodal changes) while the cost-independent analysis showed a decrease in modularity and an increase in participation coefficient (reflective of changed community structure). Minimal differences were seen for CHD patients scanned post-operatively compared to those scanned pre-operatively. Results indicate complex CHD results in lasting changes to functional network topology not ameliorated by the effects of surgery.

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731 16:12

Altered Cortical and Subcortical Structures and Structural Connectivity in Perinatally HIV-infected Children

Santosh Kumar Yadav[1], Rakesh Kumar Gupta[2], Ravindra Kumar Garg[3], Vimala Venkatesh[4], Ena Wang[1], Francesco M Marincola[1], and Mohammad Haris[1]

[1]Division of Translational Medicine, Sidra Medical and Research Center, Doha, Qatar, [2]Department of Radiology, Fortis Memorial Research Institute, Gurgaon, India, [3]Department of Neurology, King George Medical University, Lucknow, India, [4]Department of Microbiology, King George Medical University, Lucknow, India

Cortical thickness, subcortical volumes and structural brain connectivity changes in HIV-seropositive children were evaluated in comparison to HIV-seronegative children. HIV-seropositive children showed altered cortical thicknesses, subcortical volumes and structural connectivity compared to those of HIV-seronegative children. In addition, changes in cortical and subcortical structures were significantly correlated with CD4+ counts and neuropsychological scores in HIV-seropositive children. We suggest that neuronal injury due to HIV-infection and inflammation might be possible reasons for the altered cortical thickness, subcortical volumes and connectivity in these patients.

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732 16:24

Mapping longitudinal white matter changes in extremely preterm born infants

Eliza Orasanu[1], Andrew Melbourne[1], Marc Modat[1], Marco Lorenzi[1], Herve Lombaert[2], Zach Eaton-Rosen[1], Nicola Robertson[3], Giles Kendall[4], Neil Marlow[5], and Sebastien Ourselin[1]

[1]Translational Imaging Group, Centre for Medical Image Computing, University College London, London, United Kingdom, [2]INRIA, Palaiseau, France, [3]Academic Neonatology, Institute for Women's Health, University College London, London, United Kingdom, [4]Academic Neonatology, Institute for Women's Health, University College Hospital, London, United Kingdom, [5]Institute for Women's Health, University College London, London, United Kingdom

During the preterm period, the brain undergoes changes in volume, structure and cortical folding, which can be connected with cognitive abilities in preterm born infants. Diffusion MRI allows us to investigate microstructural changes during this period. In this study we registered the longitudinal diffusion tensor images of six extremely preterm born infants and looked at white matter changes. The corpus callosum and internal capsule exhibits the most microstructural changes during this crucial period and we hypothesis that this can affect the neurodevelopment in these infants.

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733 16:36

Combining lesion burden with cortical malformation morphology strongly predicts motor outcomes in children with cerebral palsy

Alex Pagnozzi[1], Nicholas Dowson[1], James Doecke[1], Simona Fiori[2], Andrea Guzzetta[3], Roslyn N Boyd[4], and Stephen Rose[1]

[1]The Australian e-Health Research Centre, CSIRO Health & Biosecurity, Brisbane, Australia, [2]Stella Maris Institute, Pisa, Italy, [3]Stella Maris institute, Pisa, Italy, [4]The University of Queensland, Queensland Cerebral Palsy and Rehabilitation Research Centre, Brisbane, Australia

Magnetic Resonance Imaging (MRI) is the clinical standard for assessing developmental brain injury in children with Cerebral Palsy (CP). We propose an automated process that segments the spectrum of white and grey matter injury, including tissue lesions and malformations of the cortex, and correlates biomarkers of injury with the Assisting Hand Assessment (AHA), a clinical score quantifying hand function. The proposed method is shown to perform accurate tissue and injury segmentation using T1 and T2 MRI compared to the manual classification of injury, and was significantly correlated with AHA ($p<0.001$).

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734 16:48

Quantitative Spectroscopic Imaging in Metachromatic Leukodystrophy: value in prognosis and treatment monitoring.
Diane van Rappard[1], Antoine Klauser[2], Marjan Steenweg[1], Marjo van der Knaap[1], Nicole Wolf[1], and Petra Pouwels[3]

[1]Child Neurology, VU University Medical Center, Amsterdam, Netherlands, [2]Centre d'Imagerie BioMédicale, Geneva University, Geneva, Switzerland, [3]Physics & Medical Technology, VU University Medical Center, Amsterdam, Netherlands

Currently, hematopoietic stem cell transplantation (HSCT) is the only treatment option for patients with metachromatic leukodystrophy (MLD). This study in MLD patients and controls investigated the possible additional prognostic value of quantitative MRSI. In WM (consisting of lesions and NAWM), ratios of Cho/NAA and Ins/NAA were significantly higher in patients who were considered non-eligible for HSCT than in eligible patients. Follow-up of successfully treated patients showed partial normalization of concentrations and ratios. This study suggests that quantitative MRS can support the decision whom to treat, especially when neurological and cognitive examinations are ambiguous.

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735 17:00

Optimizing unanesthetized cerebral oxygen consumption measures: comparison of MRI and near-infrared spectroscopy (NIRS) approaches in neonates with congenital heart disease
Jeffrey N Stout[1], Silvina Ferradal[2], Borjan Gagoski[2], Lilla Zollei[3], Divya S Bolar[3,4], Alex Lin[5], Henry H Cheng[6], Elfar Adalsteinsson[1,7,8], and Patricia Ellen Grant[2]

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Concern for cerebral perfusion in neonates with congenital heart disease (CHD) has driven investigations into cerebral hemodynamics. MRI in combination with bedside NIRS has the potential to provide complementary measures of hemodynamics to guide surgical timing and assess response to surgery. We compare MRI and NIRS measures of cerebral hemodynamics. Modality results compare well to literature studies, but intermodality correlation is limited. Before combining modalities additional studies are needed to better understand why cerebral blood flow and $CMRO_2$ measures in MRI and NIRS differ.

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736 17:12

Quantitating polyunsaturated fatty acids in neonates with hypoxic-ischemic brain injury
Jessica Lee Wisnowski[1,2], Aaron J Reitman[3,4], Tai-Wei Lee Wu[3], Eugenia Ho[5], Claire McLean[6], Douglas Lee Vanderbilt[6], Marvin D Nelson[1], Ashok Panigrahy[7], Philippe Lee Friedlich[3,8], and Stefan Lee Bluml[1]

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Polyunsaturated fatty acids (PUFA) are endogenous components of cellular membranes and a potential biomarker for apoptosis following hypoxic-ischemic (HI) brain injury. Prior studies have applied ^{1}H-MRS techniques for quantifying PUFA in human carcinomas. Here, using a retrospective dataset of 1,046 neonatal ^{1}H-MRS spectra, we demonstrate that PUFA can be routinely characterized in newborns using a modified LCModel (Provencher, Inc) pipeline.

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737 17:24

Tract-specific analysis of white matter fasciculi in a large cohort of preterm infants
Diliana Pecheva[1], Hui Zhang[2], Gareth Ball[1], Mary Rutherford[1], Nigel Kennea [3], Joseph V. Hajnal[1], Daniel Alexander[2], A. David Edwards[1], and Serena J. Counsell[1]

[1]Centre for the Developing Brain, King's College London, London, United Kingdom, [2]Department of Computer Science & Centre for Medical Image Computing, University College London, London, United Kingdom, [3]Neonatal Unit, St Georges Hospital NHS Trust, London, United Kingdom

Preterm birth adversely affects brain development and diffuse white matter (WM) injury is often observed in preterm infants. Diffusion tensor imaging (DTI) allows us to study these effects in vivo. In this study tract-specific analysis, a novel method for large infant cohort analyses, was used to study the effects of age at scan and prematurity at birth on major WM tracts in 384 preterm infants. Our results show that age at scan is associated with widespread changes in DTI metrics across WM tracts, while the impact of prematurity at birth is more localized.

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738 17:36

Brain Reorganization in Young Children with Epilepsy Surgery: Longitudinal Tractography-Based Connectome Study

Jeong-Won Jeong[1,2], Eishi Asano[1], Csaba Juhasz[1,2], and Harry T. Chugani[1,2]

[1]Pediatrics and Neurology, Wayne State University, Detroit, MI, United States, [2]Translational Imaging Laboratory, Children's Hospital of Michigan, Detroit, MI, United States

Both ictal and interictal epileptic activities can lead to progressive deterioration of affected brain structure and function with an additional indirect impairment of functional reorganization (or compensation) in no-epileptic areas. This study applies whole brain connectome analysis for children with intractable focal epilepsy in order to investigate the potential effect of epilepsy surgery and surgical outcome on the pattern of axonal plasticity in the contralateral hemisphere. We found that post-operative seizures are associated with increased connectivity, most pronounced in the temporal pole region of the contralateral hemisphere. Such increased connectivity may be an imaging marker of recurrent epilepsy after focal cortical resection.

739 17:48

Disrupted Development and Integrity of Frontal White Matter in Patients Treated for Pediatric Posterior Fossa Tumors

John O Glass[1], Robert J Ogg[1], Jung W Hyun[2], Julie H Harreld[1], Yimei Li[2], Amar Gajjar[3], and Wilburn E Reddick[1]

[1]Diagnostic Imaging, St. Jude Children's Research Hospital, Memphis, TN, United States, [2]Biostatistics, St. Jude Children's Research Hospital, Memphis, TN, United States, [3]Oncology, St. Jude Children's Research Hospital, Memphis, TN, United States

This study assessed the longitudinal white matter (WM) microstructure of 129 patients and 72 normal healthy age-similar controls. WM volume, fractional anisotropy (FA), and radial (RAD) and axial (AX) diffusivity trajectories were examined. After surgery but before any additional therapy, frontal WM volume in patients was similar to controls, while FA and AX were reduced in patients, suggestive of acute, indirect microstructural/axonal injury caused by disease and/or surgical excision. Over the next three years, AX, RAD, and WM volume decreased in patients, which would be consistent with possible resolution of axonal swelling combined with chronic demyelination.

Oral

UHF Applications

Room 324-326 16:00 - 18:00 *Moderators:*Lawrence Wald

740 16:00

Abdominal MRF at Ultra-High-Field Strengths

Martijn A Cloos[1,2], Bei Zhang[1,2], and Daniel K Sodickson[1,2]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States

Like other magnetic resonance (MR) techniques before it, magnetic resonance fingerprinting (MRF) was developed and applied in the traditional context of a precisely calibrated and uniform radiofrequency excitation field. Plug & Play Parallel Transmission (PnP-PTX), on the other hand, was designed to liberate MRF from these constraints. We evaluate the impact of excitation field non-uniformities on abdominal MRF experiments at different field strengths, and show that PnP-PTX has the potential to alleviate these challenges, and thereby opens opens up a new route towards robust, quantitative, whole-body MRI for ultra-high-field systems.

741 16:12

summa cum laude

Spiral Acquisition for High-Speed Anatomical Imaging at 7T

Lars Kasper[1,2], Christoph Barmet[1,3], Maria Engel[1], Maximilian Haeberlin[1], Bertram J Wilm[1], Benjamin E Dietrich[1], Thomas Schmid[1], David O Brunner[1], Klaas E Stephan[2,4,5], and Klaas P Pruessmann[1]

[1]Institute for Biomedical Engineering, University of Zurich and ETH Zurich, Zuerich, Switzerland, [2]Translational Neuromodeling Unit, IBT, University of Zurich and ETH Zurich, Zuerich, Switzerland, [3]Skope Magnetic Resonance Technologies, Zurich, Switzerland, [4]Wellcome Trust Centre for Neuroimaging, University College London, London, United Kingdom, [5]Max Planck Institute for Metabolism Research, Cologne, Germany

We present whole-brain, high-resolution (0.5mm) spiral imaging with proton-density and T2* contrast at 7T in less than a minute. Owing to a comprehensive characterization of the imaging process, artifact-free image reconstruction from long-readout spiral shots (20 ms) becomes feasible via an iterative SENSE algorithm. In particular, trajectory imperfections as well as dynamic off-resonance changes are captured via concurrent field monitoring, while static off-resonance as well as coil sensitivities are mapped in a multi-echo reference scan and augment image reconstruction. The resulting images exhibit the same geometric fidelity as spin-warp images at a fraction of the total acquisition duration.

742 16:24

First proof of more than two-fold increase in intrinsic SNR for prostate imaging at 7 tesla in comparison with 3 tesla.

Mariska P. Luttje[1], Ingmar J. Voogt[1], Marco van Vulpen[1], Peter R. Luijten[1], Dennis W.J. Klomp[1], and Alexander J.E. Raaijmakers[1]

[1]Imaging Division, University Medical Center Utrecht, Utrecht, Netherlands

In this study, we demonstrate that a dipole transceive antenna array with a loop coil receive array at 7T substantially outperforms state of the art 3T MRI of the prostate. Using this setup we demonstrated for the first time the intrinsic SNR benefits of using the higher field strength of 7 tesla for prostate MR imaging compared to a clinically used prostate imaging setup at 3 tesla: an overall gain in SNR of 2.1 fold as obtained in 6 subjects.

743 16:36

Utilizing the improved receive sensitivity from high permittivity materials for SNR-challenged applications of ultrahigh b-factor diffusion-weighted spectroscopy at 7 Tesla

Carson Ingo[1], Wyger M. Brink[1], Andrew G. Webb[1], and Itamar Ronen[1]

[1]*C.J. Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands*

Diffusion-weighted 7T MR spectroscopy in white matter regions of the brain using ultrahigh b-factors have established that intracellular metabolites exhibit non-Gaussian diffusion. Such measurements using b-factors well above 10,000 s/mm^2 have inherently low SNR, and so it is crucial to optimize B_1 sensitivity to ensure reliable results. Here we show that a single high permittivity pad can increase the receive sensitivity by ~30%, resulting in potential reductions in data acquisition time of ~70%.

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744 16:48

High resolution whole-brain diffusion MRI at 7 Tesla using parallel RF transmission: how fast can we go?

Xiaoping Wu[1], Nicolas Boulant[2], Vincent Gras[2], Jinfeng Tian[1], Sebastian Schmitter[1], Pierre-Francois Van de Moortele[1], and Kamil Ugurbil[1]

[1]*CMRR, Radiology, University of Minnesota, Minneapolis, MN, United States,* [2]*CEA/NeuroSpin, Saclay, France*

The Human Connectome Project (HCP) in the WU-Minn consortium aims to acquire multiband (MB)-accelerated whole brain diffusion MRI (dMRI). Although shown advantageous over 3T dMRI in inferring connectivity, the 7T acquisition suffers from transmit B1 inhomogeneity and SAR, the latter currently limiting the slice acceleration to an MB factor of 2 (MB=2). In this study, we investigated numerically the highest possible slice acceleration for 7T HCP-type dMRI acquisition with ~1-mm isotropic resolutions. Our results suggest that parallel RF transmission can be used to enable MB=4 while improving flip angle homogeneity across the whole brain as compared to a CP mode.

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745 17:00

Quantitative Single Breath-Hold Renal ASL Perfusion Imaging at 7T

Xiufeng Li[1], Pierre-Francois Van de Moortele[1], Kamil Ugurbil[1], and Gregory J. Metzger[1]

[1]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States*

In contrast to studies at 3T, where the whole body coil is used for RF transmission, studies at 7T use local transcieve coils, which have limited B_1+ coverage producing smaller temporal bolus widths that need to be estimated in order to achieve proper renal blood flow (RBF) quantification. To estimate the temporal bolus width and to quantify RBF at 7T, single breath-hold renal perfusion studies were performed using the FAIR ss-FSE method with varied delay times. Based on the results form multi-delay perfusion study, quantitative renal perfusion imaging was further achieved by using a single-subtraction approach.

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746 17:12

Prospective motion correction for ultra-high resolution Time of Flight angiography at 7T under SAR constraints

Hendrik Mattern[1], Alessandro Sciarra[1], Frank Godenschweger[1], Daniel Stucht[1], Falk Lüsebrink[1], and Oliver Speck[1,2,3,4]

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At 7T, venous saturation and magnetization transfer for Time of Flight (ToF) angiography cannot be applied directly due to the increased specific absorption rate. Additionally, motion artifacts can degrade the image quality. A sequence with prospective motion correction (PMC) and sparse saturation was implemented to overcome these challenges. In vivo ultra-high resolution ToF angiograms were acquired, providing dramatically improved level of detail and image quality if PMC and sparse saturation is used. Thus, the proposed sequence unleashes the full potential of ToF angiography at 7T.

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747 17:24

On-resonant balanced Steady-State Free Precession imaging at 9.4T

Damien Nguyen[1,2], Tom Hilbert[3,4,5], Philipp Ehses[6,7], Klaus Scheffler[6,7], Jean-Philippe Thiran[4,5], Oliver Bieri[1,2], and Tobias Kober[3,4,5]

[1]*Radiological Physics, Dep. of Radiology, University of Basel Hospital, Basel, Switzerland,* [2]*Department of Biomedical Engineering, University of Basel, Basel, Switzerland,* [3]*Advanced Clinical Imaging Technology (HC CMEA SUI DI BM PI), Siemens Healthcare AG, Lausanne, Switzerland,* [4]*Department of Radiology, University Hospital Lausanne (CHUV), Lausanne, Switzerland,* [5]*LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland,* [6]*High-Field MR Center, Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [7]*Department for Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany*

In this work, we explore the possibility of using the recently proposed highly undersampled 3D phase-cycled balanced Steady-State Free Precession (bSSFP) sequence trueCISS to generate on-resonant band-free bSSFP images at 9.4T. By applying the forward signal model, it is also possible to synthetically generate bSSFP images at higher flip angles, which would otherwise be impossible to acquire due to SAR limitations. Lastly, we show a maximum bSSFP signal intensity image of the brain using the trueCISS estimated parameter maps.

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748 17:36

Magnetic resonance imaging of low-grade and high-grade gliomas at 7 Tesla

Bixia Chen[1,2], Philipp Dammann[1,2], Stefan Maderwald[1], Soeren Johst[1], Tobias Schoemberg[1,2], Lale Umutlu[1,3], Harald H. Quick[1,4], Mark Edward Ladd[1,5], Ulrich Sure[2], and Karsten Henning Wrede[1,2]

[1]*Erwin L. Hahn Institute for MRI, University of Duisburg-Essen, Essen, Germany,* [2]*Department of Neurosurgery, University Hospital Essen, University of Duisburg-Essen, Essen, Germany,* [3]*Institute of Diagnostic and Interventional Radiology and Neuroradiology, University of Duisburg-*

Essen, Essen, Germany, [4]High Field and Hybrid MR Imaging, University Hospital Essen, University of Duisburg-Essen, Essen, Germany, [5]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

Magnetic resonance imaging (MRI) plays a major role in diagnosis, multimodal treatment planning, and follow-up of low-grade and high-grade gliomas. In this prospective study, 24 patients were intra-individually examined at 3 Tesla (T) and 7T utilizing MPRAGE, T_2 TSE, T_2 FLAIR, and SWI sequences. Image evaluation had special focus on intra-tumoral structures, vascularization, intra-lesional hemorrhages, and contrast uptake. At 7T, intra-tumoral structures were depicted in excellent image quality. Especially SWI was superior at 7T compared to 3T and revealed microhemorrhages and vascularization patterns correlating with histopathology, possibly providing an additional imaging predictor for future grading of malignant gliomas.

749 17:48 High-resolution placental MR angiography using a nanoparticle contrast agent

Ketan Ghaghada[1], Zbigniew Starosolski[1], Igor Stupin[1], Saakshi Bhayana[1], Haijun Gao[2], Rohan Bhavane[1], Chandresh Patel[1], Robia Pautler[3], Chandrasekhar Yallampalli[2], and Ananth Annapragada[1]

[1]Pediatric Radiology, Texas Children's Hospital, Houston, TX, United States, [2]Obstetrics and Gynecology, Baylor College of Medicine, Houston, TX, United States, [3]Molecular Physiology and Biophysics, Baylor College of Medicine, Houston, TX, United States

Non-invasive imaging of maternal and placental vasculature in rodent species is of interest to the pre-clinical study of clinically-relevant placental pathologies. In this work, we evaluated the utility of high-resolution contrast-enhanced MR angiography using a placental non-permeable, long circulating liposomal-Gd nanoparticle contrast agent in a pregnant rat model.

Oral

Structural & Functional Imaging of Muscle

Room 331-332 16:00 - 18:00 *Moderators:*Bruce Damon & S. Sendhil Velan

750 16:00 The relationships between microstructure and the diffusion tensor in simulated skeletal muscle

David B Berry[1], Benjamin M Regner[2], Vitaly L Galinsky[3], Samuel R Ward[1,4,5], and Lawrence R Frank[3]

[1]Bioengineering, UCSD, La Jolla, CA, United States, [2]Institute of Engineering in Medicine, UCSD, La Jolla, CA, United States, [3]Center for Scientific Computation in Imaging, UCSD, La Jolla, CA, United States, [4]Orthopaedic Surgery, UCSD, La Jolla, CA, United States, [5]Radiology, UCSD, La Jolla, CA, United States

Diffusion tensor imaging (DTI) has been used to measure changes in restricted diffusion in skeletal muscle after injury, which are thought to track microstructural, and therefore functional changes. However, there are few direct comparisons between muscle microstructure and DTI measurements because it is difficult to precisely control in vivo experiments. Here, we use a computational (in silico) modeling approach to explore changes in DTI measurements as muscle microstructure is systemically changed. Muscle fiber diameter and edema have the largest effects on the DT. Additionally, we have shown multi-echo DTI is required to resolve changes in microstructure when edema is present.

751 16:12 Towards robust Diffusion Tensor Imaging of skeletal muscles via an automatic artifact removal tool.

Chiara Giraudo[1], Stano Motyka[1], Siegfried Trattnig[1], and Wolfgang Bogner[1]

[1]Department of Biomedical Imaging and Image-guided Therapy- MR Centre of Excellence, Medical University Vienna, Vienna, Austria

STEAM-DTI sequence recently provided excellent results for DTI analysis of muscle fibers (e.g., high signal-to-noise ratio, low apparent diffusion coefficient, high fractional anisotropy values) but demonstrated also to be affected by strong artifacts, which can be assumed to be due to involuntary muscle contractions. The hereby proposed automatic post-processing method, based on weighted mean of the averages for each DTI-direction and b-value, demonstrated to successfully detect and correct these artifacts, improving fiber tracking of the calf muscles.

752 16:24 Super-Resolution Magnetic Resonance Elastography (SR-MRE) of Exercise Induced Muscle Damage (EIMD)

M. Perrins[1], E. Barnhill[2], P. Kennedy[1], J. Braun[2], I. Sack[2], A. Hunter[3], C. Brown[4], E. van Beek[1], and Neil Roberts[1]

[1]University of Edinburgh, Edinburgh, United Kingdom, [2]Department of Radiology, Charité - Universitätsmedizin Berlin, Berlin, Germany, [3]School of Sport, University of Stirling, Stirling, United Kingdom, [4]The Mentholatum Company Ltd., East Kilbride, United Kingdom

Super-Resolution (SR) Magnetic Resonance Elastography (MRE) was applied to measure thigh muscle viscoelastic properties in 20 subjects in whom Exercise Induced Muscle Damage (EIMD) was produced using a well-established muscle damage protocol. SR-MRE is made possible by analysing Multi-frequency MRE (MMRE) in a manner such that multiple low-resolution images of the same scene are interpolated and fused to create a single, high-resolution image. Muscle tissue is well suited to study using SR-MRE and the sites of muscle damage could be clearly identified suggesting potential useful clinical applications for the technique. SR-MRE also has potential to provide insight regarding the mechanisms underlying tissue damage in EIMD.

753 16:36 A Quantitative Investigation of the Fatty Degeneration of the Supraspinatus Muscle after Rotator Cuff Tear: SPLASH-MRI, Model-Based T$$$_1$$$ Mapping and Shear Wave Ultrasound

Andreas Max Weng[1], Fabian Gilbert[2], Johannes Tran-Gia[1,3], Tobias Wech[1], Detlef Klein[1], Thorsten Alexander Bley[1], and Herbert Köstler[1]

[1]Department of Diagnostic and Interventional Radiology, University of Würzburg, Würzburg, Germany, [2]Department of Trauma, Hand, Plastic and Reconstructive Surgery, University of Würzburg, Würzburg, Germany, [3]Department of Nuclear Medicine, University of Würzburg, Würzburg, Germany

Fatty degeneration of the rotator cuff is often investigated by a visual inspection of T$$$_1$$$-weighted MR images. Since this approach is in debate the aim of this study was to investigate fatty degeneration of the supraspinatus muscle by quantitative techniques: SPLASH, model-based acceleration for parameter mapping (MAP) T$$$_1$$$ measurement and shear wave ultrasound. The obtained values from SPLASH and T$$$_1$$$ mapping are in good accordance (Pearson's r=0.82). However, shear wave ultrasound does neither correlate well with SPLASH (Spearman's rho= 0.30) nor with MAP (rho=0.19). Since data acquisition time of the T$$$_1$$$ mapping technique used in our study is very short (4s), this might be the technique of choice for investigation of the fatty degeneration of the supraspinatus after rotator cuff tear.

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754 16:48

Assessment of passive muscle elongation using DTI: Correlation between fiber length and diffusion coefficients

Valentina Mazzoli[1,2,3], Jos Oudeman[1], Marco A Marra[3], Klaas Nicolay[2], Nico Verdonschot[3], Andre M Sprengers[3], Martijn Froeling[4], Aart J Nederveen[1], and Gustav J Strijkers[5]

[1]Department of Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Biomedical NMR, Department of Biomedical Engineering, Eindhoven University of Technology, Eindhoven, Netherlands, [3]Orthopaedic Research Lab, Radboud University Medical Center, Nijmegen, Netherlands, [4]Department of Radiology, University Medical Center, Utrecht, Netherlands, [5]Biomedical Engineering and Physics, Academic Medical Center, Amsterdam, Netherlands

The aim of this study is to explore Diffusion Tensor Imaging in the assessment of passive muscle elongation. We investigated two dorsiflexor and two plantarflexor muscles of the lower leg with the foot in dorsiflexion, neutral and plantarflexion position. Significant negative correlation was found between changes in fiberlength caused by passive muscle lengthening and radial diffusivity for all muscles. Furthermore the rate of change in radial diffusivity was compatible with a cylindrical model with constant volume. These findings give more insight into diffusion mechanisms in skeletal muscles and are highly relevant for biomechanical models.

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755 17:00

Age-Related Changes in Diffusion Tensor Imaging Measures in Human Skeletal Muscle

Donnie Cameron[1], David A. Reiter[1], Kenneth W. Fishbein[1], Christopher M. Bergeron[1], Richard G. Spencer[1], and Luigi Ferrucci[1]

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

This work investigates how ageing influences diffusion tensor imaging (DTI) measures through application of a robust protocol to the human thigh. Fifteen participants, from 27-73 years old, were recruited, and mean diffusivity (MD) and fractional anisotropy (FA) were calculated in their quadriceps and plotted against age. Fibre tractography was also calculated. Rectus femoris FA showed a significant correlation with age (R^2=0.27, p=0.04), while FA approached significant correlations in other muscle heads. MD had a more complicated relationship with age, if any, in contrast to previous work where lipid influence was neglected. This highlights the need for high-quality fat-suppression in DTI.

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756 17:12

summa cum laude

A multimodal MR approach to evaluate complex muscle degeneration processes in Duchenne Muscular Dystrophy

Melissa Tamara Hooijmans[1], Melissa Tamara Hooijmans[1], Nathalie Doorenweerd[1], Jedrek Burakiewicz[1], Andrew Webb[1], Jan Vershuuren[2], Erik Niks[2], and Hermien Kan[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Neurology, Leiden University Medical Center, Leiden, Netherlands

Quantitative MRI and MRS are increasingly important as non-invasive and objective outcome measures in therapy development for DMD. Several MR indices, have been shown to correlate individually with age and functional measures. However, much less attention has been given to how these indices relate to each other. Our work combined quantitative MRI and spatially resolved 31P MRS in the lower leg muscles of DMD patients and showed that combining multimodal MR measures is very important to objectively assess muscle degeneration processes and potentially the effect of therapeutic interventions in DMD.

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757 17:24

Multi parametric MRI evaluation of skeletal muscle growth and myopathies in mice

Kerryanne V. Winters[1,2], Olivier Reynaud[1,2], Dmitry S. Novikov[1,2], Els Fieremans[1,2], and Sungheon G. Kim[1,2]

[1]Center of Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [2]Center for Advanced Imaging Innovation and Research, NYU Langone Medical Center, New York, NY, United States

The random permeable barrier membrane (RPBM) model for diffusion tensor imaging (DTI) provides a non-invasive modality potentially useful for early and accurate diagnosis for the wide range of myopathies. We have utilized the DTI-RPBM method to assess myofiber changes in the Surface-to-Volume ratio *S/V* and sarcolemma permeability κ as markers in growing and wasting skeletal muscle. Preliminary results show that *S/V* and κ decrease in both wild-type and *mdx* mice, with a more pronounced change between weeks 3 and 4 in *mdx* mice. The conventional IDEAL-Dixon and T2 mapping measures were not sensitive enough to observe the same change.

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758 17:36

31P-MRI using A Spectrally Selective 3D non-Cartesian FLORET Sequence at 7 T

Prodromos Parasoglou[1], Ryan Brown[1,2], and Guillaume Madelin[1]

[1]*Department of Radiology, New York University School of Medicine, New York, NY, United States,* [2]*NYU WIRELESS, Polytechnic Institute of New York University, Brooklyn, NY, United States*

We developed a spectrally selective 3D non-Cartesian FLORET pulse sequence to map phosphorus-containing metabolites in the human tissue. In particular, through this highly efficient pulse sequence we mapped phosphocreatine and γ-adenosine triphosphate at 1.4 cm isotropic nominal voxel size in the human brain. In addition, we were able to map phosphocreatine in the skeletal muscle during exercise and recovery with 6 s temporal resolution. We showed that spectrally selective 3D-FLORET is an efficient pulse sequence that can be used to image ^{31}P-containing metabolites in the human tissue when high spatiotemporal resolution is needed.

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759 17:48

Association of quadriceps muscle fat with isometric strength measurements in healthy males using chemical shift encoding-based water-fat MRI

Thomas Baum[1], Stephanie Inhuber[2], Michael Dieckmeyer[1], Christian Cordes[1], Stefan Ruschke[1], Elisabeth Klupp[3], Holger Eggers[4], Hendrik Kooijman[5], Ernst J Rummeny[1], Ansgar Schwirtz[2], Jan S Kirschke[3], and Dimitrios C Karampinos[1]

[1]*Department of Radiology, TU Munich, Munich, Germany,* [2]*Department of Sports and Health Sciences, TU Munich, Munich, Germany,* [3]*Section of Neuroradiology, TU Munich, Munich, Germany,* [4]*Philips Research Laboratory, Hamburg, Germany,* [5]*Philips Healthcare, Hamburg, Germany*

MR-based assessment of quadriceps muscle fat has been proposed as surrogate marker in sarcopenia, osteoarthritis, and neuromuscular disorders. The present study demonstrated strong associations between chemical shift encoding-based water-fat MRI quadriceps inter- and intramuscular fat parameters and corresponding physical strength measurements in healthy males. Thus, chemical shift encoding-based water-fat MRI can provide clinically important information beyond quadriceps muscle morphology and T1-weighted muscle fat quantifications and may potentially track early changes in muscles that are not severely atrophied or fatty infiltrated in the beginning of a disease process.

Oral

fMRI Physiology

Room 334-336 16:00 - 18:00 *Moderators:*Nicholas Blockley & Kevin C. Chan

760 16:00

Detection and modeling of 0.75 Hz neural oscillations using rapid fMRI at 7 Tesla

Laura Lewis[1,2], Kawin Setsompop[2,3], Bruce R Rosen[2,3], and Jonathan R Polimeni[2,3]

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Recent work has suggested that fMRI can detect neural activity on faster timescales than previously thought. We tested the temporal limits of fMRI using oscillating visual stimuli to generate an oscillatory neural response in human visual cortex. Using rapid (TR=227 ms) fMRI acquisition at 7 Tesla, we were able to detect 0.75 Hz oscillations in visual cortex that were an order of magnitude larger than predicted by canonical linear models. Using the balloon/Windkessel model we show that continuous and rapidly varying neural activity can generate larger fMRI signals than expected. We conclude that fMRI can be used to measure oscillations of up to at least 0.75 Hz, and suggest alterations to hemodynamic response models for experiments studying continuous and rapidly varying neural activity.

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761 16:12

summa cum laude

Validation and Optimization of Calibrated fMRI from oxygen-sensitive Two-Photon Microscopy of the mouse brain

Louis Gagnon[1,2,3], Sava Sakadzic[4], Frederic Lesage[2], Philippe Pouliot[2], Anders M Dale[5], Anna Devor[5], Richard B Buxton[5], and David A Boas[3]

[1]*Department of Medicine, Laval University, Quebec, QC, Canada,* [2]*Department of Electrical Engineering, Ecole Polytechnique Montreal, Montreal, QC, Canada,* [3]*Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Charlestown, MA, United States,* [4]*Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Chalestown, MA, United States,* [5]*Department of Radiology and Neuroscience, UCSD, La Jolla, CA, United States*

Calibrated fMRI allows to estimate relative changes in the Cerebral Metabolic Rate of Oxygen Consumption ($rCMRO_2$) from combined BOLD and ASL measurements during a functional task. Here, we improved the accuracy of the approach by using Two-Photon microscopic measurements of the cortical microvasculature together with first principle Monte Carlo simulations of proton diffusion across the two-photon volumes. Our method allowed (1) to validate Calibrated fMRI from the microscopic point of view and (2) to optimize the free parameters of the biophysical model assumed, therefore increasing the accuracy of this method to estimate $rCMRO_2$.

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762 16:24

summa cum laude

Graded hypercapnia-calibrated BOLD: Beyond the iso-metabolic hypercapnia assumption

Ian D Driver[1], Richard G Wise[1], and Kevin Murphy[1]

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

We propose a method for correcting for bias introduced by an iso-metabolic assumption in hypercapnia calibrated BOLD studies. A graded hypercapnia design and an assumption of linear $CMRO_2$ dependence on hypercapnia level are used to separate the calibration parameter M from $CMRO_2$ changes during hypercapnia. This method avoids intra-subject and experimental variability introduced by making a prior assumption of iso-metabolism or a $CMRO_2$ decrease with hypercapnia based on literature values. We implement this

method using two distinct levels of hypercapnia, measuring lower M values than when making the iso-metabolic assumption, with a significant dose-wise reduction in $CMRO_2$ with hypercapnia level.

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763 16:36

The acute effects of caffeine on brain oxygen metabolism: a dual calibrated FMRI study

Alberto Merola[1], Michael A Germuska[1], Esther AH Warnert[1], Sharmila Khot[1,2], Daniel Helme[2], Lewys Richmond[2], Kevin Murphy[1], and Richard G Wise[1]

[1]CUBRIC, Cardiff University, Cardiff, United Kingdom, [2]Department of Anesthesia and Intensive Care Medicine, Cardiff University, Cardiff, United Kingdom

Caffeine acute effects on oxygen metabolism are not well characterized across the brain with MRI. We aim at measuring these in a double-blind, crossover, placebo-controlled study on sixteen healthy, moderate caffeine consumers using a dual calibrated fMRI approach and a novel forward estimation model. Results show spatial variations in OEF_0, CBF, CVR, venous CBV and $CMRO_2$ across grey matter at different levels of resolution (grey matter, ROI and voxel), in agreement with most of the literature findings. Therefore we propose this approach as the first viable method to assess the effects of drugs on brain metabolism with a voxel-wise resolution.

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764 16:48

Visual cortical responses to auditory stimulation during deep isoflurane anesthesia: an fMRI study

Celia M. Dong[1,2], Patrick P. Gao[1,2], Leon C. Ho[1,2], Alex T.L. Leong[1,2], Russell W. Chan[1,2], Xunda Wang[1,2], and Ed X. Wu[1,2]

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

Anesthesia is needed in many neuroscience studies but its effect on brain network response properties has not been fully understood. In particular, how it modulates crossmodal sensory responses remains largely unknown. This study investigated the brain responses to auditory stimulation at different isoflurane levels using large-view BOLD fMRI. Robust responses to multiple pure tone sound stimuli were detected in the bilateral visual cortex at 2.5% isoflurane but not at 1.0% isoflurane level. These results revealed the broad and profound modulation effects of anesthesia on brain crossmodal response properties during external sensory stimulation.

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765 17:00

Resting state and stimulus evoked fMRI in awake, head-posted and habituated rats.

Pei-Ching Chang [1], Daniele Procissi[2], Maria Virginia Centeno[1], and Vania Apkarian[1]

[1]Physiology, Northwestern University, Chicago, IL, United States, [2]Radiology, Northwestern University, Chicago, IL, United States

fMRI in rodents is a major tool for basic neuroscience research. It allows investigation of brain networks in different animal models of disease and injury using translational methods with clinical relevance. In many instances it is essential to image animals in an awake condition (i.e. without anesthesia). While several have shown it is possible to image animals in the awake condition they nearly all require initial anesthesia and forced restraint. In this study we describe a strategy to image rats trained to be "comfortably" restrained and head posted and show how it is possible to enhance the performance of the fMRI experiments.

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766 17:12

Concurrent fMRI and intrinsic optical imaging spectroscopy with high resolution at ultra high field (14.1T)

Matthias F. Valverde Salzmann[1], Klaus Scheffler[1], and Rolf Pohmann[1]

[1]High-field Magnetic Resonance, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany

A setup for concurrent functional MRI and intrinsic optical imaging spectroscopy inside a 14.1 T animal scanner was developed, based on a magnetic field proof camera and optics. fMRI and optical imaging were simultaneously performed on rats with electrical forepaw stimulation, resulting in excellent signals for both BOLD and optical reflectance in two wavelengths (red and green). Only minor interactions between both modalities were observed. The combination of these two techniques can be used to investigate the origins of the BOLD effect and to open up novel ways of exploring brain function.

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767 17:24

Resting-state BOLD local synchrony as a strong proxy of glucose uptake and as a biomarker of aging using functionally-driven gray matter parcelization

Michaël Bernier[1], Étienne Croteau[2], Christian-Alexandre Castellano[2], Stephen C Cunnane[2], and Kevin Whittingstall[3]

[1]Nuclear medecine and radiobiology, Université de Sherbrooke, Sherbrooke, QC, Canada, [2]Research center of aging, Université de Sherbrooke, Sherbrooke, QC, Canada, [3]Diagnostic radiology, Université de Sherbrooke, Sherbrooke, QC, Canada

Currently, PET is the primary imaging modality used to infer energy metabolism in the brain. It is also known to be a reliable biomarker of aging and cognitive diseases. However, the cost and invasive nature of PET limits its use in basic research. There is therefore great interest in developing alternative less invasive approaches for estimating brain glucose metabolism. Using resting state fMRI metrics such as regional local homogeneity (ReHo), amplitude of low-frequencies fluctuations (ALFF) and regional global connectivity (closeness) we found that both regional- and subject-variations in ReHo strongly correlate with brain glucose uptake in healthy young and aging participants.

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768 17:36

The association between cerebrovascular reactivity and resting-state fMRI connectivity in healthy adults

Ali Golestani[1], Jonathan Kwinta[1,2], Stephen Strother[1,2], Yasha Khatamian[1], and Jean Chen[1,2]

[1]Rotman Research Institute at Baycrest, Toronto, ON, Canada, [2]Medical Biophysics, University of Toronto, Toronto, ON, Canada

Changes in the cerebrovascular reactivity (CVR) in known to alter the amplitude of the task-based blood oxygenation level dependent (BOLD) fMRI signal. The effect of CVR on resting-state functional connectivity however is still unknown. In this study, we altered within-individual CVR by manipulating the end-tidal CO_2 ($PETCO_2$) level, and in each $PETCO_2$ level we calculated CVR and resting-state connectivity in the motor and executive control networks. rs-fMRI connectivity is significantly influenced with CVR, irrespective of neural function. The strength of this association varies between motor and executive control networks. This study stresses the importance of vascular measurements to remove biases in interpreting rs-fMRI connectivity.

769 17:48 Cortical Laminar Resting-State Fluctuations Scale with Hypercapnic Response

Maria Guidi[1], Laurentius Huber[2], Leonie Lampe[1], and Harald E. Möller[1]

[1]Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany, [2]NIMH, Bethesda, MD, United States

Cortical layer-dependent fMRI can investigate effective connectivity of the brain. However, in order to obtain layer-dependent activity information, the unspecific fMRI sensitivity to draining veins must be accounted for, e.g., with calibrated BOLD methods. Regional variations of resting-state fMRI signal fluctuations have been suggested to resemble features of baseline physiology, such as venous blood volume and vascular reactivity. In this study, we investigate the possibility to use resting-state signal fluctuations to normalize/calibrate layer-dependent fMRI task-responses. In calibration studies with induced hypercapnia, we validate the new approach to obtain cortical profiles of vascular reactivity by comparisons with the established M-value.

Oral

Epilepsy

Hall 606 16:00 - 18:00 *Moderators:*Konstantinos Arfanakis & David Abbott

770 16:00 Perivascular Space Analysis in Non-lesional Epilepsy: Exploring a Biomarker for Epilepsy

Rebecca Emily Feldman[1], Jack Rutland[2], Bradley Neil Delman[3], Jiyeoun Yoo[4], Madeline Cara Fields[4], Lara Vanessa Marcuse[4], and Priti Balchandani[1]

[1]Translational and Molecular Imaging Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [2]Wake Forest University, Winston-Salem, NC, United States, [3]Radiology, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Neurology, Mount Sinai Hospital, New York, NY, United States

Epilepsy is a chronic condition, affecting approximately 150,000 people in the United States. 7T MRI facilitates the visualization of the brain with unprecedented resolution and contrast. Perivascular spaces (PVS) have been reported in previous work but with uncertain significance. However, due to the increased resolution enabled at 7T, PVSs are detected with increasing frequency, both in healthy volunteers and in epilepsy patients. We investigated the symmetry in the distribution of PVSs in the brains of non-lesional epilepsy patients.

771 16:12 Structural Connectivity Changes in Refractory Childhood Absence Epilepsy

Graeme Jackson[1,2,3,4], Farnoosh Sadeghian[1], Patrick Carney[1], David Raffelt[1], Fernando Calamante[1,2], and Alan Connelly[1,2]

[1]The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia, [2]The Florey Department of Neuroscience and Mental Health, The University of Melbourne, Melbourne, Australia, [3]Department of Medicine, The University of Melbourne, Melbourne, Australia, [4]Department of Neurology, Austin Health, Melbourne, Australia

Childhood absence epilepsy (CAE) is a common neurological condition. Here we assessed white matter connectivity using fixel-based analysis (FBA) and grey matter structure using voxel-based morphometry in adult patients with refractory CAE. We identified increased grey matter volume in frontal lobe as well as decreased fibre connectivity in superior longitudinal fasciculi, right cingulum, motor area of corpus callosum and cerebellar peduncles. Our results reinforce the concept that the midline frontal areas are critically involved in the phenotype of generalised spike and wave discharges. These structural connectivity changes in CAE could be either developmental or as a consequence of seizures.

772 16:24 7 tesla MRI in the pre-surgical evaluation of 26 patients with focal epilepsy

Tim J Veersema[1], Cyrille H Ferrier[1], Pieter van Eijsden[1], Peter H Gosselaar[1], Fredy Visser[2,3], Jaco JM Zwanenburg[2,4], Hans Hoogduin[2], Gerárd AP de Kort[2], Jeroen Hendrike[2], and Kees PJ Braun[1]

[1]Department of Neurology and Neurosurgery, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands, [2]Department of Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [3]Philips Healthcare, Best, Netherlands, [4]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands

For this series we assessed all 26 epilepsy patients who underwent 7T MRI for pre-surgical evaluation in our center, and whose scans (both 7T and lower field) were discussed during epilepsy surgery meetings (ESM). We compared the conclusions of the visual assessments of 1.5T or 3T, and 7T MRI as agreed upon by the ESM team. 7T MRI holds a promise to improve identification of epileptogenic structural abnormalities in patients with intractable epilepsy. In our series of 26 patients with refractory focal epilepsy, multidisciplinary evaluation of 7T MRI identified additional lesions not seen on lower-field MRI in five patients (19.2%).

773 16:36

In Vivo Whole-Brain T1-rho Mapping in evaluation of Mesial Temporal Lobe epilepsy

Xixi Zhao[1], Junling Wang[1], Xiangliang Tan[1], Xiang Xiao[1], Jiajun Zhang[1], Yingjie Mei[2], Queenie Chan[3], and Yikai Xu[1]

[1]Department of Medical Imaging Center, Nanfang Hospital, Southern Medical University, Guangzhou, China, People's Republic of, [2]Philips Healthcare, Guangzhou, China, People's Republic of, [3]Philips Healthcare, HongKong, China, People's Republic of

In human brain, T1ρ has been proven to be relevant with the macromolecular composition of tissues, and supposed to be sensitive to neuronal degeneration. We used T1rho MR imaging to investigate the variations in T1rho values of subcortical gray matter structures automatic-drawn using FIRST segmentation among temporal lobe epilepsy patients and the underlying relation between the significantly altered T1rho values or volumes of subcortical structures and duration of epilepsy or age at epilepsy onset. Our results demonstrate the feasibility of ROI-wise analysis by atlas-based segmentation of T1rho imaging among mTLE patients

774 16:48

Sodium MRI for Evaluation of Sodium Ion Homeostasis in Epilepsy: Clinical Implementation and Initial Impressions

Timothy Michael Shepherd[1], Yongxian Qian[1], Karthik Lakshmanan[1], Ruben Kuzniecky[2], Graham Wiggins[1], and Fernando Boada[1]

[1]Radiology, New York University, New York, NY, United States, [2]Neurology, New York University, New York, NY, United States

The detection and localization of sodium tissue abnormalities in patients with epilepsy may have potential to improve seizure localization, identify effective pharmacotherapy and/or provide prognostic information for individual patients. Here, we report initial results evaluating a newly developed coil for performing 23Na MRI at 3-T in three patients with epilepsy.

775 17:00

7T MRI detection of epileptogenic foci in previously non-lesional patients with focal epilepsy

Rebecca Emily Feldman[1], Bradley Neil Delman[2], Hadrien A Dyvorne[1], Jiyeoun Yoo[3], Madeline Cara Fields[3], Lara Vanessa Marcuse[3], and Priti Balchandani[1]

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

Epilepsy affects over 150,000 people in the United States. Thirty percent of epilepsy is refractory to pharmacotherapy, and in these cases surgery may be curative. There are focal epileptogenic lesions, amenable to surgery, which are not visualized by current imaging protocols. 7T MRI scanners may increase the conspicuity of epileptogenic lesions and provide more accurate delineation of lesion boundaries. Reported are the results for a patient study, with comparison to healthy controls, to assess the value of 7T imaging to reveal subtle abnormalities acting as epileptogenic foci in patients with focal epilepsy who have non-lesional diagnostic MRI scans.

776 17:12

magna cum laude

MRI monitoring of epileptogenesis with direct histological validation

Niels Leonard Schwaderlapp[1], Philipp Janz[2], Ute Häussler[2], Jan Korvink[3], Dominik Elverfeldt[1], Jürgen Hennig[1], Carola Haas[2], and Pierre LeVan[1]

[1]Medical Physics, University Medical Center Freiburg, Freiburg, Germany, [2]Experimental Epilepsy Research, University Medical Center Freiburg, Freiburg, Germany, [3]Institut für Mikrostrukturtechnik, Karlsruher Institut für Technologie, Karlsruhe, Germany

Cellular-level pathological changes in the kainate mouse model of temporal lobe epilepsy (TLE) have been well-characterized immunohistochemically (IHC) and include neuronal injury followed by granule cell dispersion. In this work, we demonstrate the possibility to non-invasively track granule cell dispersion and neuronal injury using diffusion imaging and ^{1}H-spectroscopy. The volume of the dispersed granule cell layer quantified by DTI and the initial injury reflected by a reduction of NAA and glutamate are quantitatively validated with IHC and can be used as early markers of epileptogenicity in this mouse model of TLE.

777 17:24

magna cum laude

Decreased Fibre Density in Frontal Lobe Epilepsies related to DEPDC5 mutations

David Raffelt[1], Farnoosh Sadeghian[1], Brigid Regan[2], Sarah Garry[2], Samuel Berkovic[2], Ingrid Scheffer[2], and Alan Connelly[1,2]

[1]Florey Institute of Neuroscience, Melbourne, Australia, [2]Department of Medicine, University of Melbourne, Melbourne, Australia

Mutations in the gene DEPDC5 cause up to 12% of Familial Focal Epilepsy with Variable Foci. In this work we performed a fixel-based analysis of diffusion MRI data to understand how white matter might be altered in patients with DEPDC5 mediated frontal lobe epilepsy (FLE). We identified significant reductions in fibre density in several pathways, including the superior longitudinal fasciculi, corpus callosum, inferior longitudinal fasciculus and cingulum. We also investigated FLE mediated by KCNT1 mutation, and found similar pathways affected. In KCNT1+ve subjects, pathways had reduced cross-section, suggesting the observed effects may be related to development and not seizure effects.

778 17:36

Automated fibre quantification of the fornix predicts outcome after surgery for intractable temporal lobe epilepsy

Russell Glenn[1], Leonardo Bonilha[1], Barbara Kreilkamp[2], Mark P Richardson[3], Bernd Weber[4], and Simon S Keller[2]

[1]Medical University of South Carolina, Charleston, SC, United States, [2]University of Liverpool, Liverpool, United Kingdom, [3]King's College London, London, United Kingdom, [4]University Hospital Bonn, Bonn, Germany

Imaging markers of postoperative seizure control in refractory temporal lobe epilepsy (TLE) would provide a useful clinical tool for

surgical decision making. In the present diffusion tensor imaging study, we report that regional tissue characteristics of the fornix ipsilateral to the side of intended resection are related to postoperative seizure control in patients with TLE. Interestingly, areas found to be abnormal only in patients with a suboptimal outcome were located outside the margins of resection. The identification of fornical abnormalities outside the area of intended resection may be an important prognostic marker of suboptimal seizure control after temporal lobe surgery.

779 17:48

Individual measures of network efficiency in patients with epilepsy based on cortical thickness

Gerhard Drenthen[1,2], Marielle Vlooswijk[2,3], Marian Majoie[2], Paul Hofman[1,2], Albert Aldenkamp[2,3], Walter Backes[1,2], and Jacobus Jansen[1,2]

[1]Department of Radiology and Nuclear Medicine, Maastricht University Medical Center, Maastricht, Netherlands, [2]School for Mental Health and Neuroscience, Maastricht University, Maastricht, Netherlands, [3]Department of Neurology, Maastricht University Medical Center, Maastricht, Netherlands

Brain network analysis that infers on interregional correlations of anatomical features usually makes use of intersubject correlation matrices that characterize variations over subjects. Here, a novel method is introduced that provides measures of network efficiency on an individual basis in patients with epilepsy. To this end, for each participant a measure of deviation from a group of healthy controls is calculated, and compared to the small-world parameters (clustering coefficient and minimum path length) of a reference graph obtained for the native control group. Results show that patients with epilepsy exhibit a less efficient network compared to controls.

Oral

Motion Correction: No Brainer

Summit 1 16:00 - 18:00 *Moderators:*Mehmet Akcakaya & Claudia Prieto

780 16:00

Highly Efficient Nonrigid Motion Corrected 3D Whole-Heart Coronary Vessel Lumen and Wall Imaging

Gastao Cruz[1], David Atkinson[2], Markus Henningsson[1], René Botnar[1], and Claudia Prieto[1]

[1]Division of Imaging Sciences & Biomedical Engineering, King's College London, London, United Kingdom, [2]University College London, London, United Kingdom

Non-invasive visualization of both coronary lumen and vessel wall is desired for assessment of coronary atherosclerosis. An interleaved acquisition was recently proposed to obtain both 3D images with MRI. However, this approach is susceptible to motion artifacts and dual respiratory gating results in long and unpredictable scan times. Here, we propose a ~100% scan efficiency, two-step motion correction method using translational and nonrigid correction to produce co-registered coronary lumen and vessel wall images. The proposed method shows significant improvements over translational correction and similar lumen quality to a reference navigator-gated (6mm) scan, despite a scan time reduction of ~1.8x.

781 16:12

Discontinuity Preserving Registration using Truncated L1 Regularization and Minimum Spanning Tree based Motion Clustering

Dongxiao Li[1,2], Juerong Wu[1], Kofi M. Deh[2], Thanh D. Nguyen[2], Martin R. Prince[2], Yi Wang[2,3], and Pascal Spincemaille[2]

[1]College of Information Science and Electronic Engineering, Zhejiang University, Hangzhou, China, People's Republic of, [2]Department of Radiology, Weill Cornell Medical College, New York, NY, United States, [3]Department of Biomedical Engineering, Cornell University, Ithaca, NY, United States

Free breathing liver perfusion analysis requires non-rigid motion registration of the unavoidable respiratory motion in the dynamic data. Traditional non-rigid methods rely on spatially smooth motion parameters, which is problematic for the sliding motion of the liver against the abdominal wall. In this work, truncated L1 regularized Minimum Spanning Tree based motion clustering combined with a Markov Random Field optimization is proposed to perform liver registration without the need for manual segmentation. Results on breath-hold liver images acquired at various positions of the respiratory cycle demonstrated this method allows superior liver motion estimation when compared to traditional methods.

782 16:24

Simultaneous in-vivo respiratory and cardiac motion correction system for PET/MR

Thomas Küstner[1,2], Christian Würslin[1,3], Martin Schwartz[1,2], Petros Martirosian[1], Sergios Gatidis[1], Konstantin Nikolaou[1], Fritz Schick[1], Bin Yang[2], Nina F. Schwenzer[1], and Holger Schmidt[1]

[1]University Hospital Tübingen, Tübingen, Germany, [2]Institute of Signal Processing and System Theory, University of Stuttgart, Stuttgart, Germany, [3]University of Stanford, Palo Alto, CA, United States

In oncologic imaging, simultaneous Positron-Emission-Tomography/Magnetic Resonance (PET/MR) scanners offer a great potential for improving diagnostic accuracy. An accurate diagnosis requires a high PET image quality reflecting in long PET examination times under free movement conditions (respiration and heartbeat). Hence, to ensure this high image quality one has to overcome the motion-induced artifacts. The simultaneous acquisition allows performing a MR-based non-rigid motion correction of the PET image. We propose a clinical feasible respiratory and cardiac motion correction system with a reduced scan time of only 60s, freeing time for additional diagnostic MR sequences. *In-vivo* patient data substantiates the diagnostic improvements.

783 16:36

Image-Based Non-Rigid Motion Correction for Free-breathing 4D MR Angiography

Fei Han[1], Ziwu Zhou[1], Paul J Finn[1], and Peng Hu[1]

[1]*Radiology, University of California, Los Angeles, Los Angeles, CA, United States*

Cardiac-phase-resolved 4D MR angiography (MRA) is a promising technique for evaluating patients with cardiovascular disorder. However, current approaches usually has low scan efficiency (20-40%) due to the gating based respiratory motion compensation and therefore suffered from prolonged yet unpredictable scan time. In this work, we proposed a motion correction strategy in which complex non-rigid respiratory motion is modeled using voxel-based linear translations, which are estimated using 3D image registration. Our preliminary result shows that the proposed technique could compensate for complex motion across the large field-of-view of 4D MRA and potentially improve the scan efficiency by including more k-space data in the reconstruction.

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784 16:48

Motion-free Abdominal MRI using Manifold Alignment

Xin Chen[1], Muhammad Usman[1], Christian Baumgartner[2], Claudia Prieto[1], and Andrew King[1]

[1]*Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom,* [2]*Biomedical Image Analysis Group, Imperial College, London, United Kingdom*

We present a novel method based on manifold alignment, which enables reconstruction of motion-free abdominal images throughout the respiratory cycle to better capture respiratory intra- and inter-cycle variations. The proposed method was evaluated on both simulated and in-vivo 2D acquisitions. Based on virtual navigator measurement, the reconstructed dynamic sequence achieved Pearson correlation coefficient of 0.9504 with the ground truth of the simulated dataset. The proposed method enables much richer profile data to be used for self-gating, resulting in less blurring when compared to conventional central k-space self-gating method for the in-vivo acquisition.

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785 17:00

Free-Breathing Dynamic MRI with Sliding Slice Distorted Simultaneous Multi-Slice

Kevin M Johnson[1], James H Holmes[2], and Scott B Reeder[1,3,4]

[1]*Medical Physics, University of Wisconsin - Madison, Madison, WI, United States,* [2]*Global MR Applications and Workflow, GE Healthcare, Madison, WI, United States,* [3]*Radiology, University of Wisconsin - Madison, Madison, WI, United States,* [4]*Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States*

Sliding slice MRI is a technique which uses a magnetization prepared sliding 2D slice to cast respiratory motion artifacts as geometric distortions rather than diagnostically obscuring ghosting routinely associated with 3D phase-encoding. In this work, we present the combination of simultaneous-multi-slice with pseudo-random Cartesian based sliding slice sampling. This combination allows increased frame rates, FOV tailoring, and reduces sensitivity to off-resonance compared to past non-Cartesian radial and spiral based approaches. Preliminary results are shown in moving phantoms and in-vivo free breathing DCE, demonstrating very good image quality.

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786 17:12

Five-Dimensional Respiratory and Cardiac Motion Compensation Based on Strongly Undersampled MR Data

Christopher M Rank[1], Sebastian Sauppe[1], Thorsten Heußer[1], Andreas Wetscherek[1], and Marc Kachelrieß[1]

[1]*Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany*

We propose a new method for 5D respiratory and cardiac motion compensation (MoCo), which employs highly undersampled MR data and thus requires acquisition times as low as 2 minutes. Radial MR data of the thorax of three free-breathing patients were acquired. Respiratory and cardiac motion vector fields were estimated allowing for 5D MoCo reconstructions, which employ 100% of the measured raw data for reconstruction of each combination of respiratory and cardiac phase. These 5D MoCo reconstructions clearly resolve different combinations of respiratory and cardiac phases while achieving high temporal and spatial resolution as well as low noise and artifact levels.

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787 17:24

Respiratory and Cardiac Dual Soft-Gated 4D Cardiovascular MRI

Ziwu Zhou[1], Fei Han[1], Takegawa Yoshida[1], Kim-Lien Nguyen[1], Paul Finn[1], and Peng Hu[1]

[1]*Radiological Sciences, University of California, Los Angeles, Los Angeles, CA, United States*

In this study, we proposed a respiratory and cardiac dual soft-gated technique that efficiently suppresses respiratory motion and resolves cardiac motion in 4D cardiovascular MRI. Comparing with existing methods that exploited data redundancy in respiratory and cardiac dimensions using joint reconstruction, proposed method weights data consistency according to the degree of motion corruption. A big advantage of this approach is its short reconstruction time and low computation burden, making it feasible for practical usage.

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788 17:36

summa cum laude

Quantification and Artifact Reduction from Simple Modeling of DESS Signals

Bragi Sveinsson[1], Garry Gold[1], and Brian Hargreaves[1]

[1]*Stanford University, Stanford, CA, United States*

The double-echo in steady-state (DESS) sequence offers both 3D anatomical imaging and 3D quantitative mapping (SNR-efficient 3D maps of T2 and apparent diffusion coefficent) in various applications, such as breast imaging or knee cartilage imaging. The complicated signal behavior remains a challenge for quantitative imaging, and strong spoiling can lead to motion artifacts. Here, we introduce

simplified methods for modeling DESS signals, enabling more accurate T2 measurements and better motion artifact reduction.

789 17:48 Fully self-gated motion compensated cine reconstruction from free-breathing ungated 2D radial cardiac MRI data

André Fischer[1,2], Anne Menini[1], Aurelien Bustin[1,3], Kevin M Johnson[4], Christopher J Francois[5], and Anja C.S. Brau[2]

[1]GE Global Research, Garching bei München, Germany, [2]Cardiac Center of Excellence, GE Healthcare, Garching bei München, Germany, [3]Computer Science, Technical University Munich, München, Germany, [4]Medical Physics, University of Wisconsin, Madison, WI, United States, [5]Radiology, University of Wisconsin, Madison, WI, United States

Cardiac MRI is affected by both cardiac and respiratory motion. While ECG-gated imaging in breath hold is the clinical method of choice, free-breathing methods are needed in patients with limited breath hold capability. This works describes a method to obtain free-breathing cine datasets with high SNR and high spatial resolution (1.4mm in-plane) from a completely self-gated Golden Angle radial scan within an 11s scan time. The motion compensated reconstruction technique takes advantage of calibrated displacement fields extracted from the radial data to recover motion artifact-free cardiac phases. Beyond cine imaging, contrast-enhanced cardiac imaging can also be expected to benefit from this motion compensated reconstruction strategy.

Educational Course

Wrist Imaging

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 13:30 - 15:30 *Moderators:*Richard Kijowski & Catherine Petchprapa

13:30 Update on MRI Techniques for Assesment of the Wrist

Kimberly Amrami[1]

[1]Mayo Clinic

14:00 MRI of Traumatic Injuries of the Wrist

Karen Chi-Lynn Chen[1]

[1]Radiology, Veterans Administration San Diego Healthcare System/University of California San Diego, San Diego, CA, United States

This presentation is a brief overview of the magnetic resonance imaging appearance of wrist fractures and their complications. The diagnostic criteria for avascular necrosis and advanced imaging techniques will be discussed.

14:30 INSTABILITY

Catherine Petchprapa

Carpal (wrist) stability is dependent on static and dynamic stabilizers. Injury to these structures can result in carpal instability. The wrist is clinically considered unstable if there is symptomatic carpal malalignment, if it is unable to bear physiologic load and is found to be kinematically abnormal. Carpal instability encompasses a wide range of pathologies with varying clinical presentations, which can sometimes make clinical diagnosis challenging. Diagnostic imaging, particularly magnetic resonance (MR) imaging, plays an important role in the evaluation of the patient with suspected carpal instability, and is most successful in doing so when imaging is optimized and the interpreting radiologist is familiar with the complex anatomy and pathologic findings seen on imaging.

15:00 Wrist MRI - Inflammatory

James Teh

This lecture outlines the role of MRI in inflammatory conditions of the wrist. The imaging technique and findings are presented. Recommendations are made for the appropriate use of MRI in inflammatory arthritis.

15:30 Adjournment & Meet the Teachers

Educational Course

Traumatic Brain Injury

Organizers: Jeffrey Neil, M.D., Ph.D. & Greg Zaharachuk, M.D., Ph.D.

Nicoll 2 13:30 - 15:30 *Moderators:*Robert Mckinstry

13:30 "TBI: Susceptibility-weighted Imaging"

Karen Tong[1]

[1]*Radiology, Loma Linda University Medical Center, Loma Linda, CA, United States*

SWI is extremely sensitive for detecting small TBI-related hemorrhages (usually missed by CT or conventional MRI) which can be quite extensive or located in critical brain regions, and can serve as biomarkers of injury or help predict neurologic and neuropsychological outcomes. Quantitative susceptibility mapping can also provide additional information such as measuring iron deposition after chronic TBI, or quantify lesions for comparison or follow-up. SWI is most useful in moderate and severe TBI assessment, as microhemorrhages are less often found in mild TBI, in which case other advanced imaging modalities may be more helpful.

14:00 TBI: Diffusion Tensor Imaging
Michael L Lipton[1]

[1]*The Gruss Magnetic Resonance Research Center, Albert Einstein College of Medicine and Montefiore Medical Center, Bronx, NY, United States*

14:30 TBI: Resting-State Functional MRI
Christopher T. Whitlow[1]

[1]*Radiology and Biomedical Engineering, Wake Forest School of Medicine, Winston-Salem, NC, United States*

15:00 Pediatric TBI and Sports-Related Concussion: Common Data Elements (CDEs) to Inform Diagnosis, Neuroimaging, and Outcome Metrics.
Christopher G G Filippi[1]

[1]*Radiology, Hofstra North Shore-LIJ School of Medicine, Manhasset, NY, United States*

Demonstrating gaps in current knowledge and research in mild traumatic brain injury and sports-related concussion that are opportunities for new research endeavors and providing links to essential resources advocated by the National Institutes of Health, termed Common Data Elements (CDEs), for research in mTBI that attempt to standardize clinical data acquisition, data collection, neuroimaging, and outcome metrics to enable better comparison of research studies and multicenter collaboration.

15:30 Adjournment & Meet the Teachers

Educational Course

Quantitative Imaging of Cancer

*Organizers:*Linda Moy, M.D. & Valeria Panebianco, M.D.

Nicoll 3 13:30 - 15:30 *Moderators:*Hua Guo & Valeria Panebianco

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13:30 Quantitative Imaging of Metastatic Kidney Cancer
Laure Fournier[1], Alexandre Bellucci[1], Yann Vano[2], Daniel Balvay[3], Stephane Oudard[2], and Charles Andre Cuenod[1]

[1]*Radiology, Hopital Europeen Georges Pompidou, Paris, France,* [2]*Medical Oncology, Hopital Europeen Georges Pompidou, Paris, France,* [3]*Team 2, INSERM U470, Paris, France*

Current treatment of metastatic renal cell carcinoma relies on anti-angiogenic drugs, used successively, to prolong patient survival. Functional imaging accompanied anti-angiogenic drug development by helping elicit biological mechanisms, and developing biomarkers of tumour response. Remaining challenges include understanding drug escape mechanisms and toxicities of anti-angiogenic drugs, as well as accompanying clinical trials using new immunotherapies.

14:00 MR Imaging biomarkers in assessing response to therapy of rectal cancer
Andrea Laghi

Neoadjuvant chemo-radiotherapy (CRT) has become the standard treatment for locally advanced rectal cancer. In order to define the best therapeutic strategy following CRT, either extended surgery (Total Mesorectal Excision, TME), low-invasive transanal endoscopic microsurgery (TEM) or wait-and-watch strategy, an accurate assessment of tumor response to therapy is mandatory. Currently, MR is the modality of choice in assessing response to therapy. However, conventional morphological imaging methods are not accurate enough, particularly in evaluating complete response. Quantitative imaging biomarkers are under evaluation, with some of them showing preliminary interesting results, namely diffusion-weighted imaging, texture analysis and perfusion MR.

14:30 A Practical Approach to MRI of Female Pelvic Masses
Katja Pinker-Domenig[1]

[1]*Dept. of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria*

Female pelvic masses comprise a broad spectrum of benign and malignant tumors and conditions that often pose a diagnostic challenge. A systematic evaluation that integrates the clinical and surgical history and multiparametric magnetic resonance imaging (MRI) to identify the anatomic origin, morphologic features, and tissue composition of a female pelvic mass helps to establish a short, meaningful differential diagnosis or, often, even a definitive diagnosis. This presentation aims to review the standard female pelvic based on the indications and provide a practical approach to MRI of female pelvic masses.

15:00 Pediatric Brain
Benjamin Cohen[1]

[1]*NYU Langone Medical Center*

In conjunction with conventional sequences, advanced/quantitative MR imaging techniques can refine differential diagnostic considerations, suggest tumor grade, propose targets for stereotactic biopsy, and monitor response to therapy for pediatric brain neoplasms.

15:30 Adjournment & Meet the Teachers

Focused Discussion Session

Focused Discussion Session: Frontiers of Diffusion

Summit 2 16:00 - 18:00 *Moderators:*Alexander Leemans & Daniel Alexander

790 16:00 False positive bundles in tractography
Maxime Descoteaux[1], Jasmeen Sidhu[1], Eleftherios Garyfallidis[1], Jean-Christophe Houde[1], Peter Neher[2], Bram Stieltjes[3], and Klaus H. Maier-Hein[2]

[1]*Computer Science, Université de Sherbrooke, Sherbrooke, QC, Canada,* [2]*German Cancer Research Center, Heindeberg, Germany,* [3]*Basel University, Basel University Hospital, Switzerland*

This work provides novel insights in false positive bundles produced by tractography using a highly realistic diffusion MRI phantom with known underlying white matter ground truth anatomy. This MRI phantom was used in the ISMRM 2015 Tractography Challenge. We show that regardless of the tractography pipeline used, many invalid bundles with dense and meaningful structures are found in the tractograms.

791 16:20 Mapping the brain's "Sheet Probability Index" (SPI) with diffusion MRI: Sheet happens?!
magna cum laude
Chantal Tax[1,2], Tom Dela Haije[3], Andrea Fuster[3], Carl-Fredrik Westin[2], Max A. Viergever[1], Luc Florack[3], and Alexander Leemans[1]

[1]*Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands,* [2]*Department of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States,* [3]*Mathematics and Computer Science, Eindhoven University of Technology, Eindhoven, Netherlands*

The prevalence of sheet structure in the brain has been a debated issue since its proposal. This structure can be analyzed by means of the Lie bracket, which can be derived from diffusion MRI (dMRI) data. Due to the occurrence of noise, however, it is difficult to quantify to what degree the local structure effectively resembles a sheet. In this work, we propose a new and robust local measure based on the Lie bracket that can be interpreted as the sheet probability index (SPI).

792 16:40 To be Dispersed or Not to be Dispersed: A Study Using HCP Data
Aurobrata Ghosh[1], Daniel C Alexander[1], and Hui Zhang[1]

[1]*Centre for Medical Image Computing, University College London, London, United Kingdom*

We conduct model comparison experiments on the widely available HCP dataset to assess the importance of fibre-dispersion when modelling the brain's tissue-microstructure from diffusion MRI (dMRI). Although many fibre dispersion configurations have been identified in the brain, most dMRI methods only model parallel or crossing fibres. To highlight the importance of dispersion, we design k-fold cross-validation experiments, on two HCP subjects, and compare ten compartment-based models using three metrics. We find that up to 50% of the brain-voxels, including white matter regions, support dispersion models over crossing models. Hence we conclude that it is important to model dispersion in dMRI.

793 17:00 Challenges in solving the two-compartment free-water diffusion MRI model
Ørjan Bergmann[1,2], Carl-Fredrik Westin[1], and Ofer Pasternak[1]

[1]*Dept of Radiology, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, United States,* [2]*Norwegian Competency Center for MS, Haukeland University Hospital, Bergen, Norway*

In this work we explore the solution space of the two-compartment free-water problem under different noise levels. Based on the shape of the solution space we show that solving this model in an intuitive and straightforward manner may result in solutions which are sensitive to noise, and that are biased towards neglecting the free-water component. Although multi-shell techniques improve the situation we show that more advanced methods are required to further stabilize the solution.

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794 17:20

magna cum laude

Quantification of demyelination and remyelination with diffusion MRI: specific in vivo White Matter Tract Integrity metrics agree with electron microscopy-derived features

Ileana O Jelescu[1], Magdalena Zurek[1], Kerryanne V Winters[1], Jelle Veraart[1], Anjali Rajaratnam[1], Nathanael S Kim[1], James S Babb[1], Timothy M Shepherd[1], Dmitry S Novikov[1], Sungheon G Kim[1], and Els Fieremans[1]

[1]*Center for Biomedical Imaging, Radiology, New York University School of Medicine, New York, NY, United States*

White Matter Tract Integrity (WMTI) metrics derived from diffusion data provide a compartment-specific characterization of white matter. Here, we evaluated the specificity of the axonal water fraction (AWF) and extra-axonal radial diffusivity ($D_{e,\perp}$) by assessing their correlations to metrics derived from electron microscopy (EM), in the splenium of control, cuprizone-treated and recovering mice. As the model predicted, the WMTI-derived AWF correlated very strongly with the EM-derived AWF, but not with the *g*-ratio, while $D_{e,\perp}$ correlated with the *g*-ratio, but not with the EM-derived AWF. WMTI parameters are therefore promising biomarkers for specific biophysical aspects of white matter pathology *in vivo*.

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795 17:40

summa cum laude

Exploring fibre orientation dispersion in the corpus callosum: Comparison of Diffusion MRI, Polarized Light Imaging and Histology

Jeroen Mollink[1,2], Michiel Kleinnijenhuis[1], Stamatios N Sotiropoulos[1], Michiel Cottaar[1], Anne-Marie van Cappellen van Walsum[2], Menuka Pallebage Gamarallage[3], Olaf Ansorge[3], Saad Jbabdi[1], and Karla L Miller[1]

[1]*FMRIB centre, University of Oxford, Oxford, United Kingdom,* [2]*Donders Institute for Brain, Cognition and Behaviour, Department of Anatomy, Radboud University Medical Centre, Nijmegen, Netherlands,* [3]*Department of Neuropathology, University of Oxford, Oxford, United Kingdom*

In this study we explored fibre orientation dispersion in the corpus callosum using diffusion-weighted MRI, Polarized Light Imaging and Histology. Microscopic fibre orientations were derived from Polarized Light Imaging and histological myelin and glial cell staining, with the aim of understanding the microstructural features that correlate with the diffusion signal.

Educational Course

Clinical Implications of the MRI Phenotype in Oncology

*Organizers:*Lorenzo Mannelli, M.D., Ph.D, Ivan Pedrosa, M.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 1 16:00 - 18:00 *Moderators:*Richard Do & Takeshi Yokoo

16:00

Approach to Cystic Pancreatic Neoplasms using MRI Phenotype

Aarti Sekhar[1]

[1]*Radiology, Emory University, Atlanta, GA, United States*

Approach to Cystic Pancreatic Neoplasms using MRI Phenotype. Radiologists are only approximately 60% accurate in providing the correct diagnosis of cystic pancreatic neoplasms pre-operatively. This image rich talk will cover the typical and atypical MRI characteristics for the seven most common cystic pancreatic neoplasms (IPMN, mucinous cystic neoplasm, serous cystadenoma, pseudocyst, cystic neuroendocrine tumor, necrotic adenocarcinoma and solid pseudopapillary tumors), and emphasize distinct MRI features that can help narrow the differential diagnosis. Useful clinical information, such as patient history and demographics will be covered. Common pitfalls will also be discussed.

16:30

Hepatocellular Carcinoma

Mi-Suk Park[1]

[1]*Diagnostic Radiology, Severance hospital/Yonsei University, Seoul, Korea, Republic of*

Several studies reveal a large number of MRI phenotypes related to the biologic behavior of hepatocellular carcinoma (HCC). Hemodynamic change-related, peri-tumoral change-related, hepatocyte-related, and diffusion-related phenotypes. In this talk, I will touch on various MRI features of HCC and their implications for the diagnosis and prognosis as imaging biomarkers.

17:00

Renal Cell Carcinoma

Mike Notohamiprodjo[1]

[1]*Universitätsklinikum Tübingen*

17:30

Rectal Cancer: Clinical Implications of the MRI Phenotype in Oncology

Stephanie Nougaret[1]

[1]CHU Montpellier

1) To propose a step-by-step approach for standardized MRI staging of pre-treatment rectal carcinoma using the mnemonic "DISTANCE".

2) To become familiar with the different treatment strategies and organ preservation in rectal cancer.

3) To know the performance of modern MRI for the prediction of treatment response.

4) To learn how to evaluate response after chemoradiotherapy and understand how MRI findings may alter surgical approach and affect the likelihood of local and distant recurrence.

18:00 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Regional Function & Cardiac Tissue Characterisation

*Organizers:*Jeanette Schulz-Menger, M.D. & Martin Graves, Ph.D.

Nicoll 2 16:00 - 18:00 *Moderators:*Daniel Ennis & Bernd Wintersperger

16:00 Tissue Phase Mapping & more: new Insights into Regional Cardiac Function

Bernd Jung[1]

[1]University Hospital Bern

The purpose of this talk is the presentation of an overview of the different MRI approaches to measure regional cardiac function. Such methods go beyond the routinely used standard CINE images (providing global functional parameters such as ventricular volumes) and include myocardial tagging, DENSE, SENC and Tissue Phase Mapping. The latter technique measures myocadial velocities and will be discussed in somewhat more detail. Some recent studies are presented also including the determination of strain values from velocity data. Finally, feature tracking based on SSFP CINE images is illustrated which can also be used to determine strain values.

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796 16:30 Associations between Inflammatory Markers and Global Systolic Function Measured by MRI: The Multi-Ethnic Study of Atherosclerosis (MESA)

Amir Ali Rahsepar[1], Mohammadali Habibi[2], Cheeling Chan[3], Nadine kawel[2], Kiang Liu[3], Joao Lima[2], and James Carr[1]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Cardiology, Johns Hopkins University, Baltimore, MD, United States, [3]Preventive medicine, Northwestern University, Chicago, IL, United States

In this cross-sectional study, we investigated the associations between Inflammatory markers and global systolic function measured by MRI in The Multi-Ethnic Study of Atherosclerosis (MESA).

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797 16:42 Potential application of tissue phase mapping in early detection of heart function deficiency in Fabry disease with cardiac manifestation

Yi-Ting Wu[1], Hsu-Hsia Peng[2], Meng-Chu Chang[2], Ming-Ting Wu[3], and Hsiao-Wen Chung[1]

[1]Graduate Institute of Biomedical Electronics and Bioinformatics, Taipei, Taiwan, [2]Department of Biomedical Engineering and Environmental Sciences, National Tsing Hua University, Hsinchu, Taiwan, [3]Department of Radiology, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan

Fabry disease is an X chromosome-linked genetic disease that can lead to cardiac dysfunction later in life. For early detection of heart function deficiency, velocity information in the myocardium obtained in a cardiac cycle using MR tissue phase mapping (TPM) can potentially provide a preclinical diagnosis of Fabry cardiomyopathy. Regional MR TPM analysis was performed on 7 Fabry disease patients and 22 healthy subjects. Preliminary results demonstrated significantly delayed time course as well as decreased velocity amplitudes in myocardial contractions in the patients. MR TPM may find useful value in early detection of myocardial defects.

16:54 Innovations in Cardiac Tissue Characterization

Sonia Nielles-Vallespin[1,2], Pedro Ferreira[2], Ranil de Silva[2], Andrew D Scott[2], Philip Kilner[2], Daniel Ennis[3], Eric Aliotta[3], Peter Kellman[1], Dimitru Mazilu[1], Robert S Balaban[1], Dudley J Pennell[2], David N Firmin[2], and Andrew E Arai[1]

[1]National Institutes of Health, MD, United States, [2]Imperial College of London, Royal Brompton Hospital, London, United Kingdom, [3]University of California, CA, United States

This study shows that helical and laminar microstructures in the myocardium and their dynamic reorientations during cardiac contraction can be studied by in vivo cDTI non-invasively and non- destructively. Furthermore, it demonstrates in the loaded and beating heart in vivo that sheetlet reorientation is the predominant mechanism underlying myocardial LV wall thickening during systolic contraction. Further study of the microstructural dynamics of cardiac contraction and myocardial dysfunction with in vivo cDTI may

produce new diagnostic and prognostic information in human cardiac disease.

798 17:24

Free-breathing Diffusion Tensor Imaging of the In Vivo Human Heart - Stimulated Echo vs. Spin Echo Acquisition
Constantin von Deuster[1,2], Christian T. Stoeck[1,2], Martin Genet[2], David Atkinson[3], and Sebastian Kozerke[1,2]

[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [3]Centre for Medical Imaging, University College London, London, United Kingdom

In vivo cardiac Diffusion Tensor Imaging (DTI) using the Stimulated Echo Acquisition Mode (STEAM) is particularly challenging during free breathing acquisition. To address this limitation, spin echo (SE) sequences employing motion-compensated diffusion gradients may be used. In this work, scan time, SNR efficiency and diffusion tensor metrics are compared between the STEAM method and a second-order motion compensated SE approach. For SE, SNR and gating efficiency were increased by 2.65 and 29% relative to STEAM, respectively. It is concluded that the SE method is an attractive alternative to STEAM based approaches for in vivo free-breathing cardiac DTI.

799 17:36

Characterization of Myocardial Fiber Orientation to Assess Therapeutic Exosomes from Cardiosphere-derived Cells (CDCs) in Myocardial Infarcted Porcine with In Vivo Diffusion-Tensor CMR on a Clinical Scanner
Christopher Nguyen[1], James Dawkins[2], Xiaoming Bi[3], Debiao Li[1,4], and Eduardo Marban[2]

[1]Biomedical Imaging Research Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [3]Siemens Healthcare, Los Angeles, CA, United States, [4]Bioengineering, University of California Los Angeles, Los Angeles, CA, United States

Diffusion-Tensor cardiovascular magnetic resonance (DT-CMR) is capable of mapping myocardial fiber orientation. In myocardial infarction (MI) murine models, DT-CMR can identify the effects of stem cell therapy on myocardial fiber orientations. The study illustrated the powerful potential of DT-CMR in identifying adverse treatment despite successful delivery of viable stem cells. However, it remains to be seen if this recent work is translatable to large animal and clinical studies. In a MI porcine model, in vivo DT-CMR revealed that myocardial fiber orientation was preserved with CDC-derived exosome treatment and adversely changed with placebo treatment consistent with observed viability and function changes.

800 17:48

Resolving Microscopic Fractional Anisotropy in the Heart
Irvin Teh[1], Henrik Lundell[2], Hannah J Whittington[1], Tim Bjørn Dyrby[2], and Jürgen E Schneider[1]

[1]Division of Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [2]Danish Research Centre for Magnetic Resonance, Copenhagen University Hospital Hvidovre, Copenhagen, Denmark

Diffusion tensor imaging (DTI) is widely used for structural characterization of the heart. However, the measured fractional anisotropy (FA) is influenced by diffusion anisotropy as well as orientation dispersion. In the heart, orientation dispersion is ubiquitous and stems from the transmural variation in cardiomyocyte orientation and regions where multiple cell populations intersect. We propose microscopic FA (μFA) as a more robust measure of intrinsic diffusion anisotropy that is insensitive to orientation dispersion, and demonstrate this with simulations and ex vivo MRI.

18:00 Adjournment & Meet the Teachers

Educational Course

MR Physics & Techniques for Clinicians

*Organizers:*Marcus T. Alley, Ph.D., Brian Hargreaves, Ph.D., Michael Markl, Ph.D., Bernd Jung, Ph.D. & Nicole Seiberlich, Ph.D.

Nicoll 3 16:00 - 18:00 *Moderators:*Brian Hargreaves

16:00

Ultrafast Imaging
Mariya Doneva[1]

[1]Philips Research, Germany

16:40

Parallel Imaging
Katherine Wright[1]

[1]Case Western Reserve University

The main objective of this presentation will be to provide an overview of parallel imaging techniques and how these methods can be best used in the clinical environment. This will include an overview of accelerated data acquisition and the resulting aliasing artifacts, and will continue to describe how coil sensitivities and parallel imaging reconstruction methods can be used to reconstruct undersampled data. Importantly, there will also be a brief review of clinical applications of parallel imaging.

17:20 Diffusion & Perfusion Weighted Imaging
Matthias Weigel[1]

[1]*Radiological Physics, Dept. of Radiology, University Hospital Basel, Basel, Switzerland*

This lecture will explain the two important and popular imaging concepts of diffusion weighted imaging (DWI) and perfusion weighted imaging (PWI). The underlying physics and fundamental properties will be explained in a pictorial way (with only a few easy mathematical equations that may be important to recognize or use). The clinical significance and potentials of the two methods are also discussed. At last, DWI and PWI are combined to establish the so-called diffusion-perfusion-mismatch-concept in (acute) ischemic stroke.

18:00 Adjournment & Meet the Teachers

Corporate Symposium

Gold Corporate Symposium: Siemens Healthcare GmbH

Plenary Hall 12:15 - 13:15

Other

ISMRM Business Meeting

Room 312 18:15 - 19:15

Thursday, May 12, 2016

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Sunrise Session

Multiparametric Assessment of Cancer

*Organizers:*Guanshu Liu, Ph.D. & Mark D. Pagel, Ph.D.

Room 300-302 7:00 - 7:50 *Moderators:*Julio Cardenas

Characterization of Tumors with DCE-MRI
Wei Huang

Multiparametric Classification of Tumors
Julio Cárdenas-Rodríguez

Adjournment & Meet the Teachers

Sunrise Session

High-Throughput: The 5 Minute MR Scan

*Organizers:*Garry E. Gold, M.D. & Joshua D. Trzasko, Ph.D.

Room 324-326 7:00 - 7:50 *Moderators:*Joshua Trzasko

Breast Imaging
Christiane Kuhl

High-Throughput: The 5 Minute MR Scan: Musculoskeletal
Edwin Oei

Adjournment & Meet the Teachers

Sunrise Session

Addressing Clinical Challenges in the Body with MRI: Maternal & Fetal Evaluation

Organizers: Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Room 331-332 | 7:00 - 7:50 | *Moderators:*Kathryn Fowler & Manjiri Dighe

MRI in Pregnancy: Practical Considerations & Indications
Manjiri Dighe

Fetal Anomalies in the Body
Gabriele Masselli

Adjournment & Meet the Teachers

Sunrise Session

Demyelinating Diseases

*Organizers:*Andrew Alexander, Ph.D. & Jennifer A McNab, Ph.D.

Room 334-336 | 7:00 - 7:50 | *Moderators:*Julien Cohen-Adad & Claudia Gandini Wheeler-Kingshott

MRI of Brain Demyelination
Roland Henry

MRI of Spinal Cord Demyelination
Daniel Reich

Adjournment & Meet the Teachers

Sunrise Session

Interventional MRI: Oncology & Neuro

*Organizers:*Michael S. Hansen, Ph.D. & Viola Rieke, Ph.D.

Summit 1 | 7:00 - 7:50 | *Moderators:*Michael Hansen

Oncology & Biopsies : A Story in Prostate Cancer
Cynthia Ménard

Neuro Applications
Karl Vigen

Adjournment & Meet the Teachers

Sunrise Session

Beyond Traditional Brain Quantitative Metrics

*Organizers:*Thomas K. F. Foo, Ph.D. & Ek Tsoon Tan, Ph.D.

Summit 2 | 7:00 - 7:50 | *Moderators:*Nikola Stikov & Ek Tan

Advanced Brain Quantitative Metrics -- Description, Overview & Method
Dmitry Novikov

Advanced Brain Quantitative Metrics - Clinical Potential & Relevance
Peter Basser

Adjournment & Meet the Teachers

Sunrise Session

Artefacts in Cardiovascular MR

*Organizers:*Thomas K. F. Foo, Ph.D. & Harald Kramer, M.D.

Nicoll 1 | 7:00 - 7:50 | *Moderators:*Thomas Foo & Michael Ingrisch

Artifacts in CMR
Pedro Ferreira

Artifacts in MRA
Stanislas Rapacchi

Adjournment & Meet the Teachers

Sunrise Session

Metal Related Artefacts: Imaging Techniques & Challenges

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 2 | 7:00 - 7:50 | *Moderators:*Jiang Du & Matthew Koff

Imaging Techniques & Challenges
Bragi Sveinsson

Metal Related Artifacts: Imaging Techniques and Challenges
Alissa Burge

Adjournment & Meet the Teachers

Sunrise Session

Controversies in Diffusion & Functional MRI

*Organizers:*Daniel C. Alexander, Ph.D., Jay J. Pillai, M.D. & Jonathan R. Polimeni, Ph.D.

Nicoll 3 | 7:00 - 7:50 | *Moderators:*Jonathan Polimeni

Uncovering Hidden Activation Using Model-Free Analysis
Javier Gonzalez Castillo

Prospects for "bloodless fMRI"
Mukund Balasubramanian

Adjournment & Meet the Teachers

Plenary Session

Lauterbur Lecture

Plenary Hall | 8:15 - 9:00

Lauterbur Lecture - Label-Free Molecular Imaging: A Story of Lauterbur, Spins and Sparse Sampling
Zhi-Pei Liang[1]

[1]*Electrical and Computer Engineering, University of Illinois at Urbana-Champaign, Urbana, IL, United States*
Zhi-Pei Liang

Plenary Session

Imaging of Metabolism & Metabolic Diseases

*Organizers:*Mark D. Pagel, Ph.D.

Plenary Hall 9:00 - 10:00 *Moderators:*Jeff Bulte & Maren Laughlin

Molecular & Cellular Imaging of Diabetes
Anna Moore
Anna Moore

MR of Lipids in Biological Processes & Disease States
Chris Boesch[1]

[1]*University Bern, Switzerland*
Chris Boesch

MR of bioenergetics in metabolic diseases: a focus on the Asian phenotype
Patrick J. Cozzone[1]

[1]*Singapore Bioimaging Consortium, ASTAR*
Patrick Cozzone

Adjournment

Traditional Poster : Cancer

Exhibition Hall 10:30 - 12:30 *(no CME credit)*

Traditional Poster : Cancer

Exhibition Hall 10:30 - 12:30 *(no CME credit)*

Electronic Poster : Acquisition, Reconstruction & Analysis

Exhibition Hall 10:30 - 11:30 *(no CME credit)*

Study Groups

White Matter

Hall 405 E 10:30 - 12:30

Study Groups

Electro-Magnetic Tissue Properties (SWI)

Hall 406 D 10:30 - 12:30

Power Pitch

Contrast Mechanisms: Novel Imaging Biomarkers

Power Pitch Theatre, Exhibition Hall 10:30 - 11:30 *Moderators:*Jiadi Xu & Karin Markenroth Bloch

801 10:30 Antibody Therapy Against Tau Pathology Improves Neuronal Transport as Assessed In Vivo by Tract-Tracing Manganese-Enhanced MRI
Maria F Baron[1], Hameetha Banu Rajamohamed Sait[2], Wajitha J RajaMohamed Sait [2], D Minh Hoang[1], Einar M Sigurdsson[2,3], and Youssef Z Wadghiri[1]

[1]Radiology, Center for Advanced Imaging Innovation & Research (CAI2R) and Bernard and Irene Schwartz Center for Biomedical Imaging, NYU School of Medicine, New York, NY, United States, [2]Neuroscience and Physiology, NYU School of Medicine, New York, NY, United States, [3]Psychiatry, NYU School of Medicine, New York, NY, United States

802 10:33 In-vivo measurement of a new source of tissue contrast, the dipolar relaxation time,T_{1D}, using a modified ihMT sequence
Gopal Varma[1], Valentin H Prevost[2], Olivier M Girard[2], Guillaume Duhamel[2], and David C Alsop[1]

[1]Radiology, Division of MR Research, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, United States, [2]CRMBM-CEMEREM UMR 7339, CNRS-AMU, Aix Marseille Université, Marseille, France

803 10:36

Imaging Reactive Oxygen Species (ROS) using CEST MRI

Rong-Wen Tain[1,2], Alessandro Scotti[2,3], Weiguo Li[4,5], Xiaohong Joe Zhou[1,2,3,6], and Kejia Cai[1,2,3]

[1]Radiology, College of Medicine, University of Illinois, Chicago, IL, United States, [2]3T Research Program, Center for MR Research, College of Medicine, University of Illinois, Chicago, IL, United States, [3]Bioengineering, College of Engineering, University of Illinois, Chicago, IL, United States, [4]Research Resource Center, University of Illinois, Chicago, IL, United States, [5]Radiology, Northwestern University, Chicago, IL, United States, [6]Neurosurgery, College of Medicine, University of Illinois, Chicago, IL, United States

804 10:39

A new NOE-mediated MT signal at -1.6 ppm for detecting ischemic stroke in rat brain

Xiaoyong Zhang[1,2], Feng Wang[1,2], Aqeela Afzail[3], John C. Gore[1,2], Daniel F Gochberg[1,2], and Zhongliang Zu[1,2]

[1]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [2]Depatment of Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [3]Department of Neurological Surgery, Vanderbilt University, Nashville, TN, United States

805 10:42

summa cum laude

3D Amide-Proton-Transfer-Weighted (APTw) Image-Guided Stereotactic Biopsy in Patients with Newly Diagnosed Gliomas

Shanshan Jiang[1,2], Jaishri Blakeley[3], Charles Eberhart[4], Yi Zhang[1], Hye-Young Heo[1], Zhibo Wen[2], Lindsay Blair[3], Huamin Qin [4], Michael Lim[5], Alfredo Quinones-Hinojosa[5], Dong-Hoon Lee[1], Xuna Zhao[1], Peter C.M. van Zijl[1], and Jinyuan Zhou[1]

[1]Department of Radiology, Johns Hopkins University, Baltimore, MD, United States, [2]Department of Radiology, Southern Medical University Zhujiang Hospital, Guangzhou, China, People's Republic of, [3]Department of Neurology, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Pathology, Johns Hopkins University, Baltimore, MD, United States, [5]Department of Neurosurgery, Johns Hopkins University, Baltimore, MD, United States

806 10:45

Magnetic resonance imaging biomarkers for assessment of vascular pathologies in gliomas

Andreas Stadlbauer[1], Max Zimmermann[1], Karl Rössler[1], Stefan Oberndorfer[2], Arnd Dörfler[3], Michael Buchfelder[1], and Gertraud Heinz[4]

[1]Department of Neurosurgery, University of Erlangen, Erlangen, Germany, [2]Department of Neurology, University Clinic of St. Pölten, St. Pölten, Austria, [3]Department of Neuroradiology, University of Erlangen, Erlangen, Germany, [4]Department of Radiology, University Clinic of St. Pölten, St. Pölten, Austria

807 10:48

magna cum laude

Multi-parametric estimation of brain hemodynamics with Fingerprinting ASL

Pan Su[1,2], Deng Mao[1,2], Peiying Liu[1], Yang Li[1,2], Ye Qiao[1], and Hanzhang Lu[1]

[1]Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, Baltimore, MD, United States, [2]Graduate School of Biomedical Sciences, The University of Texas Southwestern Medical Center, Dallas, TX, United States

808 10:51

magna cum laude

Transit time mapping in the mouse brain using time-encoded pCASL

Lydiane Hirschler[1,2,3], Leon P. Munting[4,5], Wouter M. Teeuwisse[4], Ernst Suidgeest[4], Jan M. Warnking[1,2], Matthias J. P. van Osch[4], Emmanuel L. Barbier[1,2], and Louise van der Weerd[4,5]

[1]Grenoble Institut des Neurosciences, Université Grenoble Alpes, Grenoble, France, [2]Inserm U836, Grenoble, France, [3]Bruker Biospin, Ettlingen, Germany, [4]Radiology, Leiden University Medical Center, Leiden, Netherlands, [5]Human Genetics, Leiden University Medical Center, Leiden, Netherlands

809 10:54

Measuring Subtle Leakage in Patients with Cerebrovascular Disease Using Dual Temporal Resolution DCE-MRI: Is it Reproducible?

Sau May Wong[1], Jacobus F.A. Jansen[1], C. Eleana Zhang[2], Julie Staals[2], Paul A.M. Hofman[1], Joachim E. Wildberger[1], Robert J. van Oostenbrugge[2], Cécile R.L.P.N. Jeukens[1], and Walter H. Backes[1]

[1]Radiology & Nuclear Medicine, Maastricht University Medical Centre, Maastricht, Netherlands, [2]Neurology, Maastricht University Medical Centre, Maastricht, Netherlands

810 10:57

magna cum laude

Modeling demyelination in white matter: the effect of realistic geometries on the susceptibility-weighted MR signal.

Tianyou Xu[1], Way Cherng Chen[2], Michiel Kleinnijenhuis[1], Sean Foxley[1], and Karla L Miller[1]

[1]University of Oxford, Oxford, United Kingdom, [2]Singapore Bioimaging Consortium, Singapore, Singapore

811 11:00

Thalamic nuclei-specific deposits of iron and calcium in the epileptogenic rat brain revealed by quantitative susceptibility mapping

Manisha Aggarwal[1], Xu Li[2], Peter C van Zijl[2], Olli Gröhn[3], and Alejandra Sierra[3]

[1]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F. M. Kirby Research Center, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Department of Neurobiology, A. I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland

812 11:03

Functional Quantitative Susceptibility Mapping at 7-Tesla: Resolving Neuronal Activation Localized in Grey-Matter
Pinar Senay Özbay[1,2], Lars Kasper[2], Klaas Paul Pruessmann[2], and Daniel Nanz[1]

[1]Department of Radiology, University Hospital Zurich, Zurich, Switzerland, [2]Institute of Biomedical Engineering, ETH Zurich, Zurich, Switzerland

813 11:06

Assessing the (ani)sotropic component of R2 as a mean of studying White Matter properties
Rita Gil[1], Diana Khabipova[1,2], Marcel Zwiers[1], Tom Hilbert[3,4,5], Tobias Kober[3,4,5], and José P. Marques[1]

[1]Donders Institute, Radboud University, Nijmegen, Netherlands, [2]Centre d'Imagerie BioMédicale, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland, [3]Advanced Clinical Imaging Technology (HC CMEA SUI DI BM PI), Siemens Healthcare AG, Lausanne, Switzerland, [4]Department of Radiology, University Hospital (CHUV), Lausanne, Switzerland, [5]LTS5, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

814 11:09

IN VIVO HYPERCEST DETECTION OF CUCURBIT[6]URIL IN RAT ABDOMEN
Francis Hane[1], Tao Li[1], Peter Smylie[1], and Mitchell S Albert[1]

[1]Lakehead University, Thunder Bay, ON, Canada

815 11:12

Hyperpolarized saline for contrast-enhanced MR at Ultra-Low field
Najat Salameh[1,2,3], Mathieu Sarracanie[1,2,3], Loyd Waites[4], David Waddington[1,3,5], and Matthew Rosen[1,2,3]

[1]MGH/HST Athinoula A. Martinos Center for Biomedical Imaging, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Department of Physics, Harvard University, Cambridge, MA, United States, [4]Rensselaer Polytechnic Institute, Troy, NY, United States, [5]ARC Center for Engineered Quantum Systems, School of Physics, University of Sydney, Sydney, Australia

Oral

MR-Guided Focused Ultrasound

Room 300-302 10:30 - 12:30 *Moderators:*Eugene Ozhinsky & Bruno Quesson

816 10:30

Multi-echo Pseudo-Golden Angle Stack of Stars Thermometry with High Spatial and Temporal Resolution
Bryant Svedin[1] and Dennis L. Parker[1]

[1]University of Utah, Salt Lake City, UT, United States

A multi-echo pseudo-golden angle stack of stars sequence is investigated for use in MR thermometry. High spatial and temporal resolution is achieved through k-space filtering. PRF temperature, T2*, ρ (signal magnituade at TE = 0), respiration correction and fat/water separation are simultaneously measured. Use of a pseudo-golden angle increment allows for the removal of phase (and therefore PRF temperature) artifacts due to changing k-space sampling between reconstructed time points. k-Space sampling based phase reference greatly improves temperature standard deviation. FUS heating experiments are performed while simulating respiration artifacts.

817 10:42

Efficient Volumetric Thermometry for MR-Guided FUS Brain Treatment Monitoring, Using Multiple-Echo Spirals and Mixed Update Rates
Michael Marx[1], Pejman Ghanouni[1], and Kim Butts Pauly[1]

[1]Radiology, Stanford University, Stanford, CA, United States

Multi-slice thermometry was developed that overcomes several limitations of single-slice 2DFT thermometry in MR-guided focused ultrasound brain treatment. Using multiple-echo spiral imaging provides much greater imaging performance, which was applied to improved focal spot localization and to improved ablation monitoring. High-resolution higher-precision multi-slice focal spot localization can shorten treatment time and improve patient safety. High-speed high-precision focal spot monitoring, combined with full-brain monitoring and 3-dimensional focal spot characterization during ablations can improve treatment guidance and feedback while also improving patient safety. The new sequences were validated both *in vivo* and in a phantom within a clinical transducer.

818 10:54

Motion Compensation using Principal Component Analysis and Projection onto Dipole Fields for Abdominal Magnetic Resonance Thermometry during High-Intensity Focused Ultrasound
Jeremy Tan[1,2,3], Adam C. Waspe[1,2], Charles Mougenot[4], Kullervo Hynynen[1,5], James M. Drake[1,2], and Samuel Pichardo[3,6]

[1]University of Toronto, Toronto, ON, Canada, [2]Hospital for Sick Children, Toronto, ON, Canada, [3]Thunder Bay Regional Research Institute, Thunder Bay, ON, Canada, [4]Philips Healthcare, Toronto, ON, Canada, [5]Sunnybrook Research Institute, Toronto, ON, Canada, [6]Electrical

Engineering, Lakehead University, Thunder Bay, ON, Canada

Accurate thermometry during abdominal high-intensity focused ultrasound is severely compromised by motion and susceptibility artifacts. A hybrid artifact correction method has been developed using principal component analysis as a multi-baseline method and projection onto dipole fields as a near-referenceless approach. The hybrid algorithm was tested using free-breathing porcine and human subjects and achieved an average temperature stability and precision of 0.31 (±0.22) °C and 1.18 (±0.94) °C, respectively in the kidney.

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819 11:06

Non-invasive cardiac stimulation with MR guided HIFU: a rapid, cardiac triggered, MR-ARFI method for direct visualization of stimulation site and assessment of tissue stiffness.

Pierre Bour[1,2], Fabrice Marquet[2], Fanny Vaillant[2], Valery Ozenne[2], Solenn Toupin[2,3], Matthieu Lepetit coiffe[3], Erik Dumont[1], and Bruno Quesson[2]

[1]IGT, PESSAC, France, [2]IHU-LIRYC, PESSAC, France, [3]Siemens Healthcare, Saint-Denis, France

HIFU cardiac stimulation may enable diagnostic and therapeutic applications such as noninvasive electrophysiological exam, emergency care and temporary stimulation. *In-vivo* proof of concept of HIFU cardiac stimulation has already been done on pig. We propose here a first proof of feasibility to monitor the displacement induced by acoustic radiation force impulse (MR-ARFI) during contactless stimulation *ex-vivo*, on a beating pig heart model. ARFI displacement maps will be used for precise localization of the depolarization source and a quantification of displacement will be done during refractory (contraction) and non-refractory (resting time) period.

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820 11:18

magna cum laude

Simultaneous Acquisition of Acoustic Radiation Force Imaging and Proton Resonance Frequency Shift Thermometry Using Interleaved Acquisition with Temporally Constrained Reconstruction for Increased Temporal Resolution

Joshua de Bever[1,2], Henrik Odéen [1,2], and Dennis L. Parker[1,2]

[1]Department of Radiology, University of Utah, Salt Lake City, UT, United States, [2]Utah Center for Advanced Imaging Research, Salt Lake City, UT, United States

Using focused ultrasound and MR acoustic radiation force imaging (MR-ARFI), the mechanical properties of tissues can be interrogated. Changes to tissue properties, for instance before and after a MR guided focused ultrasound thermal therapy, could help evaluate treatment success. This abstract presents a novel method for measuring acoustic radiation force simultaneously with proton resonance shift thermometry. This would enhance the safety of MR-ARFI, and provide additional temperature information that may indicate when, and at what temperature, a tissue property change occurred. Temporal resolution was enhanced by a factor of 5 by employing a temporally constrained reconstruction algorithm.

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821 11:30

Acceleration of 3D UTE Imaging to Quantify Temperature-Dependent T1 Changes in Cortical Bone

Misung Han[1], Wenwen Jiang[2], Roland Krug[1], Peder Larson[1,2], and Viola Rieke[1]

[1]Radiology and Biomedical Imaging, University of California, San Francisco, San Francisco, CA, United States, [2]Joint Graduate Program in Bioengineering, University of California, San Francisco/Berkeley, San Francisco, CA, United States

High-intensity focused ultrasound (HIFU) is a promising, noninvasive technique to ablate bone tumors and palliate painful bone metastases. During HIFU treatment, temperature mapping is desirable for proper heat deposition to targeted bone regions. Even though conventional PRF-based thermometry cannot be applied for cortical bone due to its short T2 relaxation time, it was demonstrated using 3D UTE imaging can be used to measure T1 changes due to heating. In this work, we accelerated 3D UTE imaging by combining parallel imaging and compressed sensing and compared calculated T1 changes due to heating with those from fully sampled data.

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822 11:42

Preclinical Study of MRgFUS Ablation of the Lumbar Medial Branch Nerve: Functional Outcomes and Histology

Elena Kaye[1], Sebastien Monette[2], Majid Maybody[3], Stephen B Solomon[3], and Amitabh Gulati[4]

[1]Medical Physics, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [2]Comparative Pathology, Sloan Kettering Institute, New York, NY, United States, [3]Radiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States, [4]Anesthesiology, Memorial Sloan Kettering Cancer Center, New York, NY, United States

The main goals of this preclinical study were to determine whether direct MRgFUS ablation of the lumbar MB nerve leads to functional changes and to study the extent of the thermal damage to the targeted and adjacent tissues, including neurologic structures. We found that direct FUS ablation of the lumbar MBN achieves thermal necrosis of the targeted nerve with minimal thermal damage of the adjacent bone and muscle tissue. The extent of the cellular changes in bone is limited to a few millimeters with no changes in the spinal cord, confirming the protective effects of spine bone rapidly attenuating the ultrasound. No functional changes were observed.

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823 11:54

summa cum laude

Diffusion MRI Tractography for Improved MRI-guided Focused Ultrasound Thalamotomy Targeting for Essential Tremor

Qiyuan Tian[1,2], Max Wintermark[2], Kim Butts Pauly[2], Diane Huss[3], W. Jeffrey Elias[4], and Jennifer A. McNab[2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Physical Therapy, University of Virginia, Charlottesville, VA, United States, [4]Neurosurgery, University of Virginia, Charlottesville, VA, United States

We retrospectively studied 13 essential tremor patients treated with MRI-guided focused ultrasound. The purpose was to demonstrate

the value of using diffusion MRI tractography to help localize the ventral intermediate (Vim) nucleus of the thalamus (the treatment target). Tractography between the thalamus and hand-knob region of the motor cortex was consistent from subject-to-subject and followed the expected anatomy. The thalamic voxels with high tractography streamline counts qualitatively matched the location of Vim as depicted on the Schaltenbrand-Wahren Atlas. A trend was found towards better treatment outcome scores with higher pre-treatment probabilistic tractography streamline counts within the visualized MRgFUS treatment-induced lesion.

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824 12:06

MR-HIFU mild hyperthermia for sensitization of radiation and chemotherapy for recurrent rectal cancer: First phase I clinical trial results.
William Chu[1], Robert Staruch[2], Samuel Pichardo[3,4], Yuexi Huang[5], Charles Mougenot[6], Matti Tillander[7], Max O. Köhler[7], Mika Ylihautala[7], Merrylee McGuffin[1], Gregory Czarnota[1], and Kullervo Hynynen[5]

[1]Radiation Oncology, Sunnybrook Health Science Centre, Toronto, ON, Canada, [2]Philips Research, Cambridge, MA, United States, [3]Thunder Bay Regional Research Institute, Thunder Bay, ON, Canada, [4]Electrical Engineering, Lakehead University, Thunder Bay, ON, Canada, [5]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [6]Philips Healthcare, Toronto, ON, Canada, [7]Philips Healthcare, Vantaa, Finland

We present the first results of a Phase I trial that includes delivery of mild hyperthermia using magnetic resonance-guided high intensity focused ultrasound (MR-HIFU) combined with radiation and chemotherapy in the treatment of locally recurrentrectal cancer. MR-HIFU mild hyperthermia was delivered in three sessions (day 1, 8 and 15) during a 17-day treatment protocol (total dose 30.6 Gy combined with fluropyrimidine-based chemotherapy). MR-HIFU mild hyperthermia was successfully delivered and the procedure was well tolerated by the patient. No adverse effects have been reported 3 months after the treatment.

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825 12:18

MRI-guided laser thermal ablation for T1a renal cell carcinoma (RCC): A 4-year experience with longitudinal follow-up of patients
Juan C. Camacho[1,2], Nima Kokabi[1], Tracy E. Powell[2], and Sherif G. Nour[1,2]

[1]Radiology and Imaging Sciences, Emory University School of Medicine, Atlanta, GA, United States, [2]Interventional MRI Program, Emory University Hospital, Atlanta, GA, United States

The objective of this study is to present outcomes of MRI-guided laser ablation for early stage renal cell carcinomas and to describe associated prognostic factors in a consecutive cohort of patients with relative long-term longitudinal follow-up. A prospective cohort of patients presenting with pathology-confirmed RCC underwent MRI-guided biopsy and subsequent laser ablation. Twenty-four consecutive patients presenting with 35 RCC were recruited. Follow-up MRI imaging was obtained in all cases with a median follow-up period of 20 months. Of the different analyzed prognostic factors, R.E.N.A.L nephrometry score was the only one predicting the incidence of complications.

Oral

Body Diffusion

Room 324-326 10:30 - 12:30 *Moderators:*Valentina Taviani

826 10:30

Differentiation of Pancreatic Carcinoma and Mass-forming focal pancreatitis: assessment by dynamic contrast-enhanced MRI combined with diffusion-weighted imaging
Tingting Zhang[1] and Dengbin Wang[1]

[1]Department of Radiology, Xinhua Hospital, Shanghai Jiao Tong Medical University, Shanghai, China, Shanghai, China, People's Republic of

This study is to access the differential value in Pancreatic Carcinoma (PC) and Mass-Forming focal Pancreatitis (FP) with qualitative and quantitative analysis of DCE-MRI and DWI. Pancreatic TIC types and sub-types from DCE-MRI and ADC value and tumor-to-pancreas contrast ratio of ADC value from DWI were compared between PC and FP. We found significant differences in TIC and ADC value and ADC tumor-to-pancreas contrast ratio between PC and FP. DCE-MRI and DWI were discovered to provide reliable information for differentiating PC from FP, while the combination of them can achieve a higher sensitivity and specificity.

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827 10:42

The potential of apparent diffusion coefficient in differentiating various sub-types of breast tumors and its association with hormonal status
Khushbu Agarwal[1], Rani Gupta Sah[1], Uma Sharma[1], Smriti Hari[2], Sandeep Mathur[3], Vurthaluru Seenu[4], Rajinder Parshad[4], and Naranamangalam R Jagannathan[1]

[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, Delhi, India, [2]Department of Radio-diagnosis, All India Institute of Medical Sciences, Delhi, India, [3]Department of Pathology, All India Institute of Medical Sciences, Delhi, India, [4]Department of Surgical Disciplines, All India Institute of Medical Sciences, Delhi, India

Potential of apparent diffusion coefficient (ADC) in differentiating various sub-types of malignant and benign breast tumors using diffusion weighted MRI and its association with different hormonal status in breast cancer patients was studied. A significantly lower ADC of malignant compared to benign and healthy breast tissues was observed. The ADC of fibroadenomas was lower compared to fibrocystic with fibroadenoma and cystic lesions and higher in cystic and fibrocystic lesions than benign ductal epithelial cells. No association of ADC with molecular biomarkers ER, PR and Her2neu was seen. Results showed the utility of ADC in differentiating various types of breast tissues.

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828 10:54

Intravoxel Incoherent Motion DWI and Aquaporins MR Imaging of Transplanted Kidneys at 3.0 T

Yanjun Li[1], Shumin Tao[1], Dandan Zheng[2], Yong Zhang[2], and Guangming Lu[1]

[1]Medical Imaging, Jingling Hospital, School of Medicine, Nanjing University, Nanjing, China, People's Republic of, [2]GE Healthcare, MR Research China, Beijing, China, People's Republic of

Diffusion-weighted imaging (DWI) in human transplantation was regarded as a promising indicator for dectecting graft dysfunction.According to the IVIM theory, ADC integrates the effects of both diffusion of water molecules and microcirculation of blood in capillaries. By separating diffusion and perfusion, we could observe each component's contribution to the changes of ADC values. Furthermore, the exchanges of intracellular water molecules with extracellular's may have impact on ADC. Thus, AQP ADC might reflect quantitative water channel expression.

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829 11:06

The Diffusion and Perfusion Characteristics of Placenta with Differential Fetal Growth Restriction Types Using Intravoxel Incoherent Motion MR Imaging

TANG Min[1], Xiaoqin LIU[1], Xiaoling ZHANG[1], Kaining Shi[2], and Kaining Shi[2]

[1]Shaanxi Provincial People `s Hospital, Xi'an, China, People's Republic of, [2]Clinical science, Philips Healthcare China, Xi'an, China, People's Republic of

The purpose of this study is to explore the feasibility of assessing perfusion and diffusion information of placenta with different FGR types using Intravoxel Incoherent Motion MR Imaging .we find that there are different diffusion and perfusion characteristic in different in placenta of FGR hypotype.

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830 11:18

magna cum laude

Improved IVIM MRI of Small Lesions in the Liver by Deformable Image Registration with Modality Independent Neighborhood Descriptor

Yihao Guo[1], Zhentai Lu[1], Yingjie Mei[2], Jing Zhang[3], Yikai Xu[3], Feng Huang[4], Ed. X. Wu[5,6], and Yanqiu Feng[1,5,6]

[1]School of Biomedical Engineering and Guangdong Provincial Key Laboratory of Medical Image Processing, Southern Medical University, GuangZhou, China, People's Republic of, [2]Philips Healthcare, GuangZhou, China, People's Republic of, [3]Department of Medical Imaging Center, Nanfang Hospital, Southern Medical University, GuangZhou, China, People's Republic of, [4]Philips Healthcare(Suzhou), Suzhou, China, People's Republic of, [5]Laboratory of Biomedical Imaging and Signal Processing, The University of Hong Kong, Hong Kong SAR, China, People's Republic of, [6]Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong SAR, China, People's Republic of

Respiration-induced misalignment between multiple b-value liver DW image scan severely reduce the accuracy and stability of IVIM parameter quantification, especially in the presence of small focal lesions. These small lesions usually exhibit significantly differentintensity in different b-value images, but have similar structural information. This work introduces modality independent neighborhood descriptor to extract the structural information of small lesions for improved realignment between multiple b-value images. Preliminary results show that this structure-based registration method can well correct respiration-induced misalignment between multiple b-value images with small lesions, improve the IVIM model fitting quality, and reduce variance in quantified parameters.

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831 11:30

summa cum laude

Diffusion Tensor Imaging and Histology of the Developing Myocardium

Osama M Abdullah[1], MarJanna Dahl[2], Gavin Yeip[1], Julia Cortino[1], Arnold David Gomez[3], Thomas Seidel[1], Frank Sachse[1], Kurt Albertine[2], and Edward W Hsu[1]

[1]Bioengineering, University of Utah, Salt Lake ity, UT, United States, [2]Pediatric Neonatology, University of Utah, Salt Lake ity, UT, United States, [3]Electrical and Computer Engineering, Johns Hopkins, Baltimore, MD, United States

Diffusion tensor imaging (DTI) has emerged as the method of choice for noninvasive quantifications of myocardial microstructure. However, the origins and behaviors of DTI measurements as functions of myocardial remodeling during development remain poorly understood. In this work, conventional and bi-compartmental DTI and histological correlation were performed on an animal model of myocardial development to investigate the effects of tissue remodeling. Results indicate that tissue remodeling during development manifests in progressively increased DTI transverse diffusivities, decreased fractional anisotropy, and unchanged fiber orientation. The findings show that DTI can be used to noninvasively characterize microstructural remodeling of the myocardium during development.

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832 11:42

Comparing the breath-hold, respiratory-triggered and free-breathing techniques in the diffusion-weighted imaging for the evaluation of focal liver lesions on a 3.0T system

Zhuo Shi[1], Xinming Zhao[1], Ouyang Han[1], and Lizhi Xie[2]

[1]Department Of Imaging Diagnosis,Cancer Hospital, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing China, Beijing, China, People's Republic of, [2]GE Healthcare, MR Research China, Beijing, Beijing, China, People's Republic of

DWI plays an important role in detecting and characterizing liver lesions or tumors. There are three kinds of liver DWI acquisitions are commonly used in hepatic DWI: breath-hold , respiratory-triggered， free-breathing. This work compares the advantages and disadvantages of diagnosing focal liver lesions, to find the best acquisition sequence for different situations.

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833 11:54

Study of Spatial Function in the Human Placenta with Diffusion Weighted Imaging

Edward Sutherland [1], Luís F Gonçalves[1,2,3], and Yuxiang Zhou[1,3]

[1]William Beaumont Hospital School of Medicine, Oakland University, Rochester, MI, United States, [2]Department of Obstetrics and Gynecology, Beaumont Health, Royal Oak, MI, United States, [3]Diagnostic Radiology and Molecular Imaging, Beaumont Health, Royal Oak, MI, United States

Magnetic resonance diffusion weighted imaging (DWI) has been widely used to quantitatively measure the random motion of water molecules within a voxel of tissue and represents this information in the form of apparent diffusion coefficient (ADC) maps. As the ADC map has been shown to be influenced by circulatory motion and perfusion at low b-values, we hypothesize that ADC values obtained from the placenta may vary as a function of distance to the umbilical cord insertion. In this retrospective study, 78 healthy placentas were evaluated by MR-DWI. We conclude that ADC values of placental tissues obtained at high b-values do not vary in normal human placentas as a function of distance to umbilical cord insertion.

834 12:06

Comparison of multi-component restricted and anisotropic models of diffusion in glandular breast tissue
Sisi Liang[1], Narina Norddin[2], Eleftheria Panagiotaki [3], Andre Bongers[4], Peng Shi[1], Laurence Gluch[5], and Roger Bourne[2]

[1]College of Engineering and Science, Victoria University, Melbourne, Australia, [2]Discipline of Medical Radiation Sciences, Faculty of Health Sciences, University of Sydney, Sydney, Australia, [3]Center for Medical Image Computing, University College London, London, United Kingdom, [4]Biological Resource Imaging Laboratory, University of New South Wales, Sydney, Australia, [5]The Strathfield Breast Centre, Strathfield, Australia

DWI signal attenuation measured in biological tissue is widely observed to be non-monoexponential. One important diffusion characteristic underlying that complex behavior is restriction and hindrance to water diffusion. This study compared multi-component restricted and unrestricted models of diffusion in the glandular part of breast tissue. The results show that multi-component restricted and anisotropic models explain the data best. This finding is consistent with the presence of distinct diffusion microenvironments in breast tissue. Development of clinical DWI methods that incorporate these features may improve breast cancer assessment.

835 12:18

Evaluation of the levator ani muscle in primiparas six weeks after vaginal delivery using diffusion tensor imaging and fiber tractography
Can Cui[1], Yujiao Zhao[1], Yu Zhang [2], and Wen Shen[3]

[1]Radiology, Tianjin First Center Clinical College, Tianjin Medical University, Tianjin, China, People's Republic of, [2]Philips Healthcare, Beijing, China, People's Republic of, [3]Radiology, Tianjin First Center Hospital, Tianjin, China, People's Republic of

The aim of this study was to investigate the clinical application of DTI fiber tractography on evaluating the levator ani injury after first vaginal delivery. Thirty-five primiparous women with 6 weeks after vaginal delivery and twenty-five age-matched nulliparous women volunteers as control group were included. The primiparas women were divided into 2 subgroups by the existence of pelvic organ prolapse. DTI with fiber tractography provided satisfactory 3D representation of puboviscerali while the study of iliococcygeus was more difficult. No significant differences of FA and ADC values were found among primiparous normal group, primiparous POP group and control group for puboviscerali.

Oral

Cancer Metabolism & Metabolomics

Room 331-332 10:30 - 12:30 *Moderators:*Tone Frost Bathen & Kristine Glunde

836 10:30

Metabolic profiling of the tumor interstitial fluid using NMR: contribution of breast cancer subtypes and VEGF overexpression
Santosh K Bharti[1], Louis Dore-Savard[1], Aleksander S Popel[2], and Zaver M Bhujwalla[1]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, Johns Hopkins University, School of Medicine, Division of Cancer Imaging Research, Baltimore, MD, United States, [2]Department of Biomedical Engineering, Johns Hopkins University, School of Medicine, Systems Biology Laboratory, Baltimore, MD, United States

Interstitial fluid (IF) is a key component of the tumor microenvironment (TME) that encompasses the secretome and holds the key to several of the phenotypic traits of cancer. Modern analytical methods like 1H MR spectroscopy (MRS) allow for comprehensive metabolic characterization of tissue, cell, and bio-fluids content to better understand the TME and cancer metabolism. Here, for the first time, we have metabolically characterized TIF from triple negative and estrogen receptor (ER)-positive human breast tumor xenografts with or without VEGF overexpression and detected significant differences between tumor types and with VEGF overexpression.

837 10:42

NMR-based fecal metabolomics fingerprinting as predictors of earlier diagnosis in patients with colorectal cancer
Yan Lin[1], Changchun Ma[2], Zhening Wang[1], Zhiwei Shen[1], and Renhua Wu[1]

[1]Radiology Department, Second Affiliated Hospital, Shantou University Medical College, Shantou City, China, People's Republic of, [2]Radiation Oncology, Cancer Hospital, Shantou University Medical College, Shantou City, China, People's Republic of

Colorectal cancer (CRC) is a growing cause of mortality in developing countries, warranting investigation into its earlier detection for optimal disease management.This study aimed to validate the ability of NMR-based fecal metabolomics fingerprinting as predictors of earlier diagnosis in CRC patients.Our findings revealed that the fecal metabolic profiles of healthy controls can be distinguished from CRC patients, even in the early stage (stage I/II), highlighting the potential utility of NMR-based fecal metabolomics fingerprinting as predictors of earlier diagnosis in CRC patients.

838 10:54

NMR metabolomics of biofluids for early diagnosis of brain metastasis

James R Larkin[1], Alex M Dickens[2], Timothy D W Claridge[3], Daniel C Anthony[2], and Nicola R Sibson[1]

[1]CRUK and MRC Oxford Institute for Radiation Oncology, Department of Oncology, University of Oxford, Oxford, United Kingdom, [2]Department of Pharmacology, University of Oxford, Oxford, United Kingdom, [3]Department of Chemistry, University of Oxford, Oxford, United Kingdom

Secondary tumours, or metastases, in the brain are currently detected at a late stage by gadolinium-enhanced MRI. We used mouse models of brain metastases, coupled with high resolution NMR of urine to identify characteristic patterns of metabolites in tumour-bearing animals. A model with a tumour cells implanted directly in the brain showed sensitive and specific detection at day 5 with increasing separation at later time points. Models injecting cells into the heart or venous circulation give rise to differing systemic and central nervous system (CNS) tumour burdens. Metabolite patterns allow identification of these animals with a heavy CNS tumour burden.

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839 11:06

Hyperpolarized [1-13C]-Pyruvate Differentiates Distinctive Molecular Phenotypes in Diffuse Intrinsic Pontine Gliomas

Ilwoo Park[1], Rintaro Hashizume[2], Joanna Phillips[3,4], Sabine Mueller[3,5], and Sarah Nelson[1,6]

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Diffuse intrinsic pontine gliomas (DIPGs) are one of the most difficult pediatric cancers to treat. This study investigated the feasibility of ^{13}C magnetic resonance spectroscopic imaging (MRSI) of hyperpolarized (HP) [1-^{13}C]pyruvate for differentiating molecular characteristics of DIPGs. Differences in the lactate signal that were observed in two distinct biopsy-originated orthotopic DIPG tumors were associated with changes in the levels of LHDA and HIF-1α activity. This suggests that the non-invasive characterization of DIPGs using this new neuroimaging method may be helpful for assessing treatment response and tumor progression.

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840 11:18

magna cum laude

Glutamatergic production of 2HG in IDH1-mutant tumor cells is retained by glutamate import in glutamine-free medium

Tom Peeters[1], Vincent Breukels[1], Krissie Lenting[2], Sanne van Lith[2], Arno van Rooij[3], Remco Molenaar[4], William Leenders[2], and Arend Heerschap[1]

[1]Radiology and Nuclear Medicine, Radboud university medical center, Nijmegen, Netherlands, [2]Pathology, Radboud university medical center, Nijmegen, Netherlands, [3]Laboratory Medicine, Radboud university medical center, Nijmegen, Netherlands, [4]Cell Biology and Histology, Academic Medical Center, Amsterdam, Netherlands

This study demonstrates that in IDH1-mutant tumor cells the pool of oncometabolite 2HG is predominantly replenished by αKG precursors glutamine and glutamate, and to a lesser extent by glucose-derived metabolites. Furthermore, we show that 2HG production is not significantly decreased when total the pool of glutamine and glutamate drops, which occurs upon substitution of glutamine by glutamate in the culture medium.

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841 11:30

Differential Metabolism of Glucose and Acetate in Mitochondria of Early Stage Breast Cancer In Vivo

Elizabeth Maher[1], Kumar Pichumani[2], Venetia Sarode[3], Tomoyuki Mashimo[1], Manoj Cheriyan[1], Vamsidhara Vemireddy[1], Barbara Haley[1], Dean Sherry[2], Roshni Rao[4], Craig Malloy[2], and Robert Bachoo[5]

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Metabolic reprogramming of bioenergetic substrate utilization was shown in primary and metastatic brain tumors. Whether the use of substrates other than glucose to fuel the citric acid cycle is a property of cancer cell growth in the brain or a fundamental property of a transformed cell is not known. To address this question we studied early stage breast cancer patients using infusion of ^{13}C-glucose or ^{13}C-acetate during initial surgery. ^{13}C-NMR spectra of resected tumors show that acetate but not glucose is oxidized in the citric acid cycle, suggesting that acetate may contribute to energy production in these early stage cancers.

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842 11:42

Simultaneous imaging and 1H spectroscopy of small volume (1 µl) intracerebral microdialysate in healthy and glioblastoma-bearing rats using highly sensitive micro-coils

Silvia Rizzitelli[1], Stefan Glöggler[1], Noël Pinaud[1], Gerard Raffard[1], Veronique Bouchaud[1], Vanessa Zhendre[1], Stephane Sanchez[1], Alan Wong[2], and Yannick Cremillieux[1]

[1]Centre de Resonance Magnétique des Systemes Biologiques, University of Bordeaux, Bordeaux, France, [2]NIMBE/LSDRM, CEA-Saclay, Gif-sur-Yvette, France

The challenge of this study was to investigate the ability of a custom-made 1H microsolenoidal coil operating at 7T, with an inner volume of 1 µL, of visualizing the on-line metabolism of brain metabolites through the use of a microdialysis catheter, carried out with the complementarity of MRI and MRS techniques. ^{1}H-MR spectra of *in vitro* (human gliobastoma cells) and *in vivo* (healthy and glioblastoma-bearing rats) were acquired every 3.50 minutes to monitor the real-time variations of metabolites concentration, after injection of ^{13}C labelled compunds.

843 11:54

Molecular Effects of the Chemotherapeutic Drug Doxorubicin on Choline Phospholipid Metabolism of Breast Cancer Cells
Menglin Cheng[1], Asif Rizwan[1], Zaver M. Bhujwalla[1,2], Lu Jiang[1], and Kristine Glunde[1,2]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, The Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]The Sidney Kimmel Comprehensive Cancer Center, The Johns Hopkins University School of Medicine, Baltimore, MD, United States

This study shows that the widely used chemotherapeutic drug doxorubicin increases the ^{1}H or ^{31}P MRS detectable glycerophosphocholine (GPC) concentration, while decreasing the phosphocholine (PC) concentration in human MCF-7 and MDA-MB-231 breast cancer cell lines. This GPC increase and PC decrease was caused by doxorubicin-induced decreases in the expression of the GPC-phosphodiesterase GDPD6, choline kinase α, and phospholipase D1. GDPD6 silencing was able to counteract the doxorubicin-induced promotion of breast cancer cell migration, which can occur at low doxorubicin concentrations. GPC, PC, and PC/GPC may serve as non-invasive surrogate makers of therapeutic response in breast cancer patients undergoing doxorubicin chemotherapy.

844 12:06

Measurement of Liver Fat Fraction and T2 Relaxation Times in an Experimental Rat Model of Hepatocarcinogenesis at 9.4T
Sami Alghamdi[1,2], Gary Cowin[1], Ian Brereton[1], and Yasvir Tesiram[1]

[1]Centre for Advanced Imaging, University of Queensland, Brisbane, Australia, [2]Dept. of Radiological sciences,King Saud University, Riyadh, Saudi Arabia

To investigate the correlation between fat fraction (FF) measured by in/out-phase (IP/OP) imaging, with transverse relaxation time (mono- and bi-exponential T2 values) and their relationship with nodular and tumour formation in the liver of rats maintained on a choline and amino acid modified diet (CDAA diet).

845 12:18

Evaluation of nearby lymph nodes in a tumor mouse model by longitudinal MRI imaging at 11.7 Tesla.
María Jiménez-González[1], Sandra Plaza-García[1], Géraldine Pastor[1], and Torsten Reese[1]

[1]Molecular Imaging Unit, CIC biomaGUNE, San Sebastián, Spain

We developed a pancreatic tumor xenograft model in a nude mice to study characteristics of nearby lymph nodes. Using non invasive *in vivo* MR imaging at 11.7 Tesla, we monitored the tumor progression from 8 to 20 weeks. We observed enlarged lymph nodes in tumor bearing animals comparing to controls. Histological analysis demonstrated the presence of significant histiocytosis but not metastasis. Our study suggests that lymph node histiocytosis, in absence of functional adaptative immune system, plays a significant role of the innate immuno defense against cancer cells spreading.

Oral

Spinal Cord: Clinical Applications

Room 334-336 10:30 - 12:30 *Moderators:*Suchandrima Banerjee & Masaaki Hori

846 10:30

Translating State-Of-The-Art Spinal Cord MRI Techniques To Clinical Use: A Systematic Review Of Clinical Studies Utilizing DTI, MT, MWF, MRS, and fMRI
Allan R. Martin[1], Izabela Aleksanderek[1], Julien Cohen-Adad[2], Zenovia Tarmohamed[3], Lindsay Tetreault[1], Nathaniel Smith[4], David W. Cadotte[1], Adrian Crawley[5], Howard Ginsberg[1], David J. Mikulis[5], and Michael G. Fehlings[1]

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5 state-of-the-art spinal cord MRI techniques have been identified with great clinical potential. This systematic review finds trends in the technical methods employed and measures the progress of these techniques toward clinical translation. 104 studies were identified, with 69 DTI, 25 MT, 1 MWF, 11 MRS, and 8 fMRI studies. The DTI metric FA has the strongest evidence of utility, correlating with disability in numerous spinal conditions. Large, well-designed studies with a priori hypotheses, standardized acquisition methods, detailed clinical data collection, and robust automated analysis techniques are needed to fully demonstrate the potential of these rapidly evolving techniques.

847 10:42

Combining biomechanical finite element analysis and multi-parametric MRI to assess mechanical and structural damage in cervical spondylotic myelopathy
Manuel Taso[1,2,3,4], Pierre-Jean Arnoux[2,4], Léo Fradet[4,5], Arnaud Le Troter[1,3], Jean-Philippe Ranjeva[1,3,4], Kathia Chaumoître[4,6], Pierre-Hugues Roche[4,7], and Virginie Callot[1,3,4]

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While diagnosis of cervical spondylotic myelopathy is easily done with MRI, patient outcome is still difficult to predict. It is nonetheless

associated to a strong mechanical cause as spinal cord's (SC) compression is the first event leading to tissue alterations and neurological deficits. This work proposes an original approach using biomechanical numerical simulation, to apprehend the mechanisms of SC compression by the disk, and multi-parametric MRI, to probe the consequent microstructural alterations (axonal loss, demyelination ...). Thanks to spatial normalization, first results on 3 patients are presented, allowing co-localization of personalized simulation of mechanical stress and structural MR alterations.

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848 10:54

Application of APT CEST in Cervical Spinal Cord Normal Appearing White Matter of MS Patients at 3T

Samantha By[1,2], Alex K. Smith[1,2], Adrienne N. Dula[2,3], Bailey D. Lyttle[2], Siddharama Pawate[4], and Seth A. Smith[2,3]

[1]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States, [2]Vanderbilt University Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [3]Radiology and Radiological Sciences, Vanderbilt University, Nashville, TN, United States, [4]Neurology, Vanderbilt University, Nashville, TN, United States

Amide proton transfer (APT) CEST was applied to healthy and multiple sclerosis (MS) cohorts to determine its sensitivity to changes in normal appearing white matter in MS. Using a Lorentzian difference analysis, differences in the z-spectra of the MS and healthy cohorts around the APT frequency (Δω=+3.5 ppm) were observed. Significant differences in APT effect between MS and healthy controls were seen in the whole cord (p=0.0159), dorsal column (p=0.0159), and gray matter (p=0.0317). Lastly, a group-wise analysis highlights the ability to detect a decrease in mean APT effect in the MS cohort, despite the difficulty in detecting lesions in the anatomical.

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849 11:06

Assessing Structure and Function of Myelin in Cervical Spondylotic Myelopathy: Evidence of Focal Demyelination in the Dorsal Column

Hanwen Liu[1], Erin MacMillan [1], Emil Ljungberg[1], Burkhard Mädler[2], Shannon Kolind [1], Marcel Dvorak[1], David Li[1], Alex MacKay[1], John Kramer[1], Cornelia Laule[1], and Armin Curt[3]

[1]University of British Columbia, Vancouver, BC, Canada, [2]University of Bonn, Bonn, Germany, [3]Balgrist University, Zürich, Switzerland

Cervical spondylotic myelopathy (CSM) is a major cause of spinal cord dysfunction. To better understand the pathophysiology underlying CSM, we used somatosensory evoked potentials (SSEPs) and myelin water imaging to study patients with CSM and healthy controls. Significant differences were found in the myelin water fraction (MWF) of the dorsal column between subjects classified as normal or pathological based on SSEPs. A strong correlation between tibial SSEP latency and MWF was found in CSM. Our findings suggest that MWF can monitor cervical spinal cord demyelination and may be a valuable tool to assess clinical interventions in spinal cord injury.

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850 11:18

Atrophy computation in the spinal cord using the Boundary Shift Integral

Ferran Prados[1,2], Marios C Yiannakas[2], Manuel Jorge Cardoso[1], Francesco Grussu[2], Floriana De Angelis[2], Domenico Plantone[2], David H Miller[2], Olga Ciccarelli[2], Claudia Angela Michela Gandini Wheeler-Kingshott[2,3], and Sebastien Ourselin[1]

[1]Translational Imaging Group, Medical Physics and Biomedical Engineering, University College London, London, United Kingdom, [2]NMR Research Unit, Queen Square MS Centre, Department of Neuroinflammation, UCL Institute of Neurology, University College London, London, United Kingdom, [3]Brain Connectivity Center, C. Mondino National Neurological Institute, Pavia, Italy

In this work, we introduce a new pipeline based on the latest iteration of the BSI for computing atrophy in the SC and compare its results with the most popular atrophy measurements for this region, mean CSA. We demonstrated for the first time the use of BSI in the SC, as a sensitive, quantitative and objective measure of longitudinal tissue volume change. The BSI pipeline presented in this work is repeatable, reproducible and standardises a pipeline for computing SC atrophy.

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851 11:30

Comparison of cervical cerebrospinal fluid flow between healthy controls and chronic spinal cord injury participants using cine phase contrast MRI

Kwan-Jin Jung[1], Andrea Willhite[2], and Susan Harkema[2]

[1]Radiology, University of Louisville, Louisville, KY, United States, [2]Neurological Surgery, University of Louisville, Louisville, KY, United States

The cerebrospinal fluid (CSF) flow in the cervical spine was compared between healthy controls and persons with spinal cord injury (SCI) using phase contrast MRI. The subarachnoid cross-section of SCI participants was smaller than that of healthy controls. The flow velocities in both diastolic and systolic cardiac phases were faster in SCI participants than that of healthy controls. Considering a slower heart rate and a reduced ejection fraction and stroke volume of the heart in SCI participants, the reduced subarachnoid area may be a main contributing factor to the increased velocity of CSF flow in SCI participants.

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852 11:42

Quantitative measurements of the spinal cord blood flow of an animal model of relapsing-remitting MS.

Mohamed Tachrount[1], Andrew Davies[2], Roshni Desai[2], Kenneth Smith[2], David Thomas[1], and Xavier Golay[1]

[1]Dept. of Brain Repair and Rehabilitation, UCL Institute of Neurology, London, United Kingdom, [2]Dept. of Neuroinflammation, UCL Institute of Neurology, London, United Kingdom

Perfusion-weighted imaging studies have demonstrated that there is a widespread cerebral hypoperfusion in patients with MS, regardless of the clinical subtype. The mechanism and the role of hypoxia are still unclear. The purpose of this work was to longitudinally investigate the SC blood flow (SCBF) during the different phases of disease progression in EAE rats using an optimized ASL technique. These measurements demonstrated for the first time on EAE animal model that the neurological deficits are strongly correlated with impaired blood flow.

853 11:54

A Prospective Longitudinal Study in Degenerative Cervical Myelopathy Using Quantitative Microstructural MRI with Tract-Specific Metrics
Allan R. Martin[1], Benjamin De Leener[2], Izabela Aleksanderek[1], Julien Cohen-Adad[2], David W. Cadotte[1], Sukhvinder Kalsi-Ryan[1], Lindsay Tetreault[1], Adrian Crawley[3], Howard Ginsberg[1], David J. Mikulis[3], and Michael G. Fehlings[1]

[1]Neurosurgery, University of Toronto, Toronto, ON, Canada, [2]Electrical Engineering, Polytechnique Montreal, Montreal, QC, Canada, [3]Medical Imaging, University of Toronto, Toronto, ON, Canada

This study investigates if DTI, MT, and T2*-weighted imaging of the rostral cervical cord can 1) detect injury of WM tracts, 2) correlate with global and focal disability, and 3) predict outcomes in degenerative cervical myelopathy (DCM). Data includes detailed clinical assessments, electrophysiology, and MRI, repeated at 1-year. Quantitative MRI in 37 DCM patients and 29 healthy controls provided reliable results and showed decreased CSA, FA, and MTR, and increased T2* WM/GM ratio. FA of individual tracts correlates well with clinical measures. Quantitative multimodal assessment of WM injury with a clinically feasible protocol is possible, with many potential clinical applications.

854 12:06

High Resolution Diffusion Tensor Imaging for Cervical Spondylotic Myelopathy: A Preliminary Follow-up Study
Yuhui Xiong[1], Xiaodong Ma[1], Xiaolong Chen[2], Li Guan[2], Yong Hai[2], Zhe Zhang[1], Le He[1], Chun Yuan[1,3], and Hua Guo[1]

[1]Center for Biomedical Imaging Research, Department of Biomedical Engineering, School of Medicine, Tsinghua University, Beijing, China, People's Republic of, [2]Department of Orthopedics, Beijing Chao-Yang Hospital, Capital Medical University, Beijing, China, People's Republic of, [3]Vascular Imaging Laboratory, Department of Radiology, University of Washington, Seattle, WA, United States

As a conventional method in spinal cord assessment in cervical spondylotic myelopathy (CSM) patients, intramedullary high signal intensity (HSI) in T2W images is limited in diagnosis accuracy and predictive capacity for postoperative recovery. Single-shot EPI DTI can detect microstructural information, but it has low image resolution and distortion. In this work, a multi-shot interleaved EPI DTI using SYMPHONY reconstruction method is used to assess the pathologic conditions and the function of spinal cords of CSM patients quantitatively. The results show that the high resolution MS-EPI DTI can performs better than HSI or SS-EPI DTI in CSM diagnosis and recovery monitoring.

855 12:18

Diffusion Tensor Imaging Predicts Outcome ASIA Motor Scores in Acute Traumatic C-Spinal Injury
Jiachen Zhuo[1], Hegang Chen[2], Bizhan Aarabi[3], Jay Menaker[4], Rao Gullapalli[1], and Kathirkamanathan Shanmuganathan[1]

[1]Diagnostic Radiology and Nuclear Medicine, University of Maryland School of Medicine, Baltimore, MD, United States, [2]Epidemiology & Public Health, University of Maryland School of Medicine, Baltimore, MD, United States, [3]Neurosurgery, University of Maryland School of Medicine, Baltimore, MD, United States, [4]Surgery, University of Maryland School of Medicine, Baltimore, MD, United States

Convention MRI is the imaging modality of choice to demonstrate the anatomical location and extent in spinal cord injury (SCI) following trauma. However, quantitative and qualitative lesion parameters within the cord are of limited use in predicting patient neurological outcomes. In this study we demonstrated that acute DTI measurements improve model prediction for 1 year AISA score following blunt cervical SCI. Among all DTI measurements, axial diffusivity, while not radial diffusivity, showed strong effect in predicting outcome, indicating that axonal injury in the cord may be the main factor affecting patient recovery.

Oral

TBI: Neurometabolic Consequences

Hall 606 10:30 - 12:30 *Moderators:*Steffi Dreha-Kulaczewski & Henry Ka-Fung Mak

856 10:30

Comparable glucoCEST and 2DG autoradiography measures of glucose metabolism in mild traumatic brain injury
Tsang-Wei Tu[1], Wael Ibrahim[1], Neekita Jikaria[1], William Reid[1], George Z. Papadakis[1], Dima Hammoud [1], and Joseph A. Frank[1]

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The present glucose measurements from the brain are still insufficient to provide the essential spatial-temporal information. This study presents longitudinal glucose chemical exchange saturation transfer (glucoCEST) MRI to noninvasively detect the glucose metabolism in a rat model of mild traumatic brain injury (mTBI) and compares to the gold-standard 2-deoxyglucose (2DG) autoradiography. The current glucoCEST results parallel with 2DG-autoradiography results showing glucose uptake largely decreased after mTBI, that persisted over time. GlucoCEST is capable of delivering better image quality, higher image resolution and sensitivity to identify the potential window for effective treatments to increase the survival of injured brain.

857 10:42

Cortical neurometabolic alterations induces anxiety-like behavior in rodent model of mild traumatic brain injury: A 1H-MRS and behavior study
Kavita Singh[1], Seenu Haridas[2], Kailash Manda[2], Richa Trivedi[1], and Subash Khushu[1]

[1]NMR, INMAS, DRDO, Delhi, Delhi, India, [2]Neurobehavioral lab, INMAS, DRDO, Delhi, Delhi, India

Mild traumatic brain injury (mTBI), (70-90% of all TBI) shows consequences of anxiety-like behavioral alterations in approximately 23% of

cases. The present study assesses acute anxiety-like behavior and its neurometabolic basis in a rodent model of mTBI using 1H-MRS and neurobehavioral analysis. At day5 reduced Tau/tCr levels in cortex was observed in mTBI group as compared to control. Neurobehavioral analysis showed increased anxiety-like behavior with normal cognition at day5. This study provides a putative neurometabolic basis of anxiety-like behavior in mTBI model which closely mimics human concussion injury.

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858 10:54

INDICATION OF IMPAIRED BASAL CEREBRAL BLOOD FLOW AND REACTIVE CAPACITY IN CONCUSSED ATHLETES USING DUAL-ECHO PCASL

Clarisse Ildiko Mark[1], Alex Bhogal[2], Douglas J Cook[3], and Ingrid Johnsrude[4]

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Concussion can result in disability related to covert symptoms and deficits that persist long after the initial injury. A possible explanation for these observed phenomena is sustained impairment of cerebrovascular autoregulation. Here, we complement BOLD acquisition with simultaneous cerebral blood flow (CBF) measurements during targeted hypercapnic breathing challenges in varsity athletes during the acute, early and late stages following injury. Changes in basal CBF and cerebrovascular reactivity (CVR) were observed over the first 2 weeks following injury compared to matched un-concussed athletes. These biomarkers represent promising tools to gauge the extent of brain injury and monitor recovery.

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859 11:06

MRS and DTI Examination of Immature Rats Following Mild Traumatic Brain Injury

Lesley May Foley[1], Emin Fidan[2], Henry L Alexander[2], Lee Ann New[2], Patrick M Kochanek[2,3], T Kevin Hitchens[1,4], and Hulya Bayir[2,3]

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Recently we developed a closed-skull repeated mild (rm) TBI model in postnatal day (PND) 18 rats. We hypothesized that MRS and DTI can detect early microstructural changes of brain and metabolite changes in the hippocampus. Alterations in NAA and Ins after mTBI and rmTBI likely reflect neuroaxonal damage and glial proliferation, respectively. Reduced FA and increased AD in the white matter may reflect a loss of integrity a possible indication of damage to myelin/axonal membranes or demyelination. ^{1}H-MRS and DTI can identify subtle metabolic and structural alterations in the hippocampus which appears normal on histological analysis and conventional MR images.

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860 11:18

Mapping axonal injury distribution in mild traumatic brain injury with quantitative proton MR spectroscopy

Ivan Kirov[1,2], Matthew S. Davitz[1,2], Assaf Tal[3], James S. Babb[1,2], Robert I Grossman[1,2], Yvonne W Lui[1,4], and Oded Gonen[1,2]

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Since axonal injury is a primary outcome of traumatic brain injury, our goal was to characterize its regional distribution from a metabolic perspective. We set out to identify regions prone to disproportionate injury, hence, candidate targets in potential clinical applications of proton MR spectroscopy (^{1}H-MRS). We found that metabolic axonal injury is diffusely distributed among commonly injured tracts, but multivoxel ^{1}H-MRS may lack sensitivity for its detection on a regional basis. These results motivate the use of ^{1}H-MRS approaches with higher sensitivity, such as global averaging, or large "single voxels" in areas of white matter, irrespective of placement location.

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861 11:30

Proton MR spectroscopy identifies neuronal damage consistent with gray/white matter interface involvement in mild traumatic brain injury

Ivan Kirov[1,2], Matthew S. Davitz[1,2], Assaf Tal[3], James S. Babb[1,2], Robert I Grossman[1,2], Yvonne W Lui[1,4], and Oded Gonen[1,2]

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Basic science studies have posited that the mechanical force associated with a traumatic brain injury disproportionately affects the interface between the brain's gray and white matter (GM, WM); however, this has not yet been demonstrated in vivo. In this study we used multivoxel proton MR spectroscopy to compare metabolite levels of patients and controls in voxels with different GM and WM partial volume, on a continuum from "pure" GM to "pure" WM. The results indicate that the largest amount of damage lies within voxels representative of interface tissue.

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862 11:42

Reduced Cortical and Thalamic Cerebral Blood Flow in Adolescents with Chronic Post-Concussive Symptoms

Samuel Barnes[1], Brenda Bartnik-Olson[1], Barbara Holshouser[1], and Stephen Ashwal[2]

[1]Radiology, Loma Linda University, Loma Linda, CA, United States, [2]Pediatric Neurology, Loma Linda University, Loma Linda, CA, United States

Several studies have shown regions of hypoperfusion in symptomatic patients in the chronic phase of mild TBI. In this study we used whole-brain spatial mapping and a voxel-wise statistical approach to investigate the extent and anatomical distribution of cerebral

hypoperfusion in chronic symptomatic pediatric concussion subjects. Our findings identified multiple areas of reduced CBF, incorporating both the cerebral cortex and subcortical regions. Compared to our previous results using region of interest analysis, we detected a greater number of areas of hypoperfusion suggesting that the use of whole-brain spatial mapping and voxel-wise analysis improved detection of CBF abnormalities. We speculate that hypoperfusion in these regions may be implicated in cognitive deficits in these subjects.

863 11:54

Hyperpolarized 13C Metabolic imaging of neuroinflammation in Traumatic Brain Injury
Caroline Guglielmetti[1,2], Austin Chou[1], Annemie Van der Linden[2], Susanna Rosi[1], and Myriam M Chaumeil[1]

[1]University of California San Francisco, San Francisco, CA, United States, [2]University of Antwerp, Antwerp, Belgium

This study demonstrates that ^{13}C MRS of hyperpolarized pyruvate can be used to detect increased lactate production from pro-inflammatory macrophages in a preclinical model of Traumatic Brain Injury, hence providing a novel tool for *in vivo* detection of neuroinflammation.

864 12:06

Gauging the Effectiveness of Traumatic Brain Injury Treatment using MR Phase Gradient Mapping
Gregory Simchick[1,2], Martha Betancur[3,4], Lohitash Karumbaiah[3,4], and Qun Zhao[1,2]

[1]Physics, University of Georgia, Athens, GA, United States, [2]Bio-Imaging Research Center, Athens, GA, United States, [3]Animal and Dairy Science, University of Georgia, Athens, GA, United States, [4]Regenerative Bioscience Center, Athens, GA, United States

Due to both short-term and long-term effects, traumatic brain injuries (TBIs) have been a growing topic of interest over the last several years; therefore, research related to the development of new methods to treat and monitor these types of injuries has also gained interest. Presented here is a non-invasive method using magnetic resonance (MR) phase gradient mapping (PGM) to characterize TBI treatment in relation to regional cerebral blood flow (rCBF) in angiogenesis and tissue loss. In a rat moderate-to-severe TBI model, increases between 16-29% in rCBF were seen in the treatment group twenty weeks post TBI, while decreases between 9-27% in rCBF were seen in the non-treatment group.

865 12:18

Evaluation of time-course of diffusivity changes and inflammatory response in hippocampus post moderate traumatic brain injury
Kavita Singh[1], Richa Trivedi[1], Maria M D'souza[2], and Subash Khushu[1]

[1]NMR, INMAS, DRDO, Delhi, Delhi, India, [2]Molecular imaging, INMAS, DRDO, Delhi, Delhi, India

Hippocampal atrophy is seen in traumatic brain injury even when it is remote to the site of injury. Present study assess acute microstructural and inflammatory changes affecting hippocampal damage using diffusion tensor imaging and Iba-1, GFAP immunostaining at D0, 4H, D1 and D5 in rodent model of moderate TBI. Significantly reduced mean diffusivity and radial diffusivity alongwith increased fractional anisotropy at 4H, D1 and D5. Iba-1+ cells significantly increased at D1 and D5 with GFAP+ cells peaking at D5. Study provides temporal evaluation of diffusion changes which may be due to underlying inflammatory changes.

Oral

The Sparse Road to Quantitative Imaging

Summit 1 10:30 - 12:30 *Moderators:*Ganesh Adluru & Fernando Boada

866 10:30

Compressive Parametric Manifold Recovery (PARMA) from Multi-channel Acquisition for Fast Parameter Mapping
Chaoyi Zhang[1], Yihang Zhou[1], Jingyuan Lyu[1], Ukash Nakarmi[1], and Leslie Ying[1,2]

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MR parameter mapping has shown great potential but is still limited in clinical application due to the lengthy acquisition time. To address this issue, we proposed a novel image reconstruction method(PARMA) to accelerate parameter mapping with reduced multi-channel acquisition using alternating projections on the single-exponential parametric manifold, the subspace data consistancy, and the convex of the regularized coil sensitivities. The experimental results show the potential of highly accelerated quantitative imaging by the proposed method.

867 10:42

A general low-rank tensor framework for high-dimensional cardiac imaging: Application to time-resolved T1 mapping
Anthony G. Christodoulou[1,2], Jaime L. Shaw[2,3], Behzad Sharif[2,4], and Debiao Li[2,3]

[1]Heart Institute, Cedars-Sinai Medical Center, Los Angeles, CA, United States, [2]Biomedical Imaging Research Institute, 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 Biomedical Sciences, Cedars-Sinai Medical Center, Los Angeles, CA, United States

We present a general low-rank tensor framework for high-dimensional cardiac imaging, modeling the underlying image as partially separable in all relevant dimensions: space, cardiac phase, respiratory phase, wall-clock time (e.g., for contrast agent dynamics), variable sequence parameters (e.g., inversion time), etc. An explicit-subspace variant of the framework is demonstrated, with subspaces

estimated from navigator data and a signal recovery dictionary of solutions to the Bloch equations (similar to MR fingerprinting). This variant is used to perform ECG-less cardiac- and time-resolved T_1 mapping during first-pass perfusion, as well as free-breathing, ECG-less native T_1 mapping at multiple cardiac phases. The framework shows promise for time-resolved T_1 mapping and other high-dimensional applications.

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868 10:54

Direct Reconstruction of Kinetic Parameter Maps in Accelerated Brain DCE-MRI using the Extended-Tofts Model

Yi Guo[1], Sajan Goud Lingala[1], Yinghua Zhu[1], R. Marc Lebel[2], and Krishna S Nayak[1]

[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States, [2]GE Healthcare, Calgary, AB, Canada

Pharmacokinetic (PK) parameter maps derived from DCE-MRI provide quantitative physiological information that aids in cancer diagnosis and assessment of treatment response. Recently, direct reconstruction of PK maps from under-sampled k,t-space has shown great potential to provide optimal detection of kinetic parameter maps from an information theoretic perspective. We build on prior work (using the Patlak model) and demonstrate direct reconstruction of kinetic parameter maps using the extended-Tofts model, which is a more appropriate model in brain tumor. We demonstrate convergence behavior, computational efficiency, and application to brain DCE-MRI.

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869 11:06

TGV-Regularized Single-Step Quantitative Susceptibility Mapping

Itthi Chatnuntawech[1], Patrick McDaniel[1], Stephen F. Cauley[2,3], Borjan A. Gagoski[3,4], Christian Langkammer[5], Adrian Martin[6], Ellen Grant[3,4], Lawrence L. Wald[2,3,7], Kawin Setsompop[2,3], Elfar Adalsteinsson[1,7,8], and Berkin Bilgic[2]

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To directly estimate tissue magnetic susceptibility distribution from the raw phase of a gradient echo acquisition, we propose a single-step quantitative susceptibility mapping (QSM) method that benefits from its three components: (i) the single-step processing that prevents error propagation normally encountered in multiple-step QSM algorithms, (ii) multiple spherical mean value kernels that permit high fidelity background removal, and (iii) total generalized variation regularization that promotes a piecewise-smooth solution without staircasing artifacts. A fast solver for the proposed method, which enables simple analytical solutions for all of the optimization steps, is also developed. Improved image quality over conventional QSM algorithms is demonstrated using the SNR-efficient Wave-CAIPI and 3D-EPI acquisitions.

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870 11:18

In vivo accelerated MR parameter mapping using annihilating filter-based low rank Hankel matrix (ALOHA)

Dongwook Lee[1], Kyong Hwan Jin[1], Eung-yeop Kim[2], Sunghong Park[1], and Jong Chul Ye[1]

[1]Bio and Brain Engineering, Korea Advanced Institute of Science and Technology, Daejeon, Korea, Republic of, [2]Radiology, Gachon University Gil Medical Center, Inchoen, Korea, Republic of

The purpose of this study is to develop an accelerated MR parameter mapping technique. For accelerated T1 and T2 mapping, spin-echo inversion recovery and multi-echo spin echo pulse sequences were redesigned to perform undersampling along phase encoding direction. The highly missing k-space were then interpolated by using recently proposed annihilating filter based low-rank Hankel matrix approach (ALOHA). By exploiting the duality between the transform domain sparsity and the low-rankness of weighted Hankel structured matrix in k-space, ALOHA provided outperforming reconstruction results compared to the existing compressed sensing methods.

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871 11:30

A Model-Based Approach to Accelerated Magnetic Resonance Fingerprinting Time Series Reconstruction

Bo Zhao[1], Kawin Setsompop[1], Borjan Gagoski[2], Huihui Ye[1], Elfar Adalsteinsson[3], P. Ellen Grant[2], and Larry L. Wald[1]

[1]Athinoula A. Martinos Center for Biomedical Imaging, Chalestown, MA, United States, [2]Boston Children's Hospitial, Boston, MA, United States, [3]EECS, MIT, Cambridge, MA, United States

A new model-based approach using low-rank and sparsity constraints is presented for reconstructing the accelerated magnetic resonance fingerprinting (MRF) time-series images. By enabling high-quality reconstructions of contrast-weighted images from highly-undersampled data, the proposed method produces more accurate estimates of tissue parameter maps compared to the conventional gridding based reconstruction of the time-series. Ultimately, the goal is to reduce imaging time for MRF acquisitions and improve spatial resolution.

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872 11:42

Low-Rank O-Space Reconstruction

Haifeng Wang[1], Emre Kopanoglu[1], R. Todd Constable[1,2], and Gigi Galiana[1]

[1]Department of Radiology and Biomedical Imaging, Yale University, New Haven, CT, United States, [2]Department of Neurosurgery, Yale University, New Haven, CT, United States

Low-Rank O-Space presents a scheme to incorporate O-Space imaging with Low-Rank matrix recovery. The Low-Rank reconstruction based on iterative nonlinear conjugate gradient algorithm is applied to substitute the previous Kaczmarz and Compressed Sensing (CS)

reconstructions to recover highly undersampled O-Space data. The simulations and experiments illustrate the proposed scheme can remove artifacts and noise in O-Space imaging at high reduction factors, compared to results recovered by Kaczmarz and CS. Moreover, the proposed method does not need to modify the conventional O-Space pulse sequences, and reconstruction results are better than those in radial imaging recovered by Kaczmarz, CS, or Low-Rank methods.

873 11:54

Simultaneous multi-modality/multi-contrast image reconstruction with nuclear-norm TGV

Florian Knoll[1], Martin Holler[2], Thomas Koesters[1], Martijn Cloos[1], Ricardo Otazo[1], Kristian Bredies[2], and Daniel K Sodickson[1]

[1]Center for Advanced Imaging Innovation and Research (CAI2R) and Bernard and Irene Schwartz Center for Biomedical Imaging, Department of Radiology, NYU School of Medicine, New York, NY, United States, [2]Mathematics and Scientific Computing, University of Graz, Graz, Austria

A typical clinical imaging protocol covers a large number of different image contrasts and, in the era of multi-modality systems, even different imaging modalities. While the resulting datasets share a substantial amount of structural information, they consist of fundamentally different contrasts and signal values and show unique features and image content. We propose a reconstruction framework based on nuclear-norm second-order Total Generalized Variation that exploits structural similarity both between different contrasts and modalities while still being flexible with respect to signal intensity and unique features. Numerical simulations and in vivo MR-Fingerprinting experiments demonstrate improved PET resolution and improved depiction of quantitative values. The proposed approach allows a 6 minute whole brain coverage exam that provides both quantitative PET and MR-relaxation parameters.

874 12:06

Spatiotemporal-atlas-based High-resolution Dynamic Speech MRI

Maojing Fu[1], Jonghye Woo[2], Marissa Barlaz[3], Ryan Shosted[3], Zhi-Pei Liang[1], and Bradley Sutton[4]

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Dynamic speech MRI holds great promise for visualizing articulatory motion in the vocal tract. Recent work has enabled accelerated imaging speed, resulting in the need to integrate mechanisms to enable interpretation of the dynamic images that contain great amounts of movement information. This work integrates a spatiotemporal atlas into a partial separable (PS) model-based imaging framework and uses the atlas as prior information to improve reconstruction quality. This method not only captures high-quality dynamics at 102 frames per second, but also enables quantitative characterization of articulatory variability utilizing the residual component from the atlas-based sparsity constraint.

875 12:18

High-Resolution Dynamic 31P-MRSI Using High-Order Partially Separable Functions

Chao Ma[1], Fan Lam[1], Qiang Ning[1,2], Bryan A. Clifford[1,2], Qiegen Liu[1], Curtis L. Johnson[1], and Zhi-Pei Liang[1,2]

[1]Beckman Institute, University of Illinois Urbana-Champaign, Urbana, IL, United States, [2]Electrical and Computer Engineering, University of Illinois Urbana-Champaign, Urbana, IL, United States

Dynamic MRSI measures the temporal changes of metabolite concentrations by acquiring a time series of MRSI data. These data can be used in a range of applications, including the study of the response of a metabolic system to a perturbation. However, high-resolution dynamic MRSI is challenging due to poor SNR resulting from the low concentrations of metabolites. This work presents a new method for high-resolution dynamic 31P-MRSI using high-order partially separable functions. The method has been validated using in vivo dynamic 31P-MRSI experiments, producing encouraging results.

Oral

Whole Body/PET/MRI

Summit 2 10:30 - 12:30 *Moderators:*Thomas Hope & Alan McMillan

876 10:30

Improvement in Alignment & Signal Uniformity via Realtime B0 Correction and Image Registration in Multi-station PET/MR Whole body Diffusion Imaging

Maggie Mei Kei Fung[1], Abhishek Sharma[2], Justin Lahrman[3], Lloyd Estkowski[4], and Ersin Bayram[5]

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In a PET/MR imaging, anatomical alignment between PET & MR images and good visualization of spine & lymph node are critical in the clinical interpretation of diseases. In whole body multi-station diffusion weighted imaging (DWI), it is common to observe signal drop off and spatial misalignment due to B0 inhomogeneity. In this study, we proposed a two-prong approach in improving the signal uniformity & spatial alignment by combining a real-time slice-by-slice B0 correction technique and an image registration technique. We have validated the approach in 18 volunteers with various physical attributes.

877 10:42

Diagnostic ability of Whole-Body Diffusion-Weighted Imaging in malignant tumors compared with PET-CT

Xiaoyi Wang[1], Ning Wu[1], Yanfeng Zhao[1], Han Ouyang[1], Lizhi Xie[2], Jin Zhang[1], Li Liu[1], Wenjie Zhang[1], Rong Zheng[1], Ying Liang[1], and Ying

Liu[1]

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Because of its convenience in whole body examination, whole body MRI is growing popular, especially in the tumor diagnosis. In the present work, the diagnostic ability of whole-body diffusion-weighted imaging in malignant lesions is compared with that obtained with ^{18}F-FDG PET-CT. We found that WBDWI was an effective method for screening bone metastasis, especially suitable for radiation-vonuerable population, and it is better than PET-CT in detecting low grade malignant tumor. In summary, WBDWI can be used as a potential alternative to PET/CT in addition to conventional MR examination.

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878 10:54

PET/MR attenuation correction using Zero Echo Time imaging in 15O-water study

Mohammad Mehdi Khalighi[1], Gaspar Delso[2], Praveen K. Gulaka[3], Audrey Peiwen Fan[3], Bin Shen[4], Aileen Hoehne[4], Prachi Singh[3], Jun-Hyung Park[4], Dawn Holley[3], Frederick T. Chin[3,4], and Greg Zaharchuk[3,4]

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Accurate identification of bone tissue is important to generate attenuation correction maps on a PET/MR scanner for quantification of tracer activity in PET images. Head atlas-based attenuation correction and a new zero echo time technique (ZTE) for attenuation correction are compared in an ^{15}O-water brain study. The comparison shows that ZTE-based attenuation correction provides more accurate identification of bone tissue and thus of the tracer activity. Any mismatch in bone identification will affect the tracer activity, especially in voxels close to the bone.

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879 11:06

Respiratory Resolved Attenuation Correction Maps for Motion Compensated PET-MR using Dixon-GRPE

Christoph Kolbitsch[1,2], Radhouene Neji[3], Matthias Fenchel[4], and Tobias Schaeffter[1,2]

[1]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom, [2]Physikalisch-Technische Bundesanstalt (PTB), Braunschweig and Berlin, Germany, [3]MR Research Collaborations, Siemens Healthcare, Frimley, United Kingdom, [4]MR Oncology Application Development, Siemens Healthcare, Erlangen, Germany

Quantitative PET requires accurate attenuation correction (AC) information. For simultaneous PET-MR acquisitions in the thorax or abdomen these MRAC images are obtained in a single breathhold which can lead to misregistration errors between breathhold MRAC and free-breathing PET data. Here we present a method which obtains accurate AC information (Dice coefficient higher than 0.85) during free-breathing and yields additional respiratory motion fields which can be utilised in motion-compensated MR and PET reconstructions. The proposed Dixon-GRPE method led to improvements of up to 50% in sharpness (FWHM) and a 33% improvement in the quantification of the specific uptake value (SUV).

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880 11:18

Impact of MR-based PET motion correction on the quantification of myocardial blood flow: an in-vivo simultaneous MR/PET study

Yoann Petibon[1], Behzad Ebrahimi[1], Timothy G Reese[1,2], Nicolas Guehl[1], Marc D Normandin[1], Nathaniel M Alpert[1], Georges El Fakhri[1], and Jinsong Ouyang[1]

[1]Center for Advanced Medical Imaging Sciences, Radiology, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States, [2]Athinoula A. Martinos Center, Radiology, Massachusetts General Hospital and Harvard Medical School, Boston, MA, United States

Dynamic PET imaging enables absolute quantification of myocardial blood flow (MBF). However, motion of the heart during imaging deteriorates the accuracy of PET MBF measurements. Simultaneous MR/PET makes it possible to compensate PET images for motion by incorporating MR-based motion information inside the PET reconstruction process. In this study, we propose and assess the impact of a tagged-MRI based PET motion-correction technique for improved PET MBF quantification using an *in-vivo* simultaneous MR/PET study.

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881 11:30

Efficient 5D imaging of thorax and abdomen for MR-guided PET motion correction

Christian Würslin[1], Dominik Fleischmann[2], and Roland Bammer[1]

[1]Radiological Sciences Laboratory, Stanford University, Stanford, CA, United States, [2]Cardiovascular Imaging Section, Department of Radiology, Stanford University, Stanford, CA, United States

Cardiac imaging under free breathing is a desirable tool for clinical routine, which can provide improved patient comfort and shorter examination times. Furthermore, it can be used in the context of MR-guided PET motion correction in simultaneous PET-MRI. Here, we propose a radial acquisition and reconstruction framework for the acquisition of these images. A piecewise rigid respiration motion model enables a highly efficient use of the acquired data to either achieve higher image quality or shorter examination times than standard, dual-gated techniques.

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882 11:42

MR-PET simultaneous acquisitions with attenuation correction using LSO background radiation.

Liliana Lourenco Caldeira[1], Theodoros Kaltsas[1], Jürgen Scheins[1], Elena Rota Kops[1], Lutz Tellmann[1], Uwe Pietrzyk[1], Christoph Lerche[1], and N. Jon Shah[1,2]

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In this work, the goal is to perform attenuation correction (AC) for MR-PET scanners using the background activity from LSO (Cerium-doped Lutetium Oxyorthosilicate) scintillator used in PET scanners. This approach has the advantage of obtaining a geometrically aligned AC map with the PET emission scans, which can be useful for coil AC maps. We demonstrate our approach for the Siemens 3T MR-BrainPET with a Tx/Rx 8-channel head coil and a 3-rod phantom.

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883 11:54

magna cum laude

[18F]FDG PET/MRI Of Patients With Chronic Pain Alters Management: Early Experience.
Daehyun Yoon[1], Deepak Behera[1], Dawn Holley[1], Pamela Gallant[1], Ma Agnes Martinez Ith[2], Ian Carroll[3], Matthew Smuck[2], Brian Hargreaves[1], and Sandip Biswal[1]

[1]Radiology, Stanford University, Palo Alto, CA, United States, [2]Orthopaedic Surgery, Stanford University, Palo Alto, CA, United States, [3]Anesthesia, Stanford University, Palo Alto, CA, United States

The chronic pain sufferer is currently faced with a lack of objective tools to identify the source of their pain. Increased inflammation of the nervous system, vessels, muscles, and other tissues in chronic pain sufferers and [18F]fluorodeoxyglucose positron emission tomography/magnetic resonance imaging ([18F]FDG PET/MRI) has emerged as a sensitive clinical tool to identify increased inflammation. We plan to develop clinical [18F]FDG PET/MRI method to more accurately localize sites of hypermetabolic foci as it relates to pain generators. Early clinical results suggest that [18F]FDG PET/MRI can identify abnormalities in chronic pain patients and can immediately affect their management.

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884 12:06

Distribution and metabolism of 89Zr-labeled HDL nanoparticles in atherosclerotic rabbits: in vivo, longitudinal imaging with PET/MRI
Claudia Calcagno[1,2], Carlos Perez-Medina[1,2], Tina Binderup[3], Mark E Lobatto[4], Seigo Ishino[1,2], Mootaz Eldib[1,2], Philip Robson[1,2], Sarayu Ramachandran[1,2], Thomas Reiner[5], Edward Fisher[6], Zahi A Fayad[1,2], and Willem JM Mulder[1,2]

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Abundant, active inflammatory cells are a hallmark of high-risk atherosclerotic plaques. High-density lipoprotein (HDL) is a natural nanoparticle composed of phospholipids, cholesterol and apolipoprotein A-I (APOA1), which has been shown to have atheroprotective properties. . The recent development of combined PET/MRI scanners and new advances in radio-labeling technology gives the opportunity to investigate theese properties in vivo. Using a unique set-up combining PET/CT and PET/MRI, we non-invasively assess the pharmacokinetics, distribution, metabolism and turnover of ^{89}Zr-HDL's in a rabbit model of atherosclerosis.

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885 12:18

PET/MRI in Pancreatic and Periampullary Cancer: Correlating Diffusion-weighted Imaging, MR spectroscopy, and Glucose Metabolic Activity With Clinical Stage
Bang-Bin Chen[1], Yu-Wen Tien[2], Ming-Chu Chang[3], Mei-Fang Cheng[4], Yu-Ting Chang[3], Chih-Horng Wu[1], Xin-Jia Chen[1], Ting-Chun Kuo[2], Shih-Hung Yang[5], I-Lun Shih[1], Hong-Shiee Lai[2], and Tiffany Ting-Fang Shih[1]

[1]Medical Imaging and Radiology, National Taiwan University Medical School and Hospital, Taipei, Taiwan, [2]Surgery, National Taiwan University Medical School and Hospital, Taipei, Taiwan, [3]Internal Medicine, National Taiwan University Medical School and Hospital, Taipei, Taiwan, [4]Nuclear Medicine, National Taiwan University Medical School and Hospital, Taipei, Taiwan, [5]Oncology, National Taiwan University Medical School and Hospital, Taipei, Taiwan

We demonstrated that PET/MRI provides numerous useful imaging biomarkers for clinical staging and pathological grading in patients with pancreatic cancer or periampullary cancer. ADCmin was lower in tumors with N1 and an advanced TNM stage. Choline levels were higher in T4 and poorly differentiated tumors. Tumors with high glucose metabolic activity, as reflected by MTV and TLG, were at a more advanced T stage, exhibited lymph node and distant metastasis, and were at an advanced TNM stage. Moreover, compared with MTV or ADCmin alone, the MTV/ADCmin ratio demonstrated the highest predictive ability for determining the clinical TNM stage. Thus, integrated PET/MRI could provide complementary information on tumor characteristics, and these combined data could have stronger clinical or pathological implications than MRI or PET alone.

Educational Course

All About Bones

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 10:30 - 12:30 *Moderators:*Feliks Kogan & Mary Maynard

10:30

Update on Imaging Techniques for Evaluation of Bone
Chamith Rajapakse[1]

[1]University of Pennsylvania

Millions of people worldwide suffer from bone diseases, predisposing them to fractures and related comorbidities that have devastating consequences. Imaging plays an important role in fracture risk assessment, diagnosis, staging, and treatment monitoring of patients with bone diseases. Flexibility of MRI has paved the way for non-invasive assessment of bone quality at multiple levels, including

trabecular and cortical bone. This talk will provide an overview of emerging MR-based approaches for quantifying bone quality in human subjects.

11:00 Bone Marrow Edema & Osteonecrosis
Christopher J. Hanrahan[1]

[1]Department of Radiology and Imaging Sciences, University of Utah School of Medicine, Salt Lake City, UT, United States

This presentation will review the MR appearance of normal maturation of bone marrow, osteonecrosis, and features that will aid in determining the underlying cause of bone marrow edema.

11:30 Imaging of Bone in Osteoporosis and Osteoarthritis
Sharmila Majumdar

Bone changes are important in several conditions such as osteoporosis and osteoarthritis. Imaging methods for understanding bone changes, and their relationship to fracture status in osteoporosis and cartilage changes in osteoarthritis will be covered.

12:00 Evaluation of Bone Metabolism & Remodeling with PET/MR
Feliks Kogan[1]

[1]Stanford University

18F-Sodium Fluoride (NaF) is a long recognized bone-seeking agent that is sensitive to bony metabolism and remodeling. New hybrid PET-MRI systems offer to combine the benefits of MRI high-resolution morphologic imaging with functional information from PET for simultaneous, sensitive and quantitative assessment of bone quality and remodeling. This presents an opportunity to not only assess bony activity, but to also to characterize established quantitative and qualitative MRI metrics of bone health.

12:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

The Singapore Flyer of Vascular Imaging

*Organizers:*Martin Graves, Ph.D. & Jeanette Schulz-Menger, M.D.

Nicoll 2 10:30 - 12:30 *Moderators:*Martin Graves & Konstantin Nikolaou

10:30 Advanced Techniques for MRA
Gabriele Krombach

Contrast enhanced and non-contrast enhanced MR angiography represent the two main methods for delineation of vessels. In contrast enhanced MRA, classically spatial resolution and temporal resolution have to be balanced against each other. View sharing and central read out of k-space have been introduced for subsecond acquisition of high resolution dynamics. This technique has a broad spectrum of clinical applications. In non-contrast MRA the classical approaches time-of-flight and phase contrast angiography suffered from long acquisition time and were prone to flow artifacts in regions with non-laminar flow. Application of balanced steady state free precession with flow sensitive dephasing allows for selective delineation of arteries with high signal intensity and high spatial resolution without flow related artefacts. This technique has already been demonstrated to be of high clinical impact in many vessel territories including the upper and lower extremities.

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886 11:00 Feasibility of Time-Resolved Subtractionless Contrast Enhanced Dixon MRA of the lower legs on 1.5T
Marc Kouwenhoven[1], Silke Hey[1], Christine Nabuurs[1], Alan Huang[1], Adri Duijndam[1], Elwin de Weerdt[1], Holger Eggers[2], Niels Blanken[3], and Tim Leiner[3]

[1]Philips, Best, Netherlands, [2]Philips Research, Hamburg, Germany, [3]Radiology Dept., University Medical Center, Utrecht, Netherlands

In this work, the feasibility is explored for subtractionless first-pass time-resolved contrast enhanced MRA of the lower legs on 1.5T using Dixon, viewsharing and parallel imaging with high acceleration factors. Results in seven consecutive patients are analyzed and compared with the conventional subtraction method. It is demonstrated that with the subtractionless method, bulk motion artifacts are eliminated, and SNR is significantly increased.

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887 11:15 Clinical Performance of a Non-contrast MR Angiography Protocol in the Pre-Transplant Evaluation of the Liver Vasculature
Jeremy Collins[1], Eric Keller[2], Edouard Semaan[3], Riad Salem[2], Maria Carr[2], Michael Markl[2], and James C Carr[2]

[1]Radiology, Northwestern University, Chicago, IL, United States, [2]Northwestern University, Chicago, IL, United States, [3]Chicago, IL, United States

Assessment of the hepatic vasculature is critical as part of the pre-liver transplant evaluation. The prevalence of renal insufficiency and

concerns regarding gadolinium administration in this cohort has created a need for a non-contrast alternative for vascular assessment. We evaluated the clinical performance of a non-contrast MRA (NCMRA) protocol at 3T in the assessment of the hepatic vasculature in patients with cirrhosis, with contrast-enhanced MRA (CEMRA) as the reference standard. The NCMRA protocol was diagnostic in 94% of subjects, identifying all relevant variant anatomy. Clinically available NCMRA techniques when combined into a comprehensive protocol enable assessment of the hepatic vasculature.

11:30 Advanced Techniques for Flow Imaging
Michael Hope[1]

[1]*UCSF*

We will focus on the emerging applications of multidimensional MR flow imaging (4D Flow). The techniques and hemodynamic biomarkers that we will discuss can be applied broadly throughout the cardiovascular system. **Two key issues** must be addressed when considering these applications: 1) clear advantages over ultrasound/echocardiography and 2) matching advanced imaging capabilities with clinical questions that change the management of patients with cardiovascular disease. The goal is to provide a unique understanding of how abnormal flow promotes or exacerbates disease. This understanding, in turn, could allow patients to be risk-stratified based on flow, guide medical therapy, and identify new pathways to target with drug therapy and patients that may benefit from early intervention. **The outline of the talk** is 1) review of two current clinical applications for MRI flow imaging and 2) discussion of four emerging applications for 4D Flow.

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888 12:00 Impact of Bicuspid Aortic Valve Fusion Phenotype and Valve Stenosis on Aortic 3D Hemodynamics: New Insights from a Large Cohort 4D Flow MRI Study in 312 subjects
Alex J Barker[1], Pim van Ooij[2], Emilie Bollache[1], David Guzzardi[3], S. Chris Malaisrie[4], Patrick M McCarthy[4], Jeremy D Collins[1], James Carr[1], Paul WM Fedak[3], and Michael Markl[1,5]

[1]*Radiology, Northwestern Univeristy, Chicago, IL, United States,* [2]*Academic Medical Center, Amsterdam, Netherlands,* [3]*University of Calgary, Calgary, AB, Canada,* [4]*Cardiac Surgery, Northwestern Univeristy, Chicago, IL, United States,* [5]*Bioengineering, Northwestern University, Chicago, IL, United States*

Bicuspid aortic valve (BAV) morphology will alter transvalvular blood flow patterns and vessel wall shear stress (WSS). These hemodynamic changes have been associated with the regional expression of BAV aortopathy. However, the presence of aortic stenosis can confound the regional expression of WSS. The purpose of this study was to use aortic WSS atlases to understand the role of aortic valve morphology and stenosis on the expression of WSS in the ascending aorta of a large control and BAV patient cohort (n=312).

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889 12:15 MRI assessment of aortic flow in patients with pulmonary hypertension in response to exercise
Jacob Macdonald[1], Omid Forouzan[2], Naomi Chesler[2], Christopher Francois[3], and Oliver Wieben[1,3]

[1]*Medical Physics, University of Wisconsin - Madison, Madison, WI, United States,* [2]*Biomedical Engineering, University of Wisconsin - Madison, Madison, WI, United States,* [3]*Radiology, University of Wisconsin - Madison, Madison, WI, United States*

Cardiopulmonary exercise testing is gaining increased recognition as a useful tool for assessing pulmonary hypertension (PH). Using an MRI-compatible exercise device that allows subjects to exercise in the bore of the magnet, we investigated the effects of exercise stress on blood flow in the ascending aorta in healthy controls and patients with PH. The measurements we obtained demonstrated a decreased exercise capacity in PH subjects and in older controls. Some parameters, such as cardiac output, demonstrated statistically significant changes between rest and stress, while others were unclear due to the relatively low exercise power tolerated by the PH patients.

12:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Imaging Metabolism: What Can We Detect & How?

*Organizers:*Anke Henning, Ph.D. & N. Jon Shah, Ph.D.

Nicoll 3 10:30 - 12:30 *Moderators:*Anke Henning & N. Jon Shah

10:30 Imaging Membrane & Protein Metabolism
Kristine Glunde

This presentation will provide an overview of current ^{1}H and ^{31}P magnetic resonance spectroscopy (MRS) approaches as well as chemical exchange saturation transfer (CEST) and amide proton transfer (APT) techniques that detect membrane and protein metabolism in cancer, along with a discussion of the detected molecules in the realm of cancer diagnosis and treatment monitoring.

10:50 Imaging Neurotransmission
In-Young Choi[1]

[1]University of Kansas Medical Center

11:10

Imaging Energy Metabolism
Craig R. Malloy[1]

[1]University of Texas Southwestern

890

magna cum laude

11:30

Metabolic profiling of *in vivo* brain rodent models by relaxation-enhanced ^{1}H MRS of the downfield region at 21.1 T
Tangi Roussel[1], Jens T. Rosenberg[2], Samuel Colles Grant[2,3], and Lucio Frydman[1,2]

[1]Chemical Physics, Weizmann Institute of Science, Rehovot, Israel, [2]Center for Interdisciplinary MR, National High Magnetic Field Laboratory, Tallahassee, FL, United States, [3]Chemical & Biomedical Engineering, Florida State University, Tallahassee, FL, United States

This study explores new opportunities that ultra-high field combined with non-water-suppressed ^{1}H MRS methodologies make possible regarding the profiling of signals that resonate downfield from the water peak. Studies were carried out on rats using a 21.1-T ultra-widebore system, and focused on quantitatively analyzing the metabolic concentration changes for ischemic stroke and glioblastoma tissues. A general decrease in the relative metabolic concentrations were observed for both pathologies, certain molecules depart from this trend: lactate, glutathione (stroke), choline and UDP-Nacetyl hexosamines (glioma). Potential explanations for these features and new research avenues opened by these types of measurements are discussed.

891

magna cum laude

11:42

Study of the Mutated Isocitrate Dehydrogenase 1 in Acute Myeloid Leukemia Using Hyperpolarized [1-13C]α-ketoglutaric Acid
Eugen Kubala[1,2,3], Kim A. Muñoz Álvarez[1], Oliver Dovey[4], Steffen J. Glaser[2], Markus Schwaiger[1], George S. Vassiliou[4], Roland Rad[5,6], Rolf F. Schulte[3], and Marion I. Menzel[3]

[1]Department of Nuclear Medicine, Klinikum Rechts der Isar, Technische Universität München, Munich, Germany, [2]Department of Chemistry, Technische Universität München, Munich, Germany, [3]General Electric Global Research, Munich, Germany, [4]The Welcome Trust Sanger Institute, Hinxton/Cambridge, United Kingdom, [5]Department of Medicine II, Klinikum Rechts der Isar, Technische Universität München, Munich, Germany, [6]Cancer Consortium (DKTK), German Cancer Research Center (DKFZ), Munich, Germany

Previous studies suggest that *isocitrate dehydrogenase 1* (*IDH1*) mutation plays a significant role in the cancerous metabolome. Among other alternations, expression of *branched chain amino-acid transaminase 1* (*BCAT1*) is reduced, causing a decrease of α-ketoglutaric acid (αKG) to glutamic acid metabolic pathway. More importantly, the mutated *IDH1* catalyzes a reaction of αKG to the oncometabolite 2-hydroxyglutarate. In this study we proved that these metabolic changes can be measured using hyperpolarized [1-^{13}C]α-KG and ^{13}Cmetabolic magnetic resonance spectroscopy (^{13}CMMRS) in acute myeloid leukemia cell line in *vitro*.

892

magna cum laude

11:54

CEST Imaging of the Serotonin Pathway
Rafal Janik[1], Lynsie A.M. Thomason[2], and Greg J. Stanisz[1,2,3]

[1]Medical Biophysics, University of Toronto, Toronto, ON, Canada, [2]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada, [3]Department of Nerurosurgery and Pediatric Neurosurgery, Medical University of Lublin, Lublin, Poland

A novel method for the detection of brain 5-HT, tryptophan, and 5-HIAA is presented. The method relies on the chemical exchange of an amide proton which is shifted outside the normal range for amide protons. This is demonstrate in-vivo in a rat model of 5-HT increase.

893

12:06

Towards “non-invasive histology” of the brain by diffusion-weighted MR spectroscopy in vivo: comparison between diffusion-extracted synthetic cells and real histology in the mouse and primate brain
Marco Palombo[1,2], Clémence Ligneul[1,2], Chloé Najac[1,2], Juliette Le Douce[1,2], Julien Flament[1,2], Carole Escartin[1,2], Philippe Hantraye[1,2], Emmanuel Brouillet[1,2], Gilles Bonvento[1,2], and Julien Valette[1,2]

[1]CEA/DSV/I2BM/MIRCen, Fontenay-aux-Roses, France, [2]CNRS Université Paris-Saclay UMR 9199, Fontenay-aux-Roses, France

A new diffusion-weighted MRS paradigm, combining advanced modeling with metabolites diffusion measurements at long diffusion times, is applied in the mouse and macaque brain in vivo. Resulting synthetic astrocytes and neurons (derived from cell-specific metabolite diffusion) can be compared with histological data. Very good agreement between Sholl analysis on real and synthetic astrocytes validates our approach and assumptions. We also measure increased size and complexity of synthetic astrocytes in primate compared to mouse, while dendritic organization appears better conserved throughout species. Although still in its infancy, our strategy opens new perspectives for the non-invasive evaluation of brain cell morphology.

894

12:18

In vivo ^{1}H and ^{31}P MR spectroscopy in healthy fibroglandular breast tissue at 7 Tesla.
Wybe JM van der Kemp[1], Bertine L Stehouwer[1], Vincent O Boer[1], Peter R Luijten[1], Dennis WJ Klomp[1], and Jannie P Wijnen[1]

[1]Radiology, UMC Utrecht, Utrecht, Netherlands

Water and fat suppressed ^{1}H total choline MR spectroscopy and ^{31}P MR spectroscopy were performed in healthy fibroglandular breast tissue of a group of 8 volunteers. ^{31}P T_2 values were determined, and reproducibility of ^{1}H and ^{31}P MR spectroscopy were investigated.

The ^{1}H and ^{31}P data were combined to calculate estimates of absolute concentrations of PC, GPC and PE.

12:30 Adjournment & Meet the Teachers

Traditional Poster : CV

Exhibition Hall 13:30 - 15:30 *(no CME credit)*

Electronic Poster : Neuro

Exhibition Hall 13:30 - 14:30 *(no CME credit)*

Electronic Poster : MSK

Exhibition Hall 14:30 - 15:30 *(no CME credit)*

Study Groups

MR Spectroscopy

Hall 405 E 13:30 - 15:30

Study Groups

Pediatric MR

Hall 406 D 13:30 - 15:30

Power Pitch

Molecular Imaging & Metabolomics

Power Pitch Theatre, Exhibition Hall 13:30 - 14:30 *Moderators:*Kevin Bennett

895 13:30 Vascular injury triggers a systemic response that promotes atherosclerosis progression at a remote site of injury.
Begona Lavin Plaza[1], Alkystis Phinikaridou[1], Marcelo Andia[2], Silvia Lorrio Gonzalez[1], and Rene Botnar[1]

[1]King's College London, London, United Kingdom, [2]Pontificia Universidad Catolica de Chile, Santiago de Chile, Chile

896 13:33 Translation of high-field fluorine-19 cell tracking techniques into the clinical realm
Jeff M Gaudet[1,2], Corby Fink[3,4], Matthew S Fox[1], Gregory A Dekaban[3,4], and Paula J Foster[1,2]

summa cum laude

[1]Imaging Research Laboratories, Robarts Research Institute, London, ON, Canada, [2]Medical Biophysics, Western University, London, ON, Canada, [3]Molecular Medicine, Robarts Research Institute, London, ON, Canada, [4]Microbiology and Immunology, Western University, London, ON, Canada

897 13:36 Propionate as a Probe For Myocardial Metabolism – A Biochemical and Hyperpolarized MR Study
Mukundan Ragavan[1], Xiaorong Fu[2], Shawn C Burgess[2], and Matthew E Merritt[1]

[1]Department of Biochemistry & Molecular Biology, University of Florida, Gainesville, FL, United States, [2]University of Texas Southwestern Medical Center, Dallas, TX, United States

898 13:39 In-vivo evaluation of hypometabolism associated with muscular dystrophy using Creatine CEST MRI
Rong-Wen Tain[1,2], Ahlke Heydemann[3,4], Alessandro Scotti[1,5,6], Weiguo Li[7,8], Xiaohong Joe Zhou[1,5,6,9], and Kejia Cai[1,5,6]

[1]Radiology,College of Medicine, University of Illinois, Chicago, IL, United States, [2]3T Research Program, Center for MR Research, College of Medicine, University of Illinois, Chicago, IL, United States, [3]Physiology & Biophysics,College of Medicine, University of Illinois, Chicago, IL, United States, [4]Center for Cardiovascular Research, College of Medicine, University of Illinois, Chicago, IL, United States, [5]3T Research Program, Center for MR Research, University of Illinois, Chicago, IL, United States, [6]Bioengineering, University of Illinois, Chicago, IL, United States, [7]Research Resource Center, University of Illinois, Chicago, IL, United States, [8]Radiology, Northwestern University, Chicago, IL, United States, [9]Neurosurgery, University of Illinois, Chicago, IL, United States

899 13:42 3D Dynamic Hyperpolarized 13C-Pyruvate MR Metabolic Imaging of Human Prostate Cancer
Hsin-Yu Chen[1], Peder E.Z. Larson[1,2], Jeremy W. Gordon[2], Robert A. Bok[2], Marcus Ferrone[3], Mark van Criekinge[2], Lucas Carvajal[2], Peng Cao[2], Ilwoo Park[2], Rahul Aggarwal[4], Sarah J. Nelson[1,2], John Kurhanewicz[1,2], and Daniel B. Vigneron[1,2]

[1]Graduate Program in Bioengineering, UCSF and UC Berkeley, 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]Department of Clinical Pharmacy, University of California, San Francisco, San Francisco, CA, United States, [4]Department of Medicine, Division of Hematology/Oncology, University of California, San Francisco, San Francisco, CA, United States

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900 13:45

Positive-contrast cellular MRI of embryonic stem cells for tissue regeneration using a highly efficient T1 MRI contrast agent

Sadi Loai[1], Inga E. Haedicke[2,3], Zahra Mirzaei[1], Craig Simmons[1,4], Xiao-an Zhang[2,3], and Hai-Ling Margaret Cheng[1,5]

[1]Institute of Biomaterials & Biomedical Engineering, University of Toronto, Toronto, ON, Canada, [2]Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, ON, Canada, [3]Chemistry, University of Toronto, Toronto, ON, Canada, [4]Mechanical and Industrial Engineering, University of Toronto, Toronto, ON, Canada, [5]The Edward S. Rogers Sr. Department of Electrical & Computer Engineering, University of Toronto, Toronto, ON, Canada

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901 13:48

Testing the Efficacy of GdDO3NI: A Novel Hypoxia-Targeting T1 Contrast Agent

Shubhangi Agarwal[1], Carlos Renteria[1], Xiangxing Kong[2], Yanqing Tian[2], and Vikram Kodibagkar[1]

[1]School of Biological and Health Systems Engineering, Arizona State University, Tempe, AZ, United States, [2]Biodesign Institute, Arizona State University, Tempe, AZ, United States

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902 13:51

Tracking transplanted cells with paramagnetic fluorinated nanoemulsions

Alexander A. Kislukhin[1], Hongyan Xu[1], Stephen R. Adams[2], Kazim H. Narsinh[1], Roger Y. Tsien[2,3], and Eric T. Ahrens[1]

[1]Radiology, University of California San Diego, La Jolla, CA, United States, [2]Chemistry & Biochemistry, University of California San Diego, La Jolla, CA, United States, [3]Howard Hughes Medical Institute, La Jolla, CA, United States

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903 13:54

summa cum laude

Influence of Gender and Age on the Metabolic Profile of Blood Plasma in Celiac Disease Using Proton NMR Spectroscopy

Deepti Upadhyay[1], Uma Sharma[1], Govind Makharia [2], Prasenjit Das[3], Siddharth Datta Gupta[3], and Naranamangalam R Jagannathan[1]

[1]Department of NMR & MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Gastroenterology and human Nutrition, All India Institute of Medical Sciences, New Delhi, India, [3]Department of Pathology, All India Institute of Medical Sciences, New Delhi, India

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904 13:57

Specificity and sensitivity of early predictive urinary metabolic biomarker of radiation injury: a 1H NMR based metabolomic study

Poonam Rana[1], Ritu Tyagi[1], Apurva Watve[1], Sujeet Kumar Mewar[2], Uma Sharma[2], N. R. Jagannathan[2], and Subash Khushu[1]

[1]NMR Research Centre, Institute of Nuclear Medicine and Allied Sciences (INMAS), DRDO, Delhi, India, [2]Department of NMR, All India Institute of Medical Sciences (AIIMS), Delhi, India

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905 14:00

Filtered serum-based metabolomics of prostate cancer using 1H NMR spectroscopy

Ashish Gupta[1], Deepak Kumar[1], Anil Mandhani[2], and Satya Narain Sankhwar[3]

[1]metabolomics, Centre of Biomedical Research, Lucknow, India, [2]Urology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India, [3]Urology, King George's Medical University, Lucknow, India

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906 14:03

Increased metabolites in lower quality sperm suggest altered metabolism and increased cytoplasm compared to higher quality sperm

Sarah Calvert[1], Steven Reynolds[2], Martyn Paley[2], and Allan Pacey[1]

[1]Department of Oncology & Metabolism, University of Sheffield, Sheffield, United Kingdom, [2]Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom

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907 14:06

Assessment of changes in metabolic profile of small intestinal mucosal biopsy of Celiac Disease patients after gluten-free diet: An in-vitro Proton NMR Spectroscopy study

Uma Sharma[1], Deepti Upadhyay[1], Govind Makharia[2], Siddharth Datta Gupta[3], Prasenjit Das[3], and Naranamangalam R Jagannathan[1]

[1]Department of NMR and MRI Facility, All India Institute of Medical Sciences, New Delhi, India, [2]Department of Gastroenterology and human Nutrition, All India Institute of Medical Sciences, New Delhi, India, [3]Department of Pathology, All India Institute of Medical Sciences, New Delhi, India

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908 14:09

Filtered Serum Metabolomics of Myocardial Ischemia in Unstable Angina Patients

Ashish Gupta[1], Keerti Ameta[2], Deepak Ameta[3], Rishi Sethi[3], Deepak Kumar[1], and Abbas A Mahdi[2]

[1]metabolomics, Centre of Biomedical Research, Lucknow, India, [2]Biochemistry, King George's Medical University, lucknow, India, [3]Cardiology, King George's Medical University, lucknow, India

909 14:12

Correlations between cervicovaginal fluid metabolites and gestational age at delivery
Emmanuel Amabebe[1], Steven Reynolds[2], Victoria Stern[1], Jennifer Parker[3], Graham Stafford[3], Martyn Paley[2], and Dilly Anumba[1]

[1]Academic unit of Reproductive and Developmental Medicine, University of Sheffield, Sheffield, United Kingdom, [2]Academic unit of Radiology, University of Sheffield, Sheffield, United Kingdom, [3]School of Dentistry, University of Sheffield, Sheffield, United Kingdom

Oral

Device Development & Safety

Room 300-302 13:30 - 15:30 *Moderators:*Leeor Alon

910 13:30

summa cum laude

Evaluation of RF Induced Lead Tip Heating at 1.5T and 3T in Cadavers with Cardiac Pacemakers or ICDs
Volkan Acikel[1], Patrick Magrath[1,2], Scott E Parker[1], Holden H Wu[1], Peng Hu[1], Paul J Finn[1], and Daniel B Ennis[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

MRI exams for patients with pacemakers and implanted cardioverter defibrillators (ICDs) are contraindicated at all clinical field strengths. The aim of this study was to measure directly RF induced lead tip heating during MRI exams of cadavers with existing devices at both 1.5T and 3T.

911 13:42

magna cum laude

Subacute In-vivo RF Heating of an Active Medical Implantable Device Under MRI Using Temperature Sensor Implant
Berk Silemek[1], Oktay Algin[1,2], Cagdas Oto[3], and Ergin Atalar[1,4]

[1]UMRAM, Bilkent University, Ankara, Turkey, [2]Department of Radiology, Atatürk Education and Research Hospital, Ankara, Turkey, [3]Faculty of Veterinary Medicine, Ankara University, Ankara, Turkey, [4]Electrical and Electronics Engineering, Bilkent University, Ankara, Turkey

RF tissue heating of the Active Medical Implantable Devices (AIMD) is a well-known problem. However, due to the complex structure of the body, in vivo testing of the AIMDs' heating under MRI cannot be verified with phantoms completely. Acute in vivo experiments damage the tissue and body's thermoregulation response changes which can affect the measurements and investigation of the problems. Here, we propose a Temperature Sensor Implant setup to eliminate hyperacute effects of the surgery and enable real-time temperature monitoring of the tip of the implant during MRI examination

912 13:54

Experimental System for RF-Heating Characterization of Medical Implants during MRI
Earl Zastrow[1,2], Myles Capstick[1,3], and Niels Kuster[1,2]

[1]IT'IS Foundation, Zurich, Switzerland, [2]Department of Information Technology and Electrical Engineering, ETH-Zurich, Zurich, Switzerland, [3]Zurich MedTech AG, Zurich, Switzerland

Patients with elongated conductive implants are generally excluded from MRI diagnostics because the interaction of the implant with MRI-induced RF fields can lead to hazardous localized heating in surrounding tissues. Depending on the complexity of the lead structure, numerical assessment of implant-RF interactions may require excessive computational overhead and may not be feasible. To overcome this challenge, an experimental system, based on the revised Tier 3 of the ISO/IEC TS 10974, is developed and validated with full-wave electromagnetics simulations. The experimental system is designed for the assessment of RF-induced heating of implants, irrespective of the complexity of the implant structure.

913 14:06

Convex optimization of MRI exposure for RF-heating mitigation of leaded implants: extended coverage of clinical scenarios at 128 MHz
Earl Zastrow[1,2], Juan Córcoles[3], and Niels Kuster[1,2]

[1]IT'IS Foundation, Zurich, Switzerland, [2]Department of Information Technology and Electrical Engineering, ETH-Zurich, Zurich, Switzerland, [3]Department of Electronic and Communication Technology, Universidad Autónoma de Madrid, Madrid, Spain

Interactions of long insulated implants with conductive wires (e.g., cardiac pacemaker and deep-brain stimulator) with RF during MRI can lead to excessive local heating of tissue at the vicinity of the implant and is one of the contraindication to MRI. We present the preliminary results of a convex optimization method that can be used to suppress the local deposited power in tissue in a controllable manner. The performance of the proposed method is evaluated, as a function of the trade-off between homogeneity of $|B_1^+|$ and the mitigated RF-induced power deposition caused by the implant, for multiple clinical scenarios at 128 MHz.

914 14:18

magna cum laude

Simulation and Experimental Measurements of Flow Effects on Radio Frequency Induced Heating of a Stent
David C. Gross[1,2], Benjamin Scandling[1], and Orlando P. Simonetti[3,4]

[1]Biomedical Engineering, The Ohio State University, Columbus, OH, United States, [2]Dorothy M. Davis Heart and Lung Research Institute, The Ohio State University Wexner Medical Center, Columbus, OH, United States, [3]Radiology, The Ohio State University Wexner Medical Center, Columbus, OH, United States, [4]Internal Medicine, Division of Cardiovascular Medicine, The Ohio State University Wexner Medical Center, Columbus, OH,

United States

The goal of this study was to investigate the influence of blood flow on the temperature rise of a peripheral vascular stent during MRI with flow phantom experiments and computer simulations. RF heating experiments of a vascular stent are performed during MRI at 3.0T in a flow phantom. The temperature rise of the stent is measured with varied flow rates. The temperature rise of the stent was over 10°C without flow, and was reduced by 50% with a flow rate of only 50 mL/min. Blood flow significantly reduces the temperature rise of stents and the surrounding tissue during RF heating.

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915 14:30

RF Induced Heating of Overlapped Stents

Peter Serano[1,2], Maria Ida Iacono[1], Leonardo M. Angelone[1], and Sunder S. Rajan[1]

[1]U.S. Food and Drug Administration, Washington, DC, United States, [2]Electrical and Computer Engineering, University of Maryland, College Park, MD, United States

In this study, the authors present an analysis of a potentially overlooked clinical scenario, namely overlapped stents separated with a layer of insulation. Electromagnetic and thermal simulations as well as measurements were performed to test such configurations. The results show that implanted medical devices that include gapped conductive structures, like overlapped stents, can affect the location and magnitude of peak heating near the implant.

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916 14:42

Extremely Rapid Temperature Predictions Considering Numerous Physiological Phenomena

Giuseppe Carluccio[1,2] and Christopher Michael Collins[1,2]

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In a patient exam, SAR may cause temperature increase potentially leading to tissue damage or thermoregulatory distress. Hence, development of fast and accurate temperature computation methods could be useful for safety assurance. We propose a method considering more factors than ever before (including SAR, respiration, perspiration, convection, conduction, and local perfusion rates), where the temperature over an entire MRI exam is rapidly estimated exploiting the linearity of the bioheat equation. Nonlinear effects due to thermoregulatory mechanisms of the human body, such as the variation of local blood perfusion rate, are approximated with a fast spatial filter.

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917 14:54

Incident electric field on implanted lead vs. source position and field polarization

Elena Lucano[1,2], Micaela Liberti[2], Gonzalo G Mendoza[1], Tom Lloyd[3], Francesca Apollonio[2], Steve Wedan[3], Wolfgang Kainz[1], and Leonardo M Angelone[1]

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We aim to generate a quantitative method for RF-safety of patients with partially implanted leads at 64 MHz. Within this aim, the position of the RF feeding sources and the orientation of the polarization is often unknown, as it is the quantitative effect of such variables on the induced currents on the leads. The Electric field profile was studied by means of simulations and measurements with a coil loaded with a phantom, and simulations with an anatomical human model. Changes of up to 40% of E-field magnitude were observed. Future work is needed to develop a systematic exposure procedure.

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918 15:06

Biodistribution of ferumoxytol: a longitudinal MRI study

Tilman Schubert[1,2], Utaroh Motosugi[3], Diego Hernando[1], Camilo A Campo[1], Samir Sharma[4], Scott Reeder[1,4,5,6,7], and Shane Wells[1]

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Ferumoxytol has gained increasing interest as a negative MR-contrast agent due to its high r2* relaxivity. However, limited data is available about the temporal course of the biodistribution of ferumoxytol. This study evaluated the biodistribution of ferumoxytol in different tissue types using repeated MR-measurements until the 30th day after administration. Our longitudinal MRI-study demonstrated that tissues of the monocyte−macrophage system show different, dose dependent R2* peaks after ferumoxytol injection. These results could help to determine the optimal, tissue specific imaging delay after ferumoxytol administration. Tissues not containing monocytes/macrophages parallel the time course of ferumoxytol in the blood pool.

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919 15:18

MRI RF-Induced Pacemaker Lead Heating: Effect of Single vs Dual-lead Systems

Shi Feng[1], Shiloh Sison[2], Jazmine Garcia[3], Gabriel Mouchawar[3], and Richard Williamson[3]

[1]Hardware development, St. Jude Medical, Sylmar, CA, United States, [2]St. Jude Medical, Sunnyvale, CA, United States, [3]St. Jude Medical, Sylmar, CA, United States

Metallic leads of an implanted electronic device such as a pacemaker may behave as antennae in the strong radio frequency

electromagnetic field of MRI. The induced current surrounding the electrodes may heat the local tissue. The MRI-induced tissue heating around the electrodes of a pacemaker have only been investigated for pacemakers employing a single lead. In this paper, we examine the MRI-induced temperature rise (TR) of the tip electrode(s) associated with a pacemaker system with two St. Jude Medical Tendril 2088 STS leads, and compare it to the single result. Both transfer function and in vitro temperature rise are investigated.

Oral

Diffusion Validation Using Phantoms & Histology

Room 324-326 13:30 - 15:30 *Moderators:*Matthew Budde & Hao Huang

920 13:30

Intravoxel Incoherent Motion MRI in a 3-Dimensional Microvascular Flow Phantom
Moritz Schneider[1], Thomas Gaaß[1,2], Julien Dinkel[1,2], Michael Ingrisch[1], Maximilian F Reiser[1], and Olaf Dietrich[1]

[1]Institute for Clinical Radiology, Ludwig-Maximilians-University Hospital Munich, Munich, Germany, [2]Comprehensive Pneumology Center, German Center for Lung Research, Munich, Germany

In this study we present intravoxel incoherent motion (IVIM) measurements in a flow phantom consisting of a 3-dimensional capillary network made from melt-spun, sacrificial sugar structures embedded in a synthetic resin. IVIM parameters were determined at varying water flow rates. The pseudodiffusion D* (associated with flow velocity) as well as the product D*×f (which constitutes a measure of flow) show proportionality to the applied flow rates. These results demonstrate that the presented flow phantom is ideal to assess the applicability of IVIM measurements and influence factors such as flow rates, capillary diameter or acquisition parameters.

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921 13:42

Single MR spectral peak diffusion phantom with wide ADC range based on acetone, H2O and manganese chloride
Xiaoke Wang[1], Scott B Reeder[1,2,3,4,5], and Diego Hernando[2]

[1]Biomedical 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]Medicine, University of Wisconsin-Madison, Madison, WI, United States, [5]Emergency Medicine, University of Wisconsin-Madison, Madison, WI, United States

Practical diffusion phantoms are urgently needed for technique development, protocol harmonization and quality assurance of quantitative diffusion MRI. Ideally, a diffusion phantom should have a single-peak NMR spectrum, Gaussian diffusion, with a wide range of tunable apparent diffusion coefficients (ADC). In this work, we developed and validated a novel diffusion phantom based on acetone-water mixtures doped with $MnCl_2$. This phantom exhibits the desired signal behavior, where water modulates the ADC of acetone, and $MnCl_2$ both eliminates water signal (through T2 shortening) and shortens the T1 of acetone.

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922 13:54

Validation of Diffusion Tensor MRI with Structure Tensor Synchrotron Imaging
Irvin Teh[1], Darryl McClymont[1], Marie-Christine Zdora[2,3], Valentina Davidoiu[4], Hannah J Whittington[1], Christoph Rau[2], Irene Zanette[2], and Jürgen E Schneider[1]

[1]Division of Cardiovascular Medicine, Radcliffe Department of Medicine, University of Oxford, Oxford, United Kingdom, [2]Diamond Light Source, Didcot, United Kingdom, [3]Department of Physics and Astronomy, University College London, London, United Kingdom, [4]Department of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom

Diffusion tensor imaging (DTI) is widely used to assess tissue microstructure, but is limited in resolution and cannot resolve multiple fibre populations within a voxel. Existing methods for validating DTI are limited in either resolution or coverage. 2D histological methods are additionally destructive and prone to tissue distortion. In contrast, synchrotron imaging strikes an excellent balance between resolution and coverage. Here, we demonstrate for the first time, the prospect of validating DTI with structure tensor analysis of synchrotron imaging data. Tensors reconstructed with DTI and structure tensor synchrotron imaging were consistent across the left ventricular wall of the heart.

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923 14:06

Neuroplasticity changes in rat brain following targeted irradiation assessed by diffusion MRI tractography validated by histology and behavioral tests
Julie Constanzo[1], Matthieu Dumont[2], Luc Tremblay[1], Philippe Sarret[3], Jean-Michel Longpré[3], Karyn Kirby[3], Sameh Geha[4], Laurence Masson-Côté[1], Benoit Paquette[1], and Maxime Descoteaux[2]

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Despite its high efficiency for treating brain tumors and metastases, stereotactic radiosurgery (SRS) may lead to brain swelling, necrosis, and neuronal dysfunction, thus inducing delayed adverse effects such as cognitive decline and stroke-like symptoms. Altogether, our results revealed that SRS treatment induces region-specific plasticity (i.e. structural and function changes), as demonstrated by neuronal matrix remodeling using diffusion MRI and appropriate HARDI reconstruction, corresponding to histopathological modifications and changes in behavioral responses.

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924 14:18

Comparing Diffusion MRI with the Fiber Architecture and Tract Density of Gyral Blades

Kurt Schilling[1], Vaibhav Janve[1], Yurui Gao[1], Iwona Stepniewska[1], Bennett Landman[1], and Adam Anderson[1]

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It has been reported that diffusion tractography has a tendency for streamlines to terminate preferentially on gyral crowns rather than on sulcal walls or fundi. Rather than anatomical reality, it has been suggested that this is a bias associated with tractography. To better understand this issue, we compare histology to diffusion MRI of the same specimen. We measure the trajectories and density of axons crossing the gray matter/white matter boundary and compare to diffusion tensor measures and deterministic tractography. The results of this study lead to a better understanding of gyral anatomy and potential limitations of fiber tractography.

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925 14:30

Post-mortem inference of the inner connectivity of the human hippocampus using ultra-high field diffusion MRI at 11.7T

Justine Beaujoin[1,2,3], Fawzi Boumezbeur[1,2,3], Jérémy Bernard[1,2,3], Markus Axer[4], Jean-François Mangin[2,3,5,6], and Cyril Poupon[1,2,3,6]

[1]*CEA NeuroSpin / UNIRS, Gif-sur-Yvette, France,* [2]*Université Paris-Saclay, Orsay, France,* [3]*FLI / Noeud Paris-Sud, Orsay, France,* [4]*Forschungszentrum Jülich, INM1, Jülich, Germany,* [5]*CEA NeuroSpin / UNATI, Gif-sur-Yvette, France,* [6]*http://cati-neuroimaging.com/, Gif-sur-Yvette, France*

In this work, we demonstrate that post-mortem ultra-high field (11.7T) / ultra-high gradients (760mT/m) diffusion-weighted MRI allows to finely map the inner connectivity of the human hippocampus and we show that the polysynaptic intra-hippocampal pathway can be accurately reconstructed using fiber tractography techniques at very high spatial/angular resolutions.

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926 14:42

magna cum laude

Post-mortem diffusion MRI of cervical spine and nerves roots

Wieke Haakma[1,2,3], Lidy Kuster[2], Martijn Froeling[1], Lars Uhrenholt[2], Michael Pedersen[3,4], Jeroen Hendrikse[1], Alexander Leemans[5], and Lene Warner Thorup Boel[2]

[1]*Radiology, University Medical Center Utrecht, Utrecht, Netherlands,* [2]*Forensic Medicine, Aarhus University, Aarhus, Denmark,* [3]*Comparative Medicine Lab, Department of Clinical Medicine, Aarhus University, Aarhus, Denmark,* [4]*MR Research Center, Department of Clinical Medicine, Aarhus University, Aarhus, Denmark,* [5]*Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands*

In this work we examined the architecture and diffusion measures of the cervical spine and nerves in non-fixated post-mortem subjects. We were able to display the architectural configuration of the cervical nerves at the level of C4-C8 and we computed reference values for the diffusion measures in these nerves. We showed with great detail the ventral and dorsal nerve roots with fiber tractography. Microscopic examination revealed normal anatomy. We expect that post-mortem diffusion MRI will be valuable for understanding of pathological mechanisms underlying degenerative neurological diseases, as it is possible to compare any findings directly to histological examinations.

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927 14:54

magna cum laude

Microstructure models for diffusion MRI in breast cancer and surrounding stroma: an ex vivo study

Colleen Bailey[1], Bernard Siow[2], Eleftheria Panagiotaki[1], John H Hipwell[1], Sarah E Pinder[3], Daniel C Alexander[1], and David J Hawkes[1]

[1]*Centre for Medical Image Computing, University College London, London, United Kingdom,* [2]*Centre for Advanced Biomedical Imaging, University College London, London, United Kingdom,* [3]*Breast Research Pathology, King's College London and Guy's Hospital, London, United Kingdom*

A variety of one- and two-compartment models were fitted to rich diffusion data sets from ex vivo breast tissue samples containing tumour. Two compartment models with restriction explained the data better than conventional ADC and bi-exponential models, as determined by the Akaike Information Criterion. In four of seven samples, anisotropy was also observed, although parametric maps of the primary eigenvector direction show that regions of coherence are small (~1 mm diameter).

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928 15:06

summa cum laude

Validation of quantitative MRI metrics using full slice histology with automatic axon segmentation

Tanguy Duval[1], Blanche Perraud[1], Manh-Tung Vuong[1], Nibardo Lopez Rios[1,2], Nikola Stikov[1,3], and Julien Cohen-Adad[1,4]

[1]*Polytechnique Montréal, Montréal, QC, Canada,* [2]*Medical Biophysics Center, Oriente University, Santiago de Cuba, Cuba,* [3]*Montreal Heart Institute, Montréal, QC, Canada,* [4]*Functional Neuroimaging Unit, CRIUGM, Université de Montréal, Montréal, QC, Canada*

In this work we propose to validate and compare AxCaliber/ActiveAx/Noddi/MTV in the spinal cord using full slice histology with axon/myelin segmentation. High resolution data (150µm/px) were acquired on an ex vivo spinal cord and compared voxel by voxel with histology. We found that q-space metrics were precise enough to distinguish between various fiber distributions. A correlation coefficient of r=0.62 was found between AxCaliber and histology for axon diameter metric. Also, good agreement were found between the different q-space models and with MTV.

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929 15:18

Validating tractography of high resolution post-mortem human brain at 7T with polarized light imaging

Sean Foxley[1], Jeroen Mollink[1], Saad Jbabdi[1], Stuart Clare[1], Moises Hernandez Fernandez[1], Connor Scott[2], Olaf Ansorge[2], and Karla Miller[1]

[1]*FMRIB Centre, University of Oxford, Oxford, United Kingdom,* [2]*Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom*

In this work we present voxel-wise orientation estimates from diffusion-weighted steady state free precession MRI data of post-mortem human brain, acquired with three resolutions at 7T. Data were acquired with 0.5mm, 1mm, and 2mm isotropic resolution over 90 directions. These resolutions were chosen because 1mm and 2mm are typical of *in vivo* DTI. Deterministic tractography was produced in

various regions using the highest resolution dataset. Orientation maps demonstrate small structures that are less apparent in lower resolution data. Orientation estimates and tractography results were validated with polarized light microscopy imaging.

Oral

Characterizing Field Environment in the MR Scanner: B0, B1 & Gradients

Room 331-332 13:30 - 15:30 *Moderators:*Priti Balchandani & Qi Duan

930 13:30

magna cum laude

B0-Atlas with Field-Probe Guidance: Application in Real-Time Field Control
Simon Gross[1], Yolanda Duerst[1], Laetitia Maëlle Vionnet[1], Christoph Barmet[1,2], and Klaas Paul Pruessmann[1]

[1]*Institute for Biomedical Engineering, ETH and University of Zurich, Zurich, Switzerland,* [2]*Skope Magnetic Resonance Inc., Zurich, Switzerland*

A novel model for the prediction of B_0-maps from external field measurements is presented. It is based on the joint analysis of training data from simultaneously acquired B0-maps and magnetic field evolution measured with NMR field probes. A first application to real-time shim feedback is demonstrated.

931 13:42

Model-based rapid field map prediction for dynamic shimming applications
Yuhang Shi[1], Johanna Vannesjo[1], Karla L. Miller[1], and Stuart Clare[1]

[1]*Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom*

This work presents a rapid field map prediction method based on the individual subject's quick localizer scan and a large brain field map database to accelerate the field map acquisition stage for dynamic shimming applications. Our model-based method is able to better identify the steep change in the field associated with some slices in the lower part of the brain, however a low-resolution field map performs better for the rest of the brain.

932 13:54

Fast B0 first order inhomogeneity estimation using radial acquisition
Ali Aghaeifar[1,2], Alexander Loktyushin[1], Christian Mirkes[1,3], Axel Thielscher[1], and Klaus Scheffler[1,3]

[1]*Max Planck Institute for Biological Cybernetics, Tübingen, Germany,* [2]*IMPRS for Cognitive and Systems Neuroscience, Tübingen, Germany,* [3]*Department of Biomedical Magnetic Resonance, University of Tübingen, Tübingen, Germany*

B0 field inhomogeneity is a major source of distortion in MR images. Current approaches to dynamic shimming require extra acquisition time or external hardware. We propose a method that estimates first order shim errors by using projections of radial acquisition. The errors can be estimated from three projections multiple times in each measurement, which makes the method highly robust. The proposed method is evaluated in simulation and in vivo. Obtained results show a strong agreement between applied and measured first order shim errors.

933 14:06

BMART: B0 Mapping using Rewind Trajectories
Corey Allan Baron[1] and Dwight G. Nishimura[1]

[1]*Electrical Engineering, Stanford University, Stanford, CA, United States*

B_0 inhomogeneity leads to image artifacts and/or blurring. These issues can be addressed by using a B_0 map, which typically requires an extra scan. In addition to the longer total scan time required, motion occurring between the acquisition of the imaging data and B_0 map can lead to misregistration. The proposed method utilizes images reconstructed from rewind trajectories to construct a B_0 map. In pulse sequences that already use gradient rewinds (e.g., bSSFP), a B_0 map that is inherently registered to the imaging data can be created with no additional scan time.

934 14:18

Broadband Frequency Mapping with Balanced SSFP
Oliver Bieri[1,2], Grzegorz Bauman[1,2], and Carl Ganter[3]

[1]*Radiology, University Hospital Basel, Basel, Switzerland,* [2]*Biomedical Engineering, University of Basel, Basel, Switzerland,* [3]*Diagnostic Radiology, Technical University Munich, Munich, Germany*

A new method for accurate and fast broadband frequency mapping with balanced steady state free precession is introduced. The method mitigates the need for advanced phase unwrapping algorithms from a matrix pencil analysis of sequentially shifted echo times. Typically, the new method offers a spectral resolution in the range of Hertz with a sensitivity range in the order of several thousands of Hertz.

935 14:30

Determination of Relative B1+ Sensitivities Using Accelerated Simultaneous Excitation with Multiple Transmit Channels and Controlled Aliasing
Iulius Dragonu[1], Craig Buckley[1], Peter Weale[1], Matthew D Robson[2], and Aaron T Hess[2]

[1]Siemens Healthcare Ltd, Frimley, Camberley, United Kingdom, [2]University of Oxford Centre for Clinical Magnetic Resonance Research (OCMR), John Radcliffe Hospital, Headington, United Kingdom

Radiofrequency shimming with multiple channel excitation is a well established method to increase the transverse magnetic field homogeneity and reduce SAR at high magnetic field strength(≥7T). To harness the benefits of a parallel transmit system, the magnitude and relative phase of each transmit channel must be determined during a calibration scan. We propose a new strategy to accelerate the acquisition of such calibration images by simultaneously exciting several transmit channels and reconstructing the calibration images using the technique similar to simultaneous multi-slice acquisitions.

936 14:42

Combining B1 mapping with TIAMO for fast and accurate multi-channel RF shimming in 7 Tesla body MRI

Sascha Brunheim[1,2], Stephan Orzada[1], Soeren Johst[1], Marcel Gratz[1,2], Maximilian N. Voelker[1], Oliver Kraff[1], Martina Floeser[3], Andreas K. Bitz[3], Mark E. Ladd[1,3], and Harald H. Quick[1,2]

[1]Erwin L. Hahn Institute for Magentic Resonance Imaging, University Duisburg-Essen, Essen, Germany, [2]High Field and Hybrid MR Imaging, University Hospital Essen, Essen, Germany, [3]Medical Physics in Radiology, German Cancer Research Center (DKFZ), Heidelberg, Germany

With current methods the mitigation of transmit field inhomogeneity at ultrahigh field by multi-channel RF shimming with conventional methods is relatively time consuming. This applies in particular for parallel transmit/receive in-vivo body imaging within breath-hold and during organ motion. Therefore, we propose a new technique merging fast acquired relative single channel maps and the spatial-dependent flip-angle distribution of two complementary shims to define absolute transmit coil maps for fast and accurate RF shim calculation. The performance of this technique is validated against established methods in phantom measurements and its reliability is shown in comparison to simulation data serving as reference.

937 14:54

Silent, Free-Breathing B1+ Mapping using DREAM

Kay Nehrke[1] and Peter Börnert[1,2]

[1]Philips Research, Hamburg, Germany, [2]Radiology, LUMC, Leiden, Netherlands

To improve the workflow for B_1^+ calibration on a dual transmit MRI system, the DREAM B_1^+ mapping sequence has been streamlined for acoustic noise reduction and free-breathing acquisition using a standard external respiratory motion sensor. About 10 dB reduction in sound pressure level were achieved by optimizing the echo order with respect to gradient strength reduction. Feasibility was shown in volunteer experiments on abdominal B_1^+ mapping.

938 15:06

DREAM Based Receive Sensitivity Correction

Wyger Brink[1] and Andrew Webb[1]

[1]Radiology, Leiden University Medical Center, Leiden, Netherlands

Imaging methods at high fields can suffer from receive non-uniformities from the body coil, particularly when the body coil is used as a reference for intensity correction. In this work we show that the DREAM B1 mapping sequence can be used for receive uniformity correction in RF-shimmed whole-body imaging at 3T.

939 15:18

Simultaneous Estimation of Auto-calibration Data and Gradient Delays in non-Cartesian Parallel MRI using Low-rank Constraints

Wenwen Jiang[1], Peder E.Z Larson[2], and Michael Lustig[3]

[1]Bioengineering, UC Berkeley/ UCSF, Berkeley, CA, United States, [2]Radiology and Biomedical Imaging, UCSF, San francisco, CA, United States, [3]Electrical Engineering and Computer Science, UC Berkeley, Berkeley, CA, United States

Gradient timing delay errors in non-Cartesian trajectories often induce spurious image artifacts. More importantly, misaligned k-space center data results in auto-calibration errors for parallel imaging methods. We propose a general approach that simultaneously estimates consistent calibration data and corrects for gradient delays. We pose the joint estimation problem as a low-rank minimization problem, and solve it using a Gauss-Newton method. We demonstrate the feasibility of the proposed method by simulation and phantom experiments.

Oral

fMRI: Acquisition, Contrast, Artefacts

Room 334-336 13:30 - 15:30 *Moderators:*Dimo Ivanov & Kawin Setsompop

940 13:30

summa cum laude

Motion correction for functional MRI with hybrid radial-Cartesian 3D EPI

Nadine N Graedel[1], Mark Chiew[1], and Karla L Miller [1]

[1]FMRIB Centre for Functional MRI of the Brain, University of Oxford, Oxford, United Kingdom

We used a hybrid radial-Cartesian 3D EPI trajectory with a golden ratio based angle update to perform retrospective motion correction in severely motion corrupted fMRI data. Motion estimates were based on high temporal resolution image timeseries and and k-space

based estimates. The calculated rotations and translations were corrected in k-space prior to the final reconstruction, allowing the correction of both inter- and intra-volume motion artifacts. This approach is self-navigated, requires no additional hardware and is suitable for correction in fast fMRI acquisition.

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941 13:42

Ultra-fast gradient echo EPI with controlled aliasing at 3T: simultaneous multi-slice vs. 3D-EPI
Rüdiger Stirnberg[1], Willem Huijbers[1], Benedikt A. Poser[2], and Tony Stöcker[1,3]

[1]German Center for Neurodegenerative Diseases (DZNE), Bonn, Germany, [2]Faculty of Psychology and Neuroscience, Maastricht University, Maastricht, Netherlands, [3]Department of Physics and Astronomy, University of Bonn, Bonn, Germany

We conducted a feasibility study to compare state-of-the-art simultaneous multi-slice EPI vs. segmented 3D-EPI – both utilizing equivalent undersampling techniques for controlled aliasing – optimized for ultra-fast whole-brain fMRI at 3T. We compared temporal signal-to-noise ratio, sensitivity per unit scan time and temporal whole-brain spectra of 8 minutes time-series. While both fast sequences are well-suited to separate physiological from BOLD signal, the 3D-EPI sequence achieves greater sensitivity and signal-to-noise ratio throughout the brain using whole-brain protocols matched for identical TR.

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942 13:54

Evaluation of SLIce Dithered Enhanced Resolution Simultaneous MultiSlice (SLIDER-SMS) for human fMRI at 3T
An T. Vu[1,2], Alex Beckett[1], Kawin Setompop[3], and David A. Feinberg[1,2]

[1]Helen Wills Neuroscience Institute, UC Berkeley, Berkeley, CA, United States, [2]Advanced MRI Technologies, Sebastopol, CA, United States, [3]Martinos Center for Biomedical Imaging, Charlestown, MA, United States

We evaluate the synergistic combination of super-resolution and SMS for high-resolution whole brain fMRI. We find that SLIDER-SMS can acquire high resolution, high CNR fMRI data at 3T which is normally only acquired at 7T. The regularized deblurring/reconstruction of SLIDER yielded 40% more BOLD CNR than normally acquired high resolution (HR) data, while omitting the deblurring step altogether yielded 100% more BOLD contrast with similar high k-space frequency tSNR. Future use of SLIDER for fMRI may enable robust columnar level results at 3T and allow higher spatial resolution fMRI investigations at 7T than currently possible.

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943 14:06

Physiology Recording with NMR Field Probe: Application to de-Noising of fMRI Time-Series at 7 Tesla
Laetitia Vionnet[1], Simon Gross[1], Lars Kasper[1,2], Benjamin Emanuel Dietrich[1], and Klaas Paul Pruessmann[1]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Translational Neuromodeling Unit, Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

NMR field probe were used to record subject physiology at 7T. The signals were used to de-noise fMRI dataset and showed to be equivalent to standard devices.

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944 14:18

Blood volume fMRI with 3D-EPI-VASO: any benefits over SMS-VASO?
Laurentius Huber[1], Dimo Ivanov[2], Sean Marrett[1], Puja Panwar[1], Kamil Uludag[2], Peter A Bandettini[1], and Benedikt A Poser[2]

[1]Section of Functional Imaging Methods, National Institute of Mental Health, Bethesda, MD, United States, [2]MBIC, Maastricht University, Maastricht, Netherlands

Cerebral blood volume (CBV) fMRI has the potential to overcome known limitations of BOLD fMRI with respect to spatial specificity and quantifiability of mapping brain activity. To overcome the coverage limitations of conventional CBV mapping with VASO, a novel VASO method with 3D-EPI readout was developed. This new approach is compared to BOLD fMRI and VASO with simultaneous multi-slice EPI readout. We provide evidence for a high sensitivity and improved specificity of 3D-EPI VASO compared to conventional BOLD fMRI. We conclude that because of its superior resolution in slice-direction, 3D-EPI VASO may play an important role in high-resolution fMRI.

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945 14:30

Optimization of Asymmetric Spin Echo Pulse Sequences in Functional MRI
Eun Soo Choi[1] and Gary Glover[2]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States

In BOLD contrasts fMRI, the most commonly used sequences, gradient-echo and spin-echo, have been challenged due to their limited spatial specificity or functional sensitivity. As an alternative, an asymmetric spin-echo sequence was introduced, yet, its characteristics in different conditions are still unclear. In this study, we performed simulations and in-vivo experiments to design the optimal ASE pulse sequence that maximizes functional sensitivity while preserving high spatial specificity.

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946 14:42

Simultaneous Multi-slice Inverse imaging for high temporal resolution fMRI
Ying-Hua Chu[1], Yi-Cheng Hsu[1], and Fa-Hsuan Lin[1]

[1]Institute of Biomedical Engineering, National Taiwan University, Taipei, Taiwan

We proposed the simultaneous multi-slice (SMS) inverse imaging (InI) method to achieve 10 Hz sampling rate and significantly improved spatial resolution (30-fold higher than typical inverse imaging; quantified by point-spread function). SMS-InI was demonstrated in a visual fMRI experiment showing maps of brain activity similar to EPI and hemodynamic response with 0.1 s precision.

947 14:54

An interleaved spherical stack-of-spirals trajectory for fast segmented whole brain fMRI
Bruno Riemenschneider[1], Jakob Assländer[1], Pierre Levan[1], and Jürgen Hennig[1]

[1]*Medical Physics, University Medical Center Freiburg, Freiburg, Germany*

We investigated a segmented version of the spherical stack-of-spirals trajectory that retains highly efficient data sampling and signal recovery, but grants more flexibility in data sampling compared to the single-shot version. Whole brain acquisition with nominal isotropic resolutions of 3mm in 195ms and 2.25mm in 260ms using 3- and 4-fold segmentation have been investigated. The faster read out along the slowest encoding direction leads to reduced off-resonance artifacts in comparison to the single- shot version, and higher sampling rates allow non-regularized reconstruction.

948 15:06

Effective Connectivity Measured with Layer-Dependent Resting-State Blood Volume fMRI in Humans
Laurentius Huber[1], Daniel A Handwerker[1], Javier Gonzalez-Castillo[1], David C Jangraw[1], Maria Guidi[2], Dimo Ivanov[3], Benedikt A Poser[3], Jozien Goense[4], and Peter A Bandettini[1]

[1]*Section of Functional Imaging Methods, National Institute of Mental Health, Bethesda, MD, United States,* [2]*Human Cognitive and Brain Sciences, Max Planck Institute, Leipzig, Germany,* [3]*MBIC, Maastricht University, Maastricht, Netherlands,* [4]*Institute of Neuroscience and Psychology, University of Glasgow, Glasgow, United Kingdom*

Measurements of layer-dependent cortical activity provide insight on how feedforward/feedback functional connectivity affects a given cortical area. Here, we simultaneously measure layer-dependent changes in resting-state BOLD and CBV with VASO. We demonstrate that the superior specificity of CBV fMRI reveals layer-dependent resting-state activity better than GE-BOLD fMRI and gives indications of effective connectivity in the human sensory-motor system. In particular, superficial and deeper layers in M1 show different connectivity patterns than those associated with the middle layer, likely driven by input from S1. Our data show that the middle layer in M1 correlates with contralateral M1, while it anti-correlates with contralateral S1.

949 15:18

The BOLD-sensitivity of balanced SSFP at very high fields is similar to GE-EPI but more selective to small vessels.
Mario Gilberto Baez Yanez[1,2], Phillip Ehses[1,3], and Klaus Scheffler[1,3]

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The excellent sensitivity and stability of BOLD-imaging with balanced SSFP (bSSFP) on humans at 9.4T has been demonstrated in a recent paper. Here, we analyze the signal change of bSSFP for different vessel (spheres) sizes and susceptibility differences for different repetition times and flip angles using Monte Carlo simulations and experiments on micro spheres, and compare it to gradient echo EPI. Simulated and measured signal changes (using values of susceptibility changes and vessel sized comparable to a typical BOLD experiment at 9.4T) of bSSFP are in the range of 10 to 15% with a peak sensitivity to the vessel (sphere) size at about 3 mm, and a decreased sensitivity for larger vessels (spheres). For GE-EPI, signal changes are similar to bSSFP, however, no selectivity to small vessels is visible

Oral

Structural/Functional Connectomics

Hall 606 13:30 - 15:30 *Moderators:*Victoria Morgan & Jay Pillai

13:30 Introduction

950 13:50

Bayesian Exponential Random Graph Modeling of Whole-Brain Structural Networks across Lifespan
Michel R.T. Sinke[1], Willem M. Otte[1,2], Alberto Caimo[3], Cornelis J. Stam[4], and Rick M. Dijkhuizen[1]

[1]*Biomedical MR Imaging and Spectroscopy Group, Center for Image Sciences, University Medical Center Utrecht, Utrecht, Netherlands,* [2]*Department of Pediatric Neurology, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, Netherlands,* [3]*Social Network Analysis Research Centre, Interdisciplinary Institute of Data Science, University of Lugano, Lugano, Switzerland,* [4]*Department of Clinical Neurophysiology, Neuroscience Campus Amsterdam, VU University Medical Center, Amsterdam, Netherlands*

Comparison of brain networks that differ in size or edge density may be inadequate with frequently applied descriptive graph analysis methods. To resolve this, we propose an alternative framework based on Bayesian generative modeling, allowing unbiased assessment of local substructures that shape the global network topology. Structural networks were derived from DTI-based whole-brain tractography of 382 healthy subjects (age: 20-86 years), and successfully simulated. Despite clear effects of age and hub damage on network topologies, relative contributions of local substructures did not change significantly. The use of generative models may shed new light on the complex (re)organization of the brain.

951 14:10

Resting state fMRI of spinal cord is keeping synchronistic with brain

Jinsong Zhang[1], Lingzhi Wang[2], and Jun Li[2]

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The spinal cord and brain form central nervous system and sensory and motor signals are relayed by spinal cord and processed by brain. Studies have suggested that resting state functional connectivity (rsFC) are fundamental, common feature of the entire nervous system. However, it still remain unknown the correlation between rsFCs within spinal cord and brain. The present study discovered dorsal and ventral resting state networks (RSNs) within spinal cord and sensory-motor RSN within brain. Further, correlation analysis suggest that dorsal and ventral RSNs connected to sensory and motor RSNs respectively.

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952 14:30

Functional connectivity self-regulation of cerebellum and primary motor area with fMRI-Brain Computer Interfaces. Pilot results.

Patricia Andrea Vargas[1,2], Ranganatha Sitaram[1,3,4,5], Pradyumna Sepúlveda[2,6], Cristian Montalba[2], Mohit Rana[1], Cristián Tejos[2,6], and Sergio Ruiz[1,3]

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In recent years there is a growing interest in the potential application of Brain-Computer interfaces (BCI) for psychiatric and neurological disorders. After stroke, if the primary motor cortex (M1) is affected, it is common to find a “deactivation” of the contralateral cerebellum.

The aim of this study was to evaluate the feasibility of achieving volitional control of M1-cerebellum functional connectivity, in healthy subjects with an fMRI-BCI system.

The results indicate that volitional self-regulation of cerebellum-M1 connectivity is feasible with fMRI-BCI. The data also suggests that cerebellum is more easily recruited than M1.

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953 14:50

Connectivity-based parcellation of nucleus accumbens into putative core and shell guiding for stereotactic target localization and alterations in each NAc subdivision in mTLE patients

Xixi Zhao[1], Junling Wang[1], Xiangliang Tan[1], Xiang Xiao[1], Zeyu Zheng[1], Yingjie Mei[2], Queenie Chan[3], Yikai Xu[1], Ru Yang[4], and Qianjin Feng[4]

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NAc was supposed be involved in epileptogenesis, especially shell portion. The exact parcellation within the NAc and structural alterations in vivo of NAc subdivisions in EP patients remains unclear. We used diffusion probabilistic tractography to subdivide NAc into putative core shell subdivisions in individual mTLE patients for guiding NAc shell stereotactic target localization. Our results revealed that both left and right mTLE patients exhibited decreased FA and increased MD in shell portion of bilateral NAc, which may reflect neuronal degeneration and damage caused by seizure mainly in shell portions, and suggest a possible role of the NAc shell in epileptogenesis

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954 15:10

Brain White Matter Plasticity and Functional Reorganization Underlying the Central Pathogenesis of Idiopathic Trigeminal Neuralgia

Linying Guo[1], Tian Tian[1], and Wenzhen Zhu[1]

[1]Department of Radiology, Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Hubei, China, People's Republic of

Previous studies on trigeminal neuralgia (TN) have mainly focused on peripheral nerve damage, but little is known about the structural and functional changes in central nervous system (CNS) that can occur following trigeminal nerve dysfunction. In this study, we used diffusion kurtosis imaging (DKI) and functional connectivity density (FCD) mapping in TN patients to investigate both structural and functional changes in CNS. We found TN patients have correlated white matter and FCD reorganization that may contribute to pathologic algogenic system. Our findings may be helpful guidance for systematic therapeutics in both peripheral and central nerves.

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955 15:30

Connectivity Domain Analysis of the Default Mode Network in Mild Traumatic Brain Injury at The Acute Stage

Armin Iraji[1], Natalie Wiseman[2], Robert Welch[3], Brian O'Neil[3], E. Mark Haacke[1,4], and Zhifeng Kou[1,4]

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Most functional and structural MRI studies in mild traumatic brain injury (mTBI) are performed at the group level. Recently, there is concern regarding the validity of group-level analyses findings in mTBI due to the heterogeneity of TBI. However, while group-level analysis cannot demonstrate a complete view of impairments, we hypothesize that there are similar patterns in group-level and subject-level findings, especially in higher order brain activities and networks. We evaluated this in the DMN using a new framework known as

the connectivity domain. This is the first study of utilizing the connectivity domain to investigate changes after a brain disorder.

956 15:50

Brain connectivity of glioblastoma patients using MR-PET and DTI data

Ana Carina Mendes[1], Ana-Maria Oros-Peusquens[2], André Santos Ribeiro[1,3], Karl-Josef Langen[2], Carolin Weiß Lucas[4], Nadim Jon Shah[2], and Hugo Alexandre Ferreira[1]

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Methods capable of mapping brain connectivity pathways may prove useful by providing valuable information in order to prevent sequelae following a surgical intervention. This study presents an approach for the whole-brain connectivity evaluation of nine patients with lateralized gliobastoma, using the Multimodal Imaging Brain Connectivity Analysis (MIBCA) toolbox to process MR and PET data. Results show changes in connectivity metrics across both hemispheres for all patients accompanied by an increased number of fibres which may result from reorganization of connectivity pathways caused by the disruption of the original ones by the tumour.

957 16:10

Thresholding to Improve the Specificity of High Spatial and Angular Resolution In Vivo Diffusion-Weighted Tractography to Estimate Brain Stem Connectivity.

Matthew Hey[1], Luis Colon-Perez[2], William Triplett[3], David Fitzgerald[4], and Thomas Mareci[5]

[1]University of Florida, Gainesville, FL, United States, [2]Department of Psychiatry, University of Florida, Gainesville, FL, United States, [3]Department of Physical Therapy, University of Florida, Gainesville, FL, United States, [4]Department of Neurology, University of Florida College of Medicine, Gainesville, FL, United States, [5]Department of Biochemistry and Molecular Biology, University of Florida College of Medicine, Gainesville, FL, United States

The spatial resolution of diffusion-weighted (DWI) images limits the white matter streamline fiber tracks, which can be followed in the brain stem. To address this issue, we introduce a high spatial resolution protocol and the use of a threshold to limit the false positive in streamline track density maps by requiring that a minimum amount of fibers pass through a voxel. This provides increased accuracy in the visualization of streamlines connecting specific regions of the brain stem and may allow the recognition of structural abnormalities due to neurological diseases.

958 16:30

Influence of repetitive transcranial magnetic stimulation on functional connectivity and hemodynamics in the rat brain

Julia Boonzaier[1], Geralda A. F. van Tilborg[1], Mark J.R.J. Bouts[2,3,4], Petar P.I. Petrov[5], Caroline L. van Heijningen[1], Gerard van Vliet[1], Annette van der Toorn[1], Sebastiaan F.W. Neggers[5], and Rick M. Dijkhuizen[1]

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Repetitive transcranial magnetic stimulation (rTMS) is a non-invasive neuromodulation technique with the ability to change cortical excitability, however its precise mechanism of action is not completely understood. Therefore, by acquiring resting-state fMRI and perfusion MRI data we assessed the influence of unilateral low-frequency (inhibitory) rTMS on functional connectivity and hemodynamics in stimulated cortical tissue in rats. After four consecutive days of rTMS we measured reduced interhemispheric functional connectivity between homotopic sensorimotor regions, while cerebral blood flow remained largely unaffected. This reduction in interhemispheric functional connectivity may be due to the inhibitory effect of low-frequency rTMS on cortical excitability.

Oral

Atherosclerosis Imaging

Summit 1 13:30 - 15:30 *Moderators:*Winfried Willinek

959 13:30

High resolution 3D diffusion imaging of carotid vessel wall using stimulated echo based diffusion prepared turbo spin echo sequence

Qinwei Zhang[1], Barbara Cervantes[2], Dimitrios C. Karampinos[2], Bram F. Coolen[1], Aart J. Nederveen[1], and Gustav J. Strijkers[3]

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Diffusion imaging is becoming a promising alternative to contrast enhanced imaging in detecting lipid core and hemorrhage in atherosclerotic plaques. Diffusion prepared turbo spin echo sequence (DP-TSE) has been proven to be feasible to acquire 3D diffusion images of carotid vessel wall, but it has critical requirement on the eddy currents. This study demonstrates that using stimulated echo based DP-TSE sequence, together with m1 nulling diffusion gradients, and MLEV refocusing RF pulses, high resolution 3D carotid vessel wall diffusion imaging can be achieved in the presence of eddy current, motion and B_1-inhomogeneity.

960 13:42

DCE-MRI reveals more extensive vasa vasorum in patients with cardiovascular events

Huijun Chen[1], Juan Wang[2], Jie Sun[3], Daniel S Hippe[3], Xihai Zhao[1], and Hongbing Liu[2]

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Pharmacokinetic modeling of DCE-MRI can quantify the adventitial vasa vasorum of carotid atherosclerotic lesions using the transfer constant (K^{trans}). However, the relationship between the DCE-MRI quantified carotid adventitial vasa vasorum and cardiovascular events remains unclear. In this study, we found that the adventitial K^{trans} of carotid artery measured by DCE-MRI was associated with cardiovascular events (cerebral ischemic events and coronary artery events), suggesting that the carotid adventitial vasa vasorum is not merely a local risk factor but also a promising systemic marker for cardiovascular risk. DCE-MRI may be valuable for identifying high risk patients in clinical practice.

961 13:54

Texture-Based Classification of Advanced Carotid Atherosclerotic Lesions on Multi-contrast Black-blood MRI at 3.0 Tesla: A Pilot Study

Huilin Zhao[1], Shiteng Suo[1], Peipei Hao[1], Xiaosheng Liu[1], Xihai Zhao[2], Yongming Dai[3], Chun Yuan[4], and Jianrong Xu[1]

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Texture analysis with the combined set of texture features may be useful in discriminating vulnerable plaque. This study sought to determine the feasibility of texture analysis for the classification of American Heart Association (AHA) type IV-V and type VI carotid atherosclerotic lesions at multi-contrast black-blood MR images. Our results suggest that texture-based classification of type IV-V and type VI lesions is feasible on precontrast T1-weighted images. This preliminary evaluation indicates that carotid plaque texture analysis is a potentially useful adjunct tool for quantitative evaluation of atherosclerotic plaque vulnerability.

962 14:06

3D Carotid Wall Imaging: Stack-of-stars Trajectory for Multi-contrast Atherosclerosis Characterization (STAR-MATCH)

Xiaoming Bi[1], Zhaoyang Fan[2], Yutaka Natsuaki[1], Debiao Li[2], and Gerhard Laub[1]

[1]Siemens Healthcare, Los Angeles, CA, United States, [2]Cedars-Sinai Medical Center, Los Angeles, CA, United States

The recently developed MATCH technique integrates multiple 3D image sets into a single measurement and it is a promising method for carotid plaque characterization. One of the remaining challenges is the gross motion of carotid arteries that originates from pulsation, breathing and swallowing. In this work, a motion robust stack-of-stars sampling trajectory was implemented into the MATCH sequence (STAR-MATCH). Preliminary studies from volunteers and patient demonstrate it is feasible to characterize carotid plaque using the STAR-MATCH sequence with improve motion robustness.

963 14:18

summa cum laude

Coronary Atherosclerosis T1-weighed Characterization with Integrated Anatomical Reference (CATCH): Comparison with High-risk Plaque Features on OCT

Yibin Xie[1], Young-Jin Kim[2], Jianing Pang[1], Qi Yang[1], Jung-Sun Kim[3], Christopher T. Nguyen[1], Zixin Deng[1], Byoung Wook Choi[2], Zhaoyang Fan[1], Daniel S. Berman[1], Hyuk-Jae Chang[3], and Debiao Li[1]

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The aim of this work is to investigate the nature of pre-contrast and post-contrast T1w plaque hyper-intensity by comparing with coronary plaque morphology assessed by intracoronary optical coherence tomography (OCT). We scanned 13 healthy subjects and 30 stable angina patients using our recently developed whole-heart T1w coronary plaque characterization framework (CATCH). Compared with the classification based on OCT, we found that pre-contrast plaque to myocardial ratio (PMR) was significantly higher in the presence of large lipids, macrophages, and cholesterol crystals, whereas post-contrast PMR was significantly higher in the presence of macrophages and microvessels.

964 14:30

Increased Coronary Vessel Wall Thickness in Hyper IgE Syndrome Patients; Depiction by Magnetic Resonance Vessel Wall Imaging and Pathological Correction

Khaled Z. Abd-Elmoniem[1], Nadine Z. Ramos[1], Saami Yazdani[2], Ahmed M. Ghanem[1,3], Steven M. Holland[4], Alexandra F. Freeman[4], and Ahmed M Gharib[1]

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In this study, coronary wall MRI is used to assess the coronary wall thickness of patients with autosomal dominant hyper-IgE (AD-HIES) or Job's syndrome; a primary immunodeficiency caused by mutations in STAT3. Supported by post-mortem histology, MRI coronary wall of AD-HIES patients was thicker than in healthy subjects but comparable to CAD patients. These findings suggest that coronary arteries in Job's syndrome are affected with atherosclerosis, contrary to prior beliefs and study findings. Direct histologic evaluation confirms the presence of atherosclerosis with lack of needed supportive adventitial thickening and elastic components. These findings suggest mechanisms for weakened vessel wall that may lead to coronary dilation and aneurysm in AD-HIES.

965 14:42

summa cum laude

Evaluation of endothelial barrier function in atherosclerosis induced rabbits using S-nitroso human serum albumin (S-NO-HSA) - blood pool agent compound and dynamic contrast-enhanced (DCE)-MRI

Peter Opriessnig[1], Gunter Almer[1], Harald Froehlich[1], Claudia Cabella[2], Rudolf Stollberger[3], Seth Hallstroem[4], Gerd Hoerl[4], and Harald Mangge[1]

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Endothelial dysfunction plays a key role in the progression and pathogenesis of atherosclerosis (AS). DCE-MRI in combination with a special nitric oxide donor S-nitroso human serum albumin (S-NO-HAS) blood pool agent (B22956/1) compound could be an additional measure that provides information on the influence of plaque burden on the vascular permeability and vasomotion. In this work, we demonstrate the feasibility to investigate endothelial barrier function and NO induced endothelium-independent vasomotor response of the abdominal aorta in control and AS induced rabbits simultaneously. Relative vessel wall signal enhancement and change in lumen area were measured using a double-inversion-recovery turbo-spin-echo sequence.

966 14:54

summa cum laude

Impact of exercise intervention on vascular function in PAD

Erin K Englund[1], Michael C Langham[2], Thomas F Floyd[3], Felix W Wehrli[2], and Emile R Mohler[4]

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Peripheral vascular function can be interrogated by measuring recovery dynamics following induced ischemia. In this study, 136 patients with peripheral artery disease were randomized into supervised exercise rehabilitation (SER) or standard medical care (SMC). Each patient's leg was scanned before and after the intervention period. MRI data were acquired throughout an ischemia-reperfusion paradigm with PIVOT, a method to simultaneously and dynamically measure perfusion, venous oxygen saturation, and skeletal muscle T_2*. Patients randomized to SER had a significant increase in peak perfusion from baseline to follow-up when averaged across the entire cross-section of the leg and in the peroneus muscle.

967 15:06

MRI biomarkers associated with guide wire puncture forces required to cross ex-vivo human peripheral arterial chronic total occlusions

Trisha Roy[1,2], Garry Liu[1], Noor Shaikh[1], Kevan Anderson[1], Nicolas Yak[1], Xiuling Qi[1], Andrew Dueck[1,2], and Graham Wright[1,3]

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Percutaneous vascular interventions (PVI) for treating peripheral arterial disease (PAD) have poor outcomes with high re-intervention and failure rates. Not all lesions are amenable to PVI, but predicting failure is difficult. While CT can identify heavily calcified lesions, current imaging offers limited differentiation between hard and soft PAD plaques, which impacts procedural success. This study demonstrates the feasibility of using MRI biomarkers to characterize plaque components in ex-vivo human peripheral arteries with histologic and microCT validation. We demonstrate that significantly higher puncture forces are required to cross non-calcified "hard" chronic total occlusions (CTOs) compared to "soft" CTOs, as classified by these MRI biomarkers.

968 15:18

Optimization of 3 dimensional (3D), high resolution T2 weighted SPACE for carotid vessel wall imaging on a 7T whole-body clinical scanner

Claudia Calcagno[1,2], Bram Coolen[3], Bei Zhang[1,2], Gilles Boeykens [3], Philip Robson[1,2], Venkatesh Mani[1,2], Aart J Nederveen[3], Willem Mulder[1,2], and Zahi Fayad[1,2]

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Accurate morphological measurements and classification of carotid plaques require imaging with high spatial resolution, and may benefit from the increased signal intrinsically available on ultra-high field (7T) magnets. Several studies have already investigated carotid vessel wall imaging at 7T and compared it with state-of-the-art 3T protocols. These initial investigations have focused on 2 dimensional (2D), multi-slice imaging. Better than this approach, 3 dimensional (3D) vessel wall imaging allows characterizing extensive vascular territories while minimizing partial volume artifacts in plaque-prone regions, such as the carotid bulb and bifurcation. Here, we demonstrated the feasibility of performing 3D carotid vessel wall imaging on a whole body 7T clinical magnet using a custom made carotid coil.

Oral

Female Pelvis/Fetal

Summit 2 13:30 - 15:30 *Moderators:*P. Ellen Grant

969 13:30

Magnetic Resonance Imaging quantification of venous return in pregnant women: A comparison between supine and left lateral tilt position.

Emer J Hughes[1], Anthony N Price[2], Laura McCabe[1], Kelly Pegoretti Baruteau[1], Jana Hutter[2], Olivia Carney[1], Andreia S Gaspar[2], Joseph V Hajnal[2], and Mary Rutherford[1]

[1]Perinatal Imaging and Health, Kings College London, London, United Kingdom, [2]Biomedical Engineering, Kings College London, London, United Kingdom

In-vivo imaging of the fetus is commonly undertaken in the left-lateral position to prevent compression of the inferior vena cava (IVC) and hence a vasovagal episode. Studies have shown that the IVC has collateral pathways, such as the lumbar venous plexus and the lumbar veins that provide collateral venous return. Here, we use phase contrast imaging to assess the venous return pathways in pregnant women lying supine and left lateral tilt in the MRI scanner. We found that the spinal venous plexus and the ascending lumbar veins act as a complimentary venous return system to maintain vascular homeostasis in pregnant women lying supine. This supports the proposition that it is feasible to scan pregnant women safely in the supine position.

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970 13:42

In vivo localization and timing of oxygen delivery in human placenta based on BOLD MRI

Jie Luo[1,2], Esra Abaci Turk[1,2], Polina Golland[3,4], Borjan Gagoski[1], Carolina Bibbo[5], Drucilla J Roberts[6], Norberto Malpica[7], Julian N Robinson[5], Patricia Ellen Grant[1], and Elfar Adalsteinsson[2,3,8]

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Clinically there is no direct measurement of oxygen delivery in placenta. In this study, we propose a method to map the timing of oxygen delivery in the human placenta in vivo. Healthy placentae show p□□□□□n□ that agree with normal perfusion timing in response to maternal hyperoxygenation. Pathological placentas exhibit a more dispersed timing across the placenta. Better understanding of the timing in different type of pathology may be achieved by spatial correlation between placental pathology and in vivo placenta images in both healthy and pathological placenta based on BOLD signal change in response to maternal hyperoxygenation.

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971 13:54

Placental vascularization quantification using ex-vivo magnetic resonance angiography

Bailiang Chen[1,2,3], Jie Duan[2,3,4], Jacques Felblinger[1,2,3,5], Olivier Morel[2,3,4], and Marine Beaumont [1,3,5]

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Abnormal uteroplacental vascurlarization can cause major obstetric complications such as intra-uterine growth restriction or abnormally invasive placenta. Clinical 3D ultrasound imaging cannot discriminate maternal and fetal flow in utero-placental unit, thus blocking a better understanding of the pathology. Conventional ex-vivo vascularization quantification relies on 2D histological slices using samples dissected from placenta. Micro-CT was applied to fixed small animal placenta but with complicated and long preparation. Here we presented the flexibility of a comprehensive 3D vascularization characterization of a fresh healthy human placenta using ex-vivo MRA. A quantification framework is proposed with defined systematic metrics to characterize the vascularization.

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972 14:06

MRI Quantification of uterine blood flow in third trimester human pregnancy and relation to birthweight

David J LOMAS[1], Rebecca HAWKES[1], Andrew N PRIEST[1], Nicholas HILLIARD[1], Andrew PATTERSON[1], Pat SET[1], and Martin J GRAVES[1]

[1]Radiology, University of Cambridge & Addenbrooke's Hospital, Cambridge, United Kingdom

Non-invasive measurement of uterine blood flow (UBF) during pregnancy is desirable to assess fetal well-being but difficult using Doppler ultrasound. This work demonstrates an MR method of identifying the uterine arteries in 31 early 3rd trimester normal human pregnancies and quantifying absolute UBF using cine phase contrast. Results are comparable with other methods for quantifying flow and demonstrate a correlation with actual birthweight. The method has potential for future UBF monitoring during pregnancy.

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973 14:18

Three-Dimensional Placental Perfusion Imaging Using Velocity-Selective Arterial Spin Labeling

Zungho Zun[1], Ajit Shankaranarayanan[2], Nickie Niforatos-Andescavage[1], Samantha Bauer[1], Diane Lanham[1], Dorothy Bulas[1], Adre J Du Plessis[1], and Catherine Limperopoulos[1]

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Pregnancies complicated by placental insufficiency such as fetal growth restriction and preeclampsia are characterized by reduced placental perfusion. Conventional MR perfusion imaging involves the use of gadolinium-based contrast agents, which are contraindicated in pregnancy. In this study we demonstrate the utility of non-invasive placental perfusion imaging using velocity-selective arterial spin labeling and 3D image acquisition with whole placenta coverage, and present global and regional placental perfusion in high and low-risk pregnancies. Global placental perfusion matched ranges of previously reported values. However, perfusion was heterogeneous and regional placental perfusion measured within the placental lobules reached levels two-fold higher than the global placental perfusion measurement.

974 14:30

Fetal cardiac MRI and flow measurement using Optimized Doppler Ultrasound Sensor (DUS) gating

Jin Yamamura[1], Bjoern Schoennagel[1], Manuele Tavares de Sousa[2], Christian Ruprecht[1], Gerhard Adam[1], and Fabian Kording[1]

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The commonly used method to evaluate the fetal heart is echocardiography (ECG). However, the detection of congenital heart diseases by ECG varies from 45% to 74% and an alternative imaging modality would be desirable. Fetal cardiac MRI has the potential to visualize anatomy and to assess functional parameters of the fetal heart. External fetal cardiac gating using a newly developed Doppler ultrasound sensor (DUS) has been introduced in previous studies. The purpose of this study was to perform fetal cardiac MRI as well as MR flow measurement within great vessels using for external fetal cardiac gating in human fetus and to optimize the device.

975 14:42

Comparative Study of Modelling DW-MRI Data From High-grade Serous Carcinomas and Clear Cell Carcinomas

Feng Wang[1], Jianyu Liu[1], Yan Zhou[1], and Lizhi Xie[2]

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The aim of this study was to assess if the histogram analysis of mono-exponential, bi-exponential and stretched exponential models of diffusion-weighted MRI (DW-MRI) parameters can differentiate two common subtypes of ovarian epithelial cancer: high-grade serous carcinomas (HGSCs) and clear cell carcinomas(CCCs). Based on an entire-tumour measurement, the following histogram parameters were derived from ADC, D, D*, F, DDC and α maps, respectively: the mean of the whole tumor, the 10th percentile and the mean of the top 10 percent. We concluded that ADC, D, F, DDC and α have showed good diagnostic performance by analyzing these data.

976 14:54

Diffusion-weighted MR Imaging (DW-MRI) in advanced epithelial ovarian and primary peritoneal cancer: anatomic site-specific changes following neoadjuvant chemotherapy for detecting residual viable tumor

Jennifer C Wakefield[1,2], Jessica M Winfield[1,2], Gordon Stamp[3], Alison MacDonald[2], Charlotte Hodgkin[4], Ayoma Attygalle[2], Desmond Barton[2], Robin Crawford[4], Susan Freeman[4], and Nandita M deSouza[1,2]

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An understanding of the apparent diffusion coefficient (ADC) changes following neoadjuvant chemotherapy at different metastatic sites in advanced ovarian and primary peritoneal cancer is essential to establish the utility of ADC as a biomarker in site-specific response assessment in this disease. In this study, we found that there was variability in the detection accuracy of DW-MRI between different disease sites and the ADC shows utility as an adjunct to morphological imaging for the detection of viable tumor. Further studies with larger numbers of lesions are needed to interrogate differences between microscopic and non-viable and residual macroscopic tumor fully.

977 15:06

Diagnostic Performance of Endovaginal Zoom EPI Images for Detecting Cervix Cancer after Distortion Correction using Gradient Reversal

Nandita deSouza[1], Matthew Orton[1], Kate Downey[1], Veronica Morgan[1], David Collins[1], Sharon Giles[1], and Geoffrey Payne[1]

[1]CRUK/EPSRC Cancer Imaging Centre, The Institute of Cancer Research and The Royal Marsden NHS Foundation Trust, Sutton, United Kingdom

Diffusion-weighted MRI (DW-MRI) suffers from distortion induced by susceptibility variation and eddy-currents. To correct this for endovaginal imaging of the uterine cervix, we implemented the forward and reversed gradient technique proposed by Chang and Fitzpatrick in the phase-encode direction and assessed clinical utility of the technique. This required acquisition of two images of the cervix under the same conditions. Correction of distortions significantly improved diagnostic performance for an experienced observer when images were viewed with the T2-W images. Correction allowed definitive diagnosis in a third of cases with tumour volumes of <0.2cm3 classified as equivocal on uncorrected images.

978 15:18

Quantitative DCE-MRI as predictors of immediate ablation efficiency in MR-HIFU treatment of uterine fibroids based on reference region model and entire-tumor histogram analysis

Chenxia Li[1,2], Chao Jin[1], Ting Liang[1,2], Gang Niu[1], Yitong Bian[1], Keserci Bilgin[3], and Jian Yang[1,2]

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The aim is to investigate whether quantitative DCE-MRI could be a predictor of immediate ablation efficiency in MR-HIFU of uterine fibroids. 24 eligible female underwent DCE-MRI during screening procedure and immediately after MR-HIFU therapy.They were divided into high non-perfused volume (NPV) ratio (>60%) and low NPV ratio (<60%) group. The reference region model was used for 3D histogram analysis.All histogram metrics of RR-K^{trans} showed significant difference between two groups. The correlation of RR-K^{trans} and NPV ratio was significantly negative (r=-0.6). It indicated that the 3D histogram metrics of RR-K^{trans} might be a sensitive predictor used for patients selection in MR-HIFU.

Oral

CMR Perfusion & Function

Room 300-302 16:00 - 18:00 *Moderators:*Vincent Ho & Behzad Sharif

990 16:00

Harmonic-Phase versus Sine-Wave Modeling for Measuring Regional Cardiac Function from Tagged MRI Images
El-Sayed H. Ibrahim[1], Scott Swanson[1], Jadranka Stojanovska[1], Claire Duvernoy[1], and Rodica Pop-Busui[1]

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

MRI tagging is a valuable method for evaluating regional heart function. This study compares the harmonic-phase (HARP) and sine-wave modeling (SinMod) tagging analysis techniques for evaluating myocardial strain and torsion in healthy controls and type-1-diabetes patients. All SinMod measurements were significantly larger than those by HARP. Nevertheless, there existed consistency in the measurements by each technique, as seen by the good correlation between the HARP and SinMod measurements in both normals and patients, except for apical strain (patients and controls) and mid-ventricular strain in patients. The inter-observer agreement was better in SinMod than in HARP for both torsion and strain.

991 16:12

Regional cardiac mechanical activation times using cine DENSE strain imaging strongly predict electrical activation times in cardiac resynchronization therapy
Daniel A Auger[1], Kenneth C Bilchick[2], and Frederick H Epstein[1,3]

[1]Department of Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Department of Medicine, Cardiovascular Medicine, University of Virginia, Charlottesville, VA, United States, [3]Radiology and Medical Imaging, University of Virginia, Charlottesville, VA, United States

A widely held goal in cardiac resynchronization therapy (CRT) is to implant the left-ventricular (LV) pacing lead in a late-activating region. Time to peak shortening (TPS) has been used to image mechanical activation; however electrical activation time is directly related to the time of onset of contraction rather than TPS. Using cine DENSE in heart failure patients, we show that the time of onset of shortening (TOS) shows a strong correlation with electrical activation time, whereas a lower correlation was found using TPS. Cine DENSE of TOS is a promising method for the detection of late-activating segments in CRT patients

992 16:24

Left ventricular (LV) volume and rate of volume change (dV/dt) during the early and late filling periods evaluated from respiratory triggered, high frame rate cine SSFP as markers of LV diastolic function: Direct correlation with Echocardiography
Jiming Zhang[1], Benjamin Y Cheong[1], Jie Chen[1], Amol Pednekar[2], Claudio Arena[1], Melissa L Andrews[1], and Raja Muthupillai[1]

[1]Diagnostic and Interventional Radiology, CHI St Luke's Health, Houston, TX, United States, [2]Phillips Healthcare, Cleveland, OH, United States

LV chamber volumes measured using MR cine SSFP imaging and trans-mitral flow velocities measured with echo are considered de facto standards for evaluating LV systolic and diastolic function respectively. Our results show that the relative change in LV volume as well as peak LV volume-rate between the early and late filling periods of the cardiac cycle as measured from high-frame rate cine SSFP imaging, correlate well with conventional echo-based diastolic function index (E/A ratio). The results from the study suggest that a free-breathing, high frame rate MR cine SSFP imaging approach can evaluate both systolic and diastolic function from a single LV volume data-set.

993 16:36

An extended 3D whole-heart myocardial first-pass perfusion sequence: Alternate-cycles interchanging high-resolution and isotropic imaging
Merlin J Fair[1,2], Peter D Gatehouse[1,2], Liyong Chen[3,4], Ricardo Wage[2], Edward VR DiBella[5], and David N Firmin[1,2]

[1]NHLI, Imperial College London, London, United Kingdom, [2]NIHR Cardiovascular BRU, Royal Brompton Hospital, London, United Kingdom, [3]UC Berkeley, Berkeley, CA, United States, [4]Advanced MRI Technologies, Sebastopol, CA, United States, [5]UCAIR, University of Utah, Salt Lake City, UT, United States

An alternate-cycle acquisition strategy is proposed for 3D whole-heart first-pass perfusion, capturing two separate datasets from the same first-pass, each pushing separate boundaries of currently achievable parameters whilst maintaining clinically feasible acquisition times. It is postulated this approach may also confer an advantage with regard to artefact detection.

994 16:48

Reduced field-of-view 3D stack-of-spirals perfusion imaging with high spatiotemporal resolution
Yang Yang[1], Li Zhao[2], Xiao Chen[3], Kelvin Chow[4], Peter W. Shaw[4], Jorge A. Gonzalez[4], Frederick H. Epstein[1,5], Craig H. Meyer[1,5], Christopher M. Kramer[4,5], and Michael Salerno[1,4,5]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Radiology, Beth Israel Deaconess Medical Center & Harvard Medical, Boston, MA, United States, [3]Medical Imaging Technologies, Siemens Healthcare, Princeton, NJ, United States, [4]Medicine, University of Virginia, Charlottesville, VA, United States, [5]Radiology, University of Virginia, Charlottesville, VA, United States

3D CMR perfusion imaging enables whole ventricular coverage at the same cardiac cycle permitting quantification of ischemic burden of patients being evaluated for coronary artery disease. Current 3D techniques have limited spatial-temporal resolution. We developed an

efficient outer-volume suppressed 3D Stack-of-Spiral perfusion sequence with motion-guided compressed sensing reconstruction which can acquire 20 partitions with 2 mm in-plane and 4 mm through-plane resolution with a temporal foot print of 180 ms. A pilot study of 10 subjects using this technique demonstrates clinically acceptable image quality.

995 17:00

Multi-center study of whole-heart dynamic 3-dimensional cardiac magnetic resonance perfusion imaging for the detection of coronary artery disease – analysis of diagnostic performance in women

Sandra Hamada[1], Alexander Gotschy[2,3], Lukas Wissmann[3], Sebastian Kozerke[3], Cosima Jahnke[4], Ingo Paetsch[4], Rolf Gebker[5], Nikolaus Marx[6], Hatem Alkadhi[1], and Manka Robert[1,7]

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Coronary heart disease accounts for a large amount of morbidity and mortality in women. To contribute to evidence for non-invasive testing in women, this study compares diagnostic performance of whole heart dynamic 3D myocardial first-pass perfusion stress imaging in female and male with findings in coronary angiography. 61 female and 139 male with suspected and known coronary artery disease were enrolled and a whole heart dynamic 3D-CMR first-pass perfusion imaging was performed at rest and at stress. Whole heart dynamic 3D-CMR perfusion imaging shows high sensitivity, specificity and diagnostic accuracy in women and men and therefore seems to be a suitable testing tool for myocardial ischemia in women and men.

996 17:12

Towards Reliable Non-Contrast Enhanced MR-based Myocardial Perfusion Imaging: Myocardial BOLD MRI Using Late Effects of Regadenoson with Simultaneous 13N-ammonia PET Validation in a Whole-body Hybrid PET/MR System

Hsin-Jung Yang[1], Damini Dey[1], Jane Sykes[2], John Butler[2], Xiaoming Bi[3], Behzad Sharif[1], Sotirios Tsaftaris[4], Debiao Li[1], Piotr Slomka[1], Frank Prato[2], and Rohan Dharmakumar[1]

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Over the past two decades myocardial BOLD MRI has seen major technical advancements and a number of clinical validation studies. However, the reliability of BOLD MRI still remains a key weakness for its widespread adoption for routine clinical use due to the unpredictable motions during stress tests. We investigated whether the unique pharmocokinetics of regadenoson, a new coronary vasodilator that is rapidly becoming the agent of choice for cardiac stress testing, can be used to markedly improve the reliability of myocardial BOLD MRI. Studies were performed in a canine model and validated in a clinical PET/MR system.

997 17:24

Comprehensive assessments of myocardial tissue kinetic parameters of K1, k2, MBF, lambda and ECV by using a synergistic quantitative analysis of first-pass myocardial perfusion MRI and pre-and post-contrast T1 mapping in patients with myocardial infarction.

Akimasa Yamada[1], Masaki Ishida[1], Takashi Ichihara[2], Takahiro Natsume[2], Yoshitaka Goto[1], Mio Uno[1], Motonori Nagata[1], Yasutaka Ichikawa[1], Kakuya Kitagawa[1], and Hajime Sakuma[1]

[1]Radiology, Mie University Hospital, Tsu-Mie, Japan, [2]Faculty of Radiological Technology, Fujita Health University School of Health Science, Toyoake-Aichi, Japan

In this study, we proposed a new method that synergistically analyzes quantitative perfusion MRI and T1-mapping for quantifying k2, as well as K1, myocardial blood flow, lambda and extracellular volume fraction. Nineteen patients with previous myocardial infarction (MI) were studied. Myocardial segments were categorized into 3 groups by presence or absence as well as severity of MI in each segment. Quantitative measurement was successful in all segments with significant difference among the 3 groups of myocardial segments for all tissue kinetic parameters including k2. Synergistic assessment of quantitative perfusion MRI and T1-mapping is promising for more detailed myocardial tissue characterization.

998 17:36

Bayesian Intravoxel Incoherent Motion Imaging to Map Perfusion in the Human Heart

Georg Spinner[1], Constantin von Deuster[1,2], Christian Torben Stoeck[1], and Sebastian Kozerke[1]

[1]Institute for Biomedical Engineering, ETH Zurich, Zurich, Switzerland, [2]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom

In vivo cardiac Intravoxel Incoherent Motion Imaging (IVIM) is particularly challenging due to low signal-to-noise ratio, cardiac and respiratory motion. To address the limitation, a spin-echo (SE) based sequence employing motion-compensated diffusion gradients during cardiac contraction was used in combination with Bayesian Shrinkage Prior (BSP) inference. In this work, parameter maps of four volunteers (two slices) are compared to standard segmented least squares (LSQ) regression. Bayesian inferred IVIM parameter maps showed reduced intra-subject variation relative to LSQ. It is concluded that the proposed method is a promising alternative to map myocardial perfusion without the need for contrast agent administration.

999 17:48

Non-contrast Vasodilatory Response Assessment in a porcine model of Acute Myocardial Infarction using Arterial Spin Labeled CMR

Hung Phi Do[1], Venkat Ramanan[2], Graham A Wright[2,3], Nilesh R Ghugre[2,3], and Krishna S Nayak[4]

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Sunnybrook Research Institute, Toronto, ON, Canada, [3]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [4]Ming Hsieh Department of Electrical Engineering, University of Southern California, Los Angeles, CA, United States

Myocardial vasodilatory response is an important indicator of microvascular function and viability. Arterial spin labeled (ASL) CMR is a non-contrast method that can quantify myocardial blood flow making it attractive to study vasodilatory response. In this work, we demonstrate the feasibility of ASL in the assessment of regional vasodilatory response in a porcine model of acute myocardial infarction (AMI) using a pharmacological stress agent. Quantitative monitoring of microvascular function in the infarcted, salvageable and remote myocardial territories may potentially help identify patients who are prone to adverse long-term remodeling post-AMI.

Oral

Arterial Spin Labeling

Room 324-326 16:00 - 18:00 *Moderators:*Maria Fernandez-Seara & Henk Mutsaerts

1000 16:00

Automatic adaption of ASL labeling parameters: Walsh-sorted time-encoded pCASL with a dynamic feedback algorithm
Nora-Josefin Breutigam[1], Federico von Samson-Himmelstjerna[1], and Matthias Günther[1]

[1]MR Physics, Fraunhofer MEVIS, Bremen, Germany

A dynamic feedback algorithm to find the optimal free-lunch (FL) bolus-length in a multi-TI Hadamard-encoding scheme is presented. An estimated FL bolus-length is often not ideal for the examined subject. In arterial spin labeling (ASL) this frequently results in unwanted arterial transit-delay (ATD) artefacts. The proposed method allows approaching the optimal FL bolus-length individually by analyzing intermediate decoded perfusion-weighted images during a running MRI scan. The aim is to reduce the FL bolus-length as much as necessary, but to keep it as long as possible to yield maximal signal.

1001 16:12

summa cum laude

Combined Angiography and Perfusion using Radial Imaging and Arterial Spin Labeling
Thomas W. Okell[1]

[1]FMRIB Centre, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom

A new golden angle radial arterial spin labeling acquisition method is proposed in which labeled blood water is continuously imaged as it passes through the large arteries and into the tissue. Both angiographic and perfusion images can then be reconstructed from the same raw data set at any retrospectively chosen time points and temporal resolution. This makes efficient use of the post-labeling delay dead time to provide a more complete assessment of blood flow into the brain, which may be of use in a variety of cerebrovascular diseases.

1002 16:24

summa cum laude

Comparison of perfusion signal acquired by ASL prepared IVIM and conventional IVIM to unravel the origin of the IVIM-signal
Xingxing Zhang[1], Carson Ingo[1], and Matthias J.P. van Osch[1,2]

[1]C. J. Gorter Center for High Field MRI, Department of Radiology, Leiden University Medical Center, Leiden, Netherlands, [2]Leiden Institute for Brain and Cognition, Leiden, Netherlands

ASL-prepared IVIM is proposed to study the arterial IVIM signal as a function of post-labeling-delay. The D*-value as calculated from ASL-IVIM decreases as a function of PLD, reaching a plateau for PLDs>2000ms. Signal from conventional IVIM shows an intermediate D*-value corresponding to the ASL-IVIM-signal for a PLD of ~1750ms indicating the IVIM signal does not only originate from the microvasculature, but also includes vascular signal. The alternative explanation of extravasation of labeled spins into the extravascular compartment seems unlikely, since the observed D* at these PLDs are still a factor 3~4 higher than the diffusion coefficient of the slow compartment.

1003 16:36

Flow territory instability may provide a new measure of hemodynamic reserve capacity in patients with intracranial stenosis
Daniel Arteaga[1], Megan Strother[1], Taylor Davis[1], Carlos Faraco[1], Lori Jordan[2], Allison Scott[1], and Manus Donahue[1]

[1]Radiology, Vanderbilt University, Nashville, TN, United States, [2]Neurology, Vanderbilt University, Nashville, TN, United States

Non-invasive, hemodynamic markers are needed to better characterize stroke risk in patients with symptomatic intracranial (IC) stenosis. We developed and applied a planning-free vessel-encoded pseudo-continuous arterial spin labeling sequence in IC stenosis patients during room air and hypercapnia to examine the extent of geometrical changes in cerebral blood flow territories. IC stenosis patients demonstrated increased shifting relative to healthy controls; among IC stenosis patients, shifting was higher in those who experienced non-cardioembolic stroke within two-years. Shifting of cerebral blood flow territories may provide a novel marker of hemodynamic impairment and stroke risk.

1004 16:48

Comparing Single-Delay, Sequential Multi-delay, and Hadamard Multi-delay ASL for Measuring CBF and Arterial Transit Delay in Normal Subjects and Patients with Cerebrovascular Disease
Samantha Holdsworth[1], Audrey Fan[1], Marc Lebel[2], Zungho Zun[3], Ajit Shankaranarayanan[4], and Greg Zaharchuk[1]

[1]Department of Radiology, Stanford University, Stanford, CA, United States, [2]GE Healthcare, Calgary, Canada, [3]George Washington University,

Washington, DC, United States, [4]GE Healthcare, Menlo Park, CA, United States

One promising approach to multi-delay ASL is to perform the labeling using a Hadamard-encoded method, which promises to improve the SNR efficiency compared with sequential multi-delay ASL. In this study, we compared single-delay ASL, sequential multi-delay ASL, and Hadamard-encoded multi-delay ASL in normal subjects and in patients with cerebrovascular disease. Consistent with theory, Hadamard-encoding had better SNR than sequential multi-delay ASL for measuring CBF and arterial transit delay.

1005 17:00

magna cum laude

Hypoglycemia-induced changes in global and regional cerebral blood flow; impact of type 1 diabetes and impaired awareness of hypoglycemia

Evita Wiegers[1], Kirsten Becker[1], Hanne Rooijackers[2], Cees Tack[2], Arend Heerschap[1], Bastiaan de Galan[2], and Marinette van der Graaf[1,3]

[1]Radiology and Nuclear Medicine, Radboud umc, Nijmegen, Netherlands, [2]Internal Medicine, Radboud umc, Nijmegen, Netherlands, [3]Pediatrics, Radboud umc, Nijmegen, Netherlands

Hypoglycemia-induced changes in global and regional cerebral blood flow (CBF) were investigated in patients with type 1 diabetes (T1DM) and impaired (IAH) or normal awareness of hypoglycemia (NAH) and in healthy subjects. CBF-weighted images were acquired using pseudo-continuous arterial spin labeling MRI. Global CBF increased in response to hypoglycemia in T1DM IAH subjects, but not in T1DM NAH or in healthy controls. Hypoglycemia induced regional relative increases in CBF in the thalamus of both T1DM NAH and healthy controls, and in the frontal lobes of T1DM NAH, while no such increases were found in the T1DM IAH group.

1006 17:12

magna cum laude

Fast measurement of blood T1 in the internal carotid artery at 3T

Wenbo Li[1,2], Peiying Liu[1], Hanzhang Lu[1], John J. Strouse[3], Peter C.M. van Zijl[1,2], and Qin Qin[1,2]

[1]Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]F.M. Kirby Research Center for Functional Brain Imaging, Kennedy Krieger Institute, Baltimore, MD, United States, [3]Division of Pediatric Hematology, Johns Hopkins University School of Medicine, Baltimore, MD, United States

The knowledge of arterial blood T1 is important to quantify cerebral blood flow with ASL or the inversion time for VASO experiments. We used a fast blood T1 protocol to measure the arterial T1 values in the internal carotid artery in vivo. Ex-vivo experiments were conducted to validate our method. Excellent correlation and agreement was found between in vivo and ex vivo results. The group-averaged arterial blood T1 value over 9 healthy volunteers was 1864+/-92ms (Hct=0.41+/-0.04), which is 200 ms longer than the widely adopted number obtained from bovine blood experiments. The arterial T1 value per subject was found to have significant correlation with the individual Hct values.

1007 17:24

magna cum laude

Non-contrast Pulmonary Perfusion at 3T using FAIR with inflow saturation and background suppression

Joshua S. Greer[1,2], Yue Zhang[2], Christopher Maroules[2], Orhan K. Oz[2], Ivan Pedrosa[2,3], and Ananth J. Madhuranthakam[2,3]

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Flow Alternating Inversion Recovery (FAIR) has been studied extensively for pulmonary perfusion imaging at 1.5T, but suffers from low SNR, and is often corrupted by bright signal in the major vasculature and image misregistration artifacts due to respiratory motion. The purpose of this study was to evaluate FAIR at 3T for increased SNR and compare against SPECT perfusion, to combine FAIR with inflow saturation to reduce signal in the major pulmonary vessels, and to combine FAIR with background suppression strategies to minimize artifacts due to image misregistration.

1008 17:36

Velocity Selective Adiabatic Pulses for Arterial Spin Labeling

Luis Hernandez-Garcia[1], Jon-Fredrik Nielssen[2], and Douglas Noll[1]

[1]FMRI Laboratory, University of Michigan, Ann Arbor, MI, United States, [2]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States

We introduce a class of adiabatic RF pulses that can invert the magnetization of spins moving at specific velocity bands, regardless of their position within the coil. Velocity selective adiabatic pulses (VSAI) are more robust to B1 inhomogeneity than their non-adiabatic counterparts. We discuss the theory and design considerations and demonstrate their utility in an ASL experiment on a human brain at 3T.

1009 17:48

magna cum laude

Incorporation of labeling efficiency measurement into a normal pCASL perfusion scan without SNR-penalty

Zhensen Chen[1], Xihai Zhao[1], Wouter Teeuwisse[2], Bida Zhang[3], Peter Koken[4], Jouke Smink[5], and Matthias J.P. van Osch[2]

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The pCASL perfusion sequence was modified to incorporate a labeling efficiency measurement during the post-labeling delay. Our in vivo data showed that the incorporated labeling efficiency measurement had no influence on SNR of the perfusion measurements, with almost no additional time penalty. The additional labeling efficiency measurement was demonstrated its ability to identify severe

underestimation of CBF caused by sub-optimal labeling, proofing its clinical potential. Moreover, the measured labeling efficiency is artery-specific, which is important because arteries may have different labeling efficiency due to differences in flow velocity and/or off-resonance effects.

Oral

RF Pulse Design

Room 331-332 16:00 - 18:00 *Moderators:*Douglas Noll & Holden Wu

1010 16:00

Multi-Dimensional Reduced Field-of-View Excitation by Integrated RF Pulse and DYNAMITE B0 Field Design
Suryanarayana Umesh Rudrapatna[1], Robin de Graaf[1], Terrance Nixon[1], and Christoph Juchem[1]

[1]Yale University, New Haven, CT, United States

Spatially selective multi-dimensional excitation with large flip angles is challenging, as current RF pulse design methods are computationally involved and typically yield low time-bandwidth product (TB < 10) pulses. The difficulty stems from Bloch equation non-linearity and the inflexibility in B_0 pattern generation using linear gradients. This study uses the dynamic multi-coil technique (DYNAMITE), that provides unprecedented B_0 shaping flexibility, facilitating the use of 1-dimensional Shinnar-Le Roux (SLR) pulses for 2-dimensional excitation. Selective mouse brain excitation was accomplished by adaptively designing the SLR pulse and the underlying B_0 fields generated by DYNAMITE. The resultant zoomed MRI achieved more than two-fold acquisition acceleration at < 4% undesired excitation with TB > 12 pulses.

1011 16:12

Designing 2D and 3D selective adiabatic pulses
Albert Jang[1,2] and Michael Garwood[1]

[1]Center for Magnetic Resonance Research and Department of Radiology, University of Minnesota, Minneapolis, MN, United States, [2]Department of Electrical and Computer Engineering, University of Minnesota, Minneapolis, MN, United States

Two-dimensional (2D) adiabatic pulses based on sampling *k*-space have previously been developed using amplitude modulation in one orthogonal direction and frequency modulation in the other[2]. Here, a new method for designing two and three-dimensional adiabatic pulses using a sub-pulse approach is introduced. Namely, a parent adiabatic pulse is divided into sub-pulse elements, each of which is a 2D selective pulse. Using this approach, selective excitation is achieved through the 2D pulse while being adiabatically driven by the parent adiabatic pulse. This can be extended to three-dimensions by applying blips along the remaining direction between sub-pulses. Simulation and experimental results are presented, confirming the validity of this approach.

1012 16:24

Tailored Spiral In-Out Spectral-Spatial Saturation Pulses for Short and Effective Water Suppression in High Resolution MRSI
Jun Ma[1], Carrie Wismans[2], Zhipeng Cao[1], Dennis W. J. Klomp[2], Jannie P. Wijnen[2], and William A. Grissom[1,3]

[1]Vanderbilt University Institute of Imaging Science, Nashville, TN, United States, [2]Department of Radiology, University Medical Centre Utrecht, Utrecht, Netherlands, [3]Biomedical Engineering, Vanderbilt University, Nashville, TN, United States

At ultra-high field (7T and above), the increased SNR can be used to significantly improve MRSI spatial resolution, but scan time is a challenge with large acquisition matrixes, so time-efficient water signal suppression is critical. However, at ultra-high field, $B1^+$ and B0 inhomogeneities degrade the performance of time-efficient CHESS water suppression strategies. To address this, we propose to replace conventional spectrally-selective pulses with subject-tailored spiral in-out spectral-spatial (SPSP) saturation pulses that are designed using subject-specific $B1^+$ and B0 maps. The pulses were validated in in vivo experiments.

1013 16:36

Improved gradient waveforms for small-tip 3D spatially tailored excitation using Iterated Local Search
Jon-Fredrik Nielsen[1], Hao Sun[2], Jeffrey A Fessler[1,2], and Douglas C Noll[1]

[1]Biomedical Engineering, University of Michigan, Ann Arbor, MI, United States, [2]Electrical Engineering and Computer Science, University of Michigan, Ann Arbor, MI, United States

We propose a strategy for the joint design of gradient and radiofrequency waveforms for small-tip 3D spatially tailored excitation, that may lead to more globally optimal excitation k-space trajectories. Currently, gradients are either pre-defined or restricted to certain classes such as echo-planar or concentric shells. Our method makes use of a recently proposed optimization method that expresses k-space with a 2nd-order B-spline basis permitting arbitrary k-space trajectories. We employ this method in an Iterated Local Search strategy, and show that this approach reduces the sensitivity of the excited pattern to the choice of initial k-space trajectory that "seeds" the optimization.

1014 16:48

Short-T2 specific excitation by a 'back-and-forth' composite RF pulse
Ethan M Johnson[1], Adam B Kerr[1], Kim Butts Pauly[2], and John M Pauly[1]

[1]Electrical Engineering, Stanford University, Stanford, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States

Images of cortical bone have previously been created by selection of RF pulse parameters giving short-$$$T_2$$$-specificity in

excitation for a 3D UTE sequence. The previous demonstration required multiple excitations. Here a composite pulse is described that creates similar contrast for depicting cortical bone with bright signal.

1015 17:00

summa cum laude

B0-robust slice-selective excitations for ultra-high field with flip-angle mitigation using parallel transmission
Mathias Davids[1,2], Bastien Guérin[2,3], Lawrence L Wald[2,3,4], and Lothar R Schad[1]

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High field MRI suffers from non-uniform transmit fields and B_0 variations due to increased susceptibility effects, making uniform slice-excitation very difficult. We developed a new pulse trajectory – the "twisted spokes" RF pulse – to achieve accurate slice-selection with high in-plane uniformity and greatly improved B_0 robustness. The twisted spokes trajectory consists of helical k-space segments oriented along the slice-selection direction (e.g., k_z). We found that, when the helical segments are designed appropriately, the resulting RF pulses are short, achieve sharp slice profiles and uniform flip-angle distributions, and – at the same time – are very robust to off-resonance effects.

1016 17:12

summa cum laude

Optimal Control Design of Turbo Spin-Echo Sequences with Applications to Parallel-Transmit Systems
Alessandro Sbrizzi[1], Hans Hoogduin[1], Joseph V Hajnal[2], Cornelis AT van den Berg[1], Peter R Luijten[1], and Shaihan Malik[2]

[1]UMC Utrecht, Utrecht, Netherlands, [2]King's College London, London, United Kingdom

We cast the design of variable refocusing angles in TSE sequences as an optimal control problem. By application of the Adjoint States method (ASM), we are able to design dynamic shimming setting for pTx systems in a patient-specific, online fashion.

1017 17:24

magna cum laude

IMPULSE-SMS: Local SAR and peak power optimized pTx pulse design for simultaneous multislice imaging at high fields
Mihir Pendse[1] and Brian Rutt[1]

[1]Stanford University, Stanford, CA, United States

We describe an extension of the IMPULSE pTx design algorithm to enable simultaneous multislice (SMS) excitation. We introduce a strategy for integrating the optimal control method for reducing peak power in SMS with the optimization of pTx channel weightings. Desirable features of IMPULSE, including the ability to optimize spoke locations and to design pulses without SAR compression, are retained in this extension. We demonstrate that, even for large multiband acceleration factors, our approach enables design of pTx pulses that minimize local SAR while achieving acceptable in-slice homogeneity under strict peak power constraints.

1018 17:36

Universal pulses: a new concept for calibration-free parallel transmission
Vincent Gras[1], Alexandre Vignaud[1], Alexis Amadon[1], Denis Le Bihan[1], and Nicolas Boulant[1]

[1]Neurospin, CEA/DSV/I2BM, Gif-sur-Yvette, France

At ultra-high field, a drawback of parallel transmission to mitigate the RF inhomogeneity problem is the necessity to measure subject-specific field maps in order to return optimized RF pulses, thereby decreasing the time available for clinically-relevant scans. In this work, we investigate numerically and experimentally at 7T the design of "universal" kT-points pulses, which does not require the aforementioned calibration step but yet considerably improves excitation homogeneity compared to the standard circularly-polarized and RF shim modes. Such approach can simplify considerably the workflow of parallel transmission and render the potential of ultra-high field scanners more accessible to anyone in routine.

1019 17:48

RF Shimming for High Field MRI using Multi-channel Receive-Signals
Abhinav V. Sambasivan[1], Lance DelaBarre[2], Emad S. Ebbini[1], Thomas J. Vaughan[1,2], and Anand Gopinath[1]

[1]Electrical and Computer Engineering, University of Minnesota-Twin Cities, Minneapolis, MN, United States, [2]Center for Magnetic Resonance Research, UMN-Twin Cities, Minneapolis, MN, United States

Counteracting the effects of B_1 heterogeneities has been a major challenge for High field MRI systems. We propose here, a receiver-based approach called the Receive-RF Shimming (Rx-RFS) algorithm for multichannel MR systems which offers potential advantages in terms of reducing image acquisition time and mitigating SAR concerns. RX-RFS involves computing an optimal spatially-varying weight vector for combining the images from different receive elements. The reconstructed images (using Rx-RFS) exhibit enhanced contrast and more uniform signal levels when compared to standard reconstruction schemes throughout the entire Field-of-View. Rx-RFS also offers clinicians the flexibility to obtain local reconstructions at arbitrary Regions-of-Interest.

Oral

Molecular & Cellular Imaging

Room 334-336 16:00 - 18:00 *Moderators:*David Cormode & Erik Shapiro

1020 16:00

summa cum laude

A zinc-sensitive MRI contrast agent differentiates healthy from cancerous prostate in a transgenic prostate cancer model

Veronica Clavijo Jordan [1], Su-Tang Lo[1], Christian Preihs[1], Sara Chirayil[1], Wen-Hong Li[1], Neil M Rofsky[1], and Dean Sherry[1,2]

[1]UT Southwestern Medical Center, Dallas, TX, United States, [2]UT Dallas, Richardson, TX, United States

The prostate has the highest levels of Zn(II) in the organism and there are marked differences in content between the healthy, malignant, and benign hyperplastic prostate. Given that accurate differential diagnosis between these conditions is difficult non-invasively, we introduce prostate Zn(II) as a MRI imaging biomarker. In this work we use a Gd-based zinc sensor that can sensitively detect glucose-stimulated intracellular release of Zn(II) in the healthy, and malignant mouse prostate using a transgenic adenocarcinoma model.

1021 16:12

Assessment of abdominal aortic aneurysm progression using a novel tropoelastin-specific MR contrast agent

Alkystis Phinikaridou[1], Sara Lacerda[1], Begoña L Plaza[1], Marcelo Andia[2], Silvia G Lorrio[1], and René M Botnar[1]

[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]Radiology, Pontificia Universidad Católica de Chile, Santiago, Chile

The extracellular matrix proteins, elastin and collagen, are the most important structural components of the vessel wall that provide tensile strength and stability. During abdominal aortic aneurysm (AAA) formation there is both, progressive degradation and synthesis of new elastin fibers that disrupts the structural integrity of the vessel wall until it becomes unable to accommodate the high intraluminal hemodynamic forces [1-4]. AAA formation is characterized by dilation of the lumen area and thinning of the vessel wall. Possible rupture of the AAA may have fatal consequences. Rupture of aortic aneurysms is the third most common cause of sudden death after myocardial infarction and stroke. We have developed a tropoelastin-binding MR contrast agent (TESMA) and sought to investigate if it can be used as a novel biomarker to assess AAA development and the risk of rupture, beyond aneurysmal diameter.

1022 16:24

magna cum laude

Direct Quantitative 13C-Filtered 1H Magnetic Resonance Imaging of Pegylated Biomacromolecules In Vivo

Rohan Alvares[1], Justin Lau[2,3], Peter Macdonald[1], Charles Cunningham[2,3], and R. Scott Prosser[1]

[1]Department of Chemistry, University of Toronto, Toronto, ON, Canada, [2]Department of Medical Biophysics, University of Toronto, Toronto, ON, Canada, [3]Physical Sciences, Sunnybrook Research Institute, Toronto, ON, Canada

We demonstrate a new platform technology in which macromolecular constituents, such as proteins and drug delivery systems, are observed directly and quantitatively in vivo using ^{1}H MRI of ^{13}C-labeled polyethylene glycol (^{13}C-PEG) tags. The 28 kDa ^{13}C-PEG tags are non-immunogenic, and each bears approximately 2500 spectroscopically equivalent ^{1}H nuclei appearing at a single resonance position. By filtering the ^{1}H PEG signal through the directly coupled ^{13}C nuclei, background water and fat signals are largely eliminated. We demonstrate the approach by monitoring in real-time the distribution of ^{13}C-PEG and ^{13}C-pegylated albumin injected into the hind leg of a mouse.

1023 16:36

Label-free CEST MRI detection of self-assembly anticancer drug-peptide nanofibers

Yuguo Li[1,2], Lye Lin Lock[3], Renyuan Bai[4], Xinpei Mao[3], Verena Staedtke[5], Peter C.M Van Zijl[1,2], Honggang Cui[3,6], and Guanshu Liu[1,2]

[1]The Russell H. Morgan Department of Radiology and Radiological Science, Division of MR Research, 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 Chemical and Biomolecular Engineering, Johns Hopkins University, Baltimore, MD, United States, [4]Department of Neurosurgery, Johns Hopkins School of Medicine, Baltimore, MD, United States, [5]Department of Neurology, Johns Hopkins School of Medicine, Baltimore, MD, United States, [6]Institute for NanoBioTechnology, Johns Hopkins University, Baltimore, MD, United States

A new injectable and CEST MRI-detectable nanofiber hydrogel has been developed for image-guided drug delivery of anticancer drug Pemetrexed (Pem). Such a drug delivery system is composed of only drug (Pem) and peptide (FFEE) and the MRI detectability stems on the inherent CEST signal of Pem. In the present study, PemFE nanofiber hydrogel was first constructed and characterized. Then, the CEST MRI detection of the constructed hydrogel in vivo was demonstrated in an orthotopic brain tumor mouse model. Our study clearly demonstrated the ability of using CEST MRI to monitor drug delivery of PemFE hydrogel.

1024 16:48

Assessment of Thrombus Stage by 'Multicolor' 19F MRI

Sebastian Temme[1], Christoph Jacoby[2], Christoph Owenier[1], Christoph Grapentin[3], Xiaowei Wang[4], Rolf Schubert[3], Karlheinz Peter[4], Jürgen Schrader[1], and Ulrich Flögel[1,2]

[1]Molecular Cardiology, University of Düsseldorf, Düsseldorf, Germany, [2]Department of Cardiology, Pneumology and Angiology, University Hospital Düsseldorf, Düsseldorf, Germany, [3]Pharmaceutical Technology and Biopharmacy, University of Freiburg, Freiburg i. Br., Germany, [4]Atherothrombosis and Vascular Biology, Baker IDI Heart and Diabetes Institute, Victoria, Australia

The present study was aimed at developing a non-invasive approach for direct assessment of thrombus stage by 'multicolor' ^{19}F MRI. To this end, we used ligands binding specifically during different phases of thrombosis and coupled them to perfluorocarbons (PFCs) with indvidual spectral signatures. Discrimination of the targeted agents was achieved by a novel multi chemical shift selective imaging technique for simultaneous, artifact-free detection of different PFCs. The results show that this technique holds the potential to differentiate thrombi in the acute, subacute and chronic phase and may also be used for in situ labeling of a variety of other targets.

1025 17:00

In vivo imaging of cell fate decisions in cardiac cell therapy using cardioCEST MRI.
Ashley Pumphrey[1], Zhengshi Yang[2], Shaojing Ye[2], Ahmed Abdel-Latif[2], and Moriel Vandsburger[3]

[1]CVRC, University of Kentucky, Lexington, KY, United States, [2]University of Kentucky, Lexington, KY, United States, [3]Physiology, University of Kentucky, Lexington, KY, United States

We developed a cardiac specific chemical exchange saturation transfer pulse sequence and applied it to the tracking of cell survival/proliferation or rejection in murine models of cardiac cell therapy.

1026 17:12

Quantitative Evaluation of Tumour Associated Macrophages in Breast Cancer: Fluorine-19 versus Iron Oxide Nanoparticles
Ashley V Makela[1,2], Jeffrey M Gaudet[1,2], and Paula J Foster[1,2]

[1]Medical Biophysics, Western University, London, ON, Canada, [2]Robarts Research Institute, London, ON, Canada

Tumour associated macrophages (TAMs) are correlated with an aggressive tumour type and poor outcomes. This study is the first time iron and fluorine-19 (^{19}F) based MRI cell tracking methods have been compared for the detection and quantification of TAMs in an orthotopic model of breast cancer. Imaging was performed at 4 days and 3 weeks post cell implantation. Both cell tracking methods showed a much higher TAM density at 4 days; no other imaging study has examined this at such an early time point. ^{19}F MRI provided quantitative information about TAM density and tumoural distribution that was not possible with iron.

1027 17:24

Age-related changes in anterograde transport, axonal integrity and visuomotor function in the DBA/2J mouse model of chronic glaucoma
Xiao-Ling Yang[1,2], Yolandi van der Merwe[1,3], Leon C. Ho[1,4], Ian P. Conner[2,3], Seong-Gi Kim[1,5], Kira L. Lathrop[2], Gadi Wollstein[2,3], Joel S. Schuman[2,3], and Kevin C. Chan[1,2]

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Glaucoma is the leading cause of irreversible blindness worldwide and is a slowly progressing neurodegenerative disease of the visual system. While elevated intraocular pressure (IOP) and age are major risk factors, their effects on glaucoma pathogenesis remain incompletely understood. In this study, we determined the onset of glaucomatous changes and their progression in a chronic inherited glaucoma model using DBA/2J mice. Our results indicate that elevation of IOP may accelerate the deterioration of structure, physiology and function of the visual system in the DBA/2J mice across age. Comparatively, the visual system in C57BL/6J mice appeared intact across the same ages.

1028 17:36

Characterizing Iron Oxide NanoParticles using 4D Spectroscopic SWIFT
Jinjin Zhang[1], Hattie L. Ring[1], Michael Garwood[1], and Djaudat Idiyatullin[1]

[1]Center for Magnetic Resonance Research, Department of Radiology, University of Minnesota, Minneapolis, MN, United States

The ability to accurately and sensitively quantify the bio-distribution of iron oxide nanoparticles is essential for their use as both diagnostic and therapeutic agents in theranostics. In this study, a 4D spectroscopic SWIFT technique was applied and optimized to characterize the distribution of IONPs in mouse *invivo* up to high concentration (>1.0 mg Fe/g of tissue). The frequency shift due to susceptibility variation and T_2* shortening (down to 20 µs) caused by IONPs were detected in mice organs depositing IONPs. The acquired T_2* map which provide quantitative information about IONP bio-distribution makes the 4D spectroscopic SWIFT a promising tool in nanoparticle-based theranostics.

1029 17:48

The framework and AnalytiCally Represented Oxygen-17 BrAin Tumor (ACROBAT) phantom for optimization of $CMRO_2$ quantification protocols in dynamic ^{17}O-MRI.
Dmitry Kurzhunov[1], Robert Borowiak[1,2], Axel Krafft[1,2], and Michael Bock[1]

[1]University Medical Center Freiburg, Dept. of Radiology - Medical Physics, Freiburg, Germany, [2]German Cancer Research Center (DKFZ), German Cancer Consortium (DKTK), Heidelberg, Germany

Direct dynamic ^{17}O-MRI allows quantification of the cerebral metabolic rate of oxygen consumption ($CMRO_2$). The influence of acquisition parameters on the precision of $CMRO_2$ quantification needs to be investigated for routine application, but the costly and rare ^{17}O gas prohibits extensive imaging studies. Thus, in this work a flexible, Fourier domain-based simulation framework is presented and analytical tumor and numerical ^{17}O MRI brain phantoms are utilized based on experimental ^{17}O relaxation times and signal-to-noise ratios. Precision of $CMRO_2$ quantification is evaluated and optimal acquisition parameters are given.

Oral

Psychiatric Disorders: Translational Approaches

1030 16:00

The impact of ebselen administration on neurochemical profiles: A magnetic resonance spectroscopy study at 7 Tesla

Uzay E Emir[1], Charles Masaki[2], Ann L Sharpley[2], Beata R Godlewska[2], Adam Berrington[1], Tasuku Hashimoto[2], Nisha Singh[3], Sridhar R Vasudevan[3], Grant C Churchill[3], and Philip J Cowen[2]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [2]Department of Psychiatry, University of Oxford, Oxford, United Kingdom, [3]Department of Pharmacology, University of Oxford, Oxford, United Kingdom

Bipolar disorder (BPD) is a relatively common psychiatric disorder for which lithium is the gold standard of treatment. Lithium is an inhibitor of the enzyme inositol monophosphatase (IMPase) , leading to marked decreases in brain myo -inositol (*myo* -Ins) levels Recently, it has been reported that ebselen, a drug developed for its antioxidant and inflammatory properties, inhibits IMPase and lowers myo -Ins levels in the human brain. In this study, it was aimed to replicate this finding using a higher dose of ebselen and at ultra high field strength (7T).

1031 16:12

Default-mode network hypo-connectivity in a mouse model of human chromosome 16p11.2 microdeletion

Alice Bertero[1,2], Gergely David[2], Adam Liska[2], Alberto Galbusera[2], Massimo Pasqualetti[1,2], and Alessandro Gozzi[2]

[1]Department of Biology, Unit of Cell and Developmental Biology, University of Pisa, Pisa, Italy, [2]Functional Neuroimaging Lab, Center for Neuroscience and Cognitive Systems, Istituto Italiano di Tecnologia, Rovereto, Italy

Autism spectrum disorder (ASD) has been associated to reduced or aberrant functional brain connectivity as measured with resting state fMRI (rsfMRI). However little is known on the pathophysiological and genetic determinants underlying these alterations. Here we show that mice recapitulating human chromosome 16p11.2 microdeletion, a trait associated with intellectual disability and high ASD penetrance, exhibit reduced connectivity in prefrontal hubs of the mouse default mode network, recapitulating a hallmark neuroimaging finding in ASD. These findings establish a causal link between ASD-associated mutations and connectivity alterations and identify a plausible macroscale substrate for the cognitive impairments associated to 16p11.2 microdeletion.

1032 16:24

magna cum laude

Assessing the effects of methylphenidate on human brain development using pharmacological magnetic resonance imaging: a randomized controlled trial

Anouk Schrantee[1], Esther E Bron[2], Henk-Jan MM Mutsaerts[1,3], Stefan Klein[2], Wiro Niessen[2,4], Serge ARB Rombouts[5,6], and Liesbeth Reneman[1]

[1]Department of Radiology, Academic Medical Center, University of Amsterdam, Amsterdam, Netherlands, [2]Biomedical Imaging Group Rotterdam, Departments of Medical Informatics and Radiology, Erasmus MC, Rotterdam, Netherlands, [3]Sunnybrook Research Institute, Toronto, ON, Canada, [4]Imaging Physics, Applied Sciences, Delft University of Technology, Delft, Netherlands, [5]Institute of Psychology, Leiden University, Leiden, Netherlands, [6]Department of Radiology, LUMC, Leiden, Netherlands

In this randomized clinical trial we studied the effect of methylphenidate exposure on the development of the dopamine system in children and adults with ADHD. Concurrent with preclinical literature, we found an increased DA reactivity using arterial spin labeling pharmacological MRI following four months of treatment with methylphenidate in children with ADHD, but not in adult patients.

1033 16:36

Does N-acetylcysteine elevate brain glutathione levels? : a six-months double-blind randomized controlled study

Lijing Xin[1], Philippe Conus[2], Philipp S. Baumann[2,3], Margot Fournier[3], Carina Ferrari[2,3], Luis Alameda[2,3], Raoul Jenni[2,3], Thierry Buclin[4], Rolf Gruetter[5,6,7], Ralf Mekle[8], and Kim Q. Do[3]

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Dysregulation of the glutathione (GSH) metabolism has been implicated in schizophrenia pathophysiology. Boosting GSH levels by N-acetylcysteine (NAC), a precursor of GSH, was hypothesized to be a neuroprotective treatment. The aim of this study was to investigate whether the supplementation of NAC treatment has an impact on cerebral GSH levels and other metabolites in early psychosis patients using in vivo ^{1}H MRS. A significant increase of mPFC GSH levels was observed in patients with 6-months NAC treatment, however such increase was absent in placebo group.

1034 16:48

A GABA-A receptor α5 subtype specific fMRI Signature in the Rat Brain: Negative versus Positive Allosteric Modulation effects

Thomas Mueggler[1], Basil Künnecke[1], Henner Knust[1], Andreas Bruns[1], Rodolfo Gasser[1], Andrew Thomas[1], Maria-Clemencia Hernandez[1], and Markus von Kienlin[1]

[1]Pharma Research and Early Development, Roche Innovation Center Basel, Hoffmann-La Roche, Basel, Switzerland

The GABA-A α5 subunit-containing receptors are prominently expressed in the hippocampus. There is genetic and pharmacological evidence for a modulatory role in learning and memory positioning the GABA-A α5 subunit-containing receptor as potential target for treatment of cognitive dysfunction. In order to investigate the circuitry engaged by modulation of the GABA-A α5 subtype-containing

receptors we performed pharmacological MRI (phMRI) studies in the sedated rat using a selective GABA-A α5 negative (NAM) and a positive allosteric modulator (PAM) and demonstrated a differential neurofunctional response which contrasted to that of the non-selective benzodiazepine agonist diazepam.

1035 17:00

MEGAPRESS reveals lower γ-aminobutyric acid ratios in the striatum of highly-impulsive rats

Stephen J Sawiak[1], Bianca Jupp[1], Tom Taylor[1], Daniele Caprioli[1], T Adrian Carpenter[1], and Jeffrey Dalley[1]

[1]University of Cambridge, Cambridge, United Kingdom

Disorders of impulse control are a rising issue in society as diagnosis rates of conditions such as attention deficit and hyperactivity disorder are increasing. In humans, the MEGAPRESS approach to measuring GABA is becoming a standard technique but it has not yet been used much in translational studies. Here, we used it to measure GABA in the striatum of highly-impulsive rats compared to rats with low impulsivity and found significantly reduced levels of this inhibitory neurotransmitter in the impulsive animals.

1036 17:12

Thalamic-Auditory Cortical-Hippocampal Dysconnectivity in First-Episode Schizophrenia Patients with Auditory Verbal Hallucinations

Long-Biao Cui[1], Baojuan Li[2], Yi-Bin Xi[1], and Hong Yin[1]

[1]Xijing Hospital, Fourth Mililtary Medical University, Xi'an, China, People's Republic of, [2]School of Biomedical Engineering, Fourth Mililtary Medical University, Xi'an, China, People's Republic of

We found hyperconnectivity from the thalamus to auditory cortex and hypoconnectivity from the auditory cortex to the hippocampus in AVHs. The thalamic-auditory cortical-hippocampal circuit seems to be crucial for AVHs in SZ. In SZ patients with AVHs, there is a failure to attenuate the sensitivity of auditory cortex to thalamic inputs with a complementary down-regulation of hippocampal responses to ascending auditory input. These findings are consistent with current thinking about dysconnection syndromes in SZ; particularly the aberrant modulation of neuromodulatory gain control and its role assigning aberrant precision or salience to sensory evidence in conditions like SZ. Our findings might provide support for dysconnectivity hypothesis of AVHs associated with auditory/language-processing regions, default mode regions, and other networks (insula and striatum), as reviewed most recently. Dysconnectivity of this circuit may also serve as a potential diagnostic biomarker and therapeutic target of AVHs in SZ based on the direct evidence in vivo we found.

1037 17:24

Functional Dysconnectivity in Autism Spectrum Disorder Revealed by Network-Based Statistics.

AmirHussein Abdolalizadeh[1], Bahram Mohajer[1], and Nooshin Abbasi[1]

[1]Students Scientific Research Center, Tehran University of Medical Sciences, Tehran, Iran

Since the advent of Connectomics, borders of our knowledge about brain and nervous system have increased tremendously. Thus, novel methods to analyze brain connectivity have always been under focus. We used Network-based statistics (NBS), to exert a weak control over family-wise error, and discover interconnected networks in 35 Autism Spectrum Disorder (ASD) and 34 age-, sex- matched Typically developing (TD) children. We also used NBS results' nodes for structural connectivity analysis. We respectively showed increased and decreased functional connectivity of fronto-inferior temporal and default-mode networks, in patients with ASD compared to TD.

1038 17:36

Relationship between neuropsychological stress and inflammation: a PET and MRI study.

Cheuk Ying Tang[1], Victoria X Wang[2], Johnny C Ng[2], Venkatesh Mani[2], Sarah Horn[3], James Murrough[3], Chloe Solomon[2], Willem Mulder[2], Valentin Fuster[4], Dennis Charney[5], Ahmed A Tawakol[6], Lisa Shin[7], Matthias Nahrendorf[8], and Zahi A Fayad[9]

[1]Radiology & Psychiatry, Translational and Molecular Imaging Institute at Mount Sinai, New York, NY, United States, [2]Radiology, Translational and Molecular Imaging Institute at Mount Sinai, New York, NY, United States, [3]Psychiatry, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [4]Cardiovascular Institute, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [5]Psychiatry, Neuroscience & Pharmacology and Systems Therapeutics, Icahn School of Medicine at Mount Sinai, New York, NY, United States, [6]Cardiology, Massachusetts General Hospital, Boston, MA, United States, [7]Psychology, Tufts University, Medford, MA, United States, [8]Center for Systems Biology, Massachusetts General Hospital, Boston, MA, United States, [9]Radiology, Medicine & Cardiology, Translational and Molecular Imaging Institute at Mount Sinai, New York, NY, United States

We used both FDG PET and MRI to study the relationship between neuropsychological stress and inflammation in a PTSD population. Significant correlations between white matter fractional anisotropy and inflammation in the carotid as measured using FD-PET. Resting state scans and functional scans correlated with HAMA and MADRS but no relationship was detected with FDG-PET.

1039 17:48

magna cum laude

Glutathione and Glutamate in Schizophrenia: A 7T MRS Study

Jyothika Kumar[1], Emma L Hall[2], Siân E Robson[2], Carolina Fernandes[2], Elizabeth B Liddle[1], Matthew J Brookes[2], Lena Palaniyappan[1], Peter G Morris[2], and Peter F Liddle[1]

[1]Centre for Translational Neuroimaging, Division of Psychiatry and Applied Psychology, University of Nottingham, Nottingham, United Kingdom, [2]Sir Peter Mansfield Imaging Centre, School of Physics and Astronomy, University of Nottingham, Nottingham, United Kingdom

Various theories of neurochemical dysfunction in schizophrenia have been proposed. Using 7T MR spectroscopy, we aim to investigate abnormalities in the antioxidant and glutamatergic systems in patients with schizophrenia and whether there is a relationship between the two. We found reduced levels of glutathione in the anterior cingulate cortex (ACC) in patients with residual schizophrenia indicating

a reduction in the brain's antioxidant defences accompanied by reduced levels of glutamate and glutamine. A positive correlation between glutathione and glutamate was observed in the ACC in all participants indicating a mechanistic link between these two systems.

Oral

Diffusion Weighted Image Analysis

Summit 1 | 16:00 - 18:00 | *Moderators:*Mara Cercignani & Jelle Veraart

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1040 | 16:00

Diffusion parameter EStImation with Gibbs and NoisE Removal (DESIGNER)

Benjamin Ades-Aron[1], Jelle Veraart[1,2], Elias Kellner[3], Yvonne W. Lui[1], Dmitry S. Novikov[1], and Els Fieremans[1]

[1]Center for Biomedical Imaging, New York University School of Medicine, New York, NY, United States, [2]iMinds Vision Lab, University of Anterp, Antwerp, Belgium, [3]Department of Radiology, University Medical Center Freiburg, Freiburg, Germany

We propose a new pipeline (DESIGNER) for diffusion image processing that includes Marchenko Pastur denoising and Gibbs artifact removal, and thereby improves the precision and accuracy of the diffusion tensor and kurtosis tensor parameter estimation. In particular, our results show no notorious black voxels on kurtosis maps, while the original resolution is maintained in contrast to state-of-the-art processing methods that apply smoothing.

1041 | 16:12

HIgh B-value and high Resolution Integrated Diffusion (HIBRID) Imaging

Qiuyun Fan[1], Aapo Nummenmaa[1], Jonathan R. Polimeni[1], Thomas Witzel[1], Susie Y. Huang[1], Van J. Wedeen[1], Bruce R. Rosen[1,2], and Lawrence L. Wald[1,2]

[1]Massachusetts General Hospital, Boston, MA, United States, [2]Harvard-MIT Division of Health Sciences and Technology, MIT, Cambridge, MA, United States

The cerebral cortex is rich in gyral folding. Axonal fibers take sharp turns when bending into the cortex. High resolution diffusion MRI is needed to characterize cortical structures in finer scale, while high *b*-value is desired to resolve complex white matter structures. We examined the impact of imaging resolution on characterizing the radial diffusion pattern in cortex, and proposed to improve the HIgh *B*-value and high Resolution Integrated Diffusion (HIBRID) imaging by incorporating information about each voxel's proximity to the cortex. The combined data demonstrated the desired features from both high resolution and high *b*-value diffusion imaging.

1042 | 16:24

Harmonizing diffusion MRI data from multiple scanners

Hengameh Mirzaalian[1], Lipeng Ning[1], Peter Savadjiev[1], Ofer Pasternak[1], Sylvain Bouix[1], Oleg Michailovich[2], Marek Kubicki[1], Carl Fredrik Westin[1], Martha E. Shenton[1], and Yogesh Rathi[1]

[1]Harvard Medical School and Brigham and Women's Hospital, Boston, USA., Boston, MA, United States, [2]University of Waterloo, Toronto, ON, Canada

Diffusion MRI (dMRI) is increasing being used to study neuropsychiatric brain disorders. To increase sample size and statistical power of neuroscience studies, we need to aggregate data from multiple sites[1]. However this is a challenging problem due to the presence of inter-site variability in the signal originating from several sources, e.g. number of head coils and their sensitivity, non-linearity in the imaging gradient, and other scanner related parameters[2]. Prior works have addressed this issue either using meta analysis[3], or by adding a statistical covariate[4], which are not model free and may produce erroneous results.

1043 | 16:36

Free water elimination using a bi-tensor model improves test-retest reproducibility of diffusion tensor imaging indices in the brain: a longitudinal multisite reliability study of healthy elderly subjects

Angela Albi[1], Ofer Pasternak[2], Ludovico Minati[1,3], Moira Marizzoni[4], Giovanni Frisoni[4,5], David Bartrés-Faz[6], Núria Bargalló[7], Beatriz Bosch[8], Paolo Maria Rossini[9,10], Camillo Marra[11], Bernhard Müller[12], Ute Fiedler[12], Jens Wiltfang[12,13], Luca Roccatagliata[14,15], Agnese Picco[16], Flavio Mariano Nobili[16], Oliver Blin[17], Julien Sein[18], Jean-Philippe Ranjeva[18], Mira Didic[19,20], Stephanie Bombois[21], Renaud Lopes[21], Régis Bordet[21], Hélène Gros-Dagnac[22,23], Pierre Payoux[22,23], Giada Zoccatelli[24], Franco Alessandrini[24], Alberto Beltramello[24], Antonio Ferretti[25,26], Massimo Caulo[25,26], Marco Aiello[27], Carlo Cavaliere[27], Andrea Soricelli[27,28], Lucilla Parnetti[29], Roberto Tarducci[30], Piero Floridi[31], Magda Tsolaki[32], Manos Constantinidis[33], Antonios Drevelegas[34], and Jorge Jovicich[1]

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Brain diffusion tensor imaging (DTI) provides in-vivo characterization of white matter tissue microstructure. In this study we demonstrate that free water elimination in brain diffusion MRI significantly improves the test-retest reproducibility of DTI metrics (fractional anisotropy, axial, radial and mean diffusivity) in a multsite 3T setting. This work has important clinical applications since the improved reliability may provide increased sensitivity in longitudinal studies quantifying white matter neurophysiological processes related to disease stage/progression and treatment responses.

1044 16:48

Robust DKI parameter estimation in case of CSF partial volume effects

Quinten Collier[1], Arnold Jan den Dekker[1,2], Ben Jeurissen[1], and Jan Sijbers[1]

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Diffusion kurtosis imaging (DKI) suffers from partial volume effects caused by cerebrospinal fluid (CSF). We propose a DKI+CSF model combined with a framework to robustly estimate the DKI parameters. Since the estimation problem is ill-conditioned, a Bayesian estimation approach with a shrinkage prior is incorporated. Both simulation and real data experiments suggest that the use of this prior leads to a more accurate, precise and robust estimation of the DKI+CSF model parameters. Finally, we show that not correcting for the CSF compartment can lead to severe biases in the parameter estimations.

1045 17:00

Low Rank plus Sparse Decomposition of ODF Distributions for Improved Detection of Group Differences in Diffusion Spectrum Imaging

Steven H. Baete[1,2], Jingyun Chen[1,2,3], Ricardo Otazo[1,2], and Fernando E. Boada[1,2]

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Recent advances in data acquisition make it possible to use Diffusion Spectrum Imaging (DSI) as a clinical tool for in vivo study of white matter architecture. The dimensionality of DSI data sets requires a more robust methodology for their statistical analyses than currently available. Here we propose a combination of Low-Rank plus Sparse (L+S) matrix decomposition and Principal Component Analysis to reliably detect voxelwise group differences in the Orientation Distribution Function that are robust against the effects of noise and outliers. We demonstrate the performance of this approach using simulations to assess group differences between known ODF distributions.

1046 17:12

Investigating the effects of intrinsic diffusivity on neurite orientation dispersion and density imaging (NODDI)

Jose M Guerrero[1], Nagesh Adluru[2], Steven R Kecskemeti[2], Richard J Davidson[3], and Andrew L Alexander[1]

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NODDI model and its widely used estimation toolbox assume the intracellular (or intrinsic) diffusivity (ID) to a fixed value suitable for healthy adult brains. For broader applicability of the model in neurological diseases it is important to understand the effects of ID. Using multi-shell diffusion data we investigated the variability of estimated NODDI indices as well as the model residuals with respect to variations in ID. Our results suggest that the value for ID cannot simply be set to that offering the least residual since there are appreciable effects on the indices even in a small range of ID values.

1047 17:24

Denoising of diffusion MRI data using Random Matrix Theory

Jelle Veraart[1,2], Dmitry S. Novikov[2], Jan Sijbers[1], and Els Fieremans[2]

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We here adopt the idea of noise removal by means of transforming redundant data into the Principal Component Analysis (PCA) domain and preserving only the components that contribute to the signal to denoise diffusion MRI (dMRI) data. We objectify the threshold on

the PCA eigenvalues for denoising by exploiting the fact that the noise-only eigenvalues are expected to obey the universal Marchenko-Pastur (MP) distribution. By doing so, we design a selective denoising technique that reduces signal fluctuations solely rooting in thermal noise, not in fine anatomical details.

1048 17:36

A systematic comparative study of DTI and higher order diffusion models in brain fixed tissue
Elizabeth B Hutchinson[1], Alexandru Avram[1], Michal Komlosh[1], M Okan Irfanoglu[1], Alan Barnett[1], Evren Ozarslan[2], Susan Schwerin[3], Kryslaine Radomski[3], Sharon Juliano[3], and Carlo Pierpaoli[1]

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We have systematically compared four diffusion MRI models – DTI, DKI, MAP-MRI and NODDI – in the same DWI data sets for fixed brain tissue to identify the relative strengths of these approaches and characterize the effects of experimental design and image quality on the generated metrics. Metric-specific advantages in sensitivity and specificity were shown as well as differential vulnerability across the metrics to DWI sampling scheme and noise. The intention of this work is to provide an integrative view of diffusion metrics that contributes to their utility in brain research.

1049 17:48

A caveat to Bayesian estimation in intravoxel incoherent motion modelling
Peter T. While[1], Igor Vidić[2], and Pål E. Goa[2]

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Intravoxel incoherent motion (IVIM) modelling has the potential to provide pixel-wise maps of pseudo-diffusion parameters that offer insight into tissue microvasculature. However, standard approaches using least-squares fitting yield parameter maps that are typically heavily corrupted by noise. Bayesian modelling has been shown recently to be a promising alternative. In this work we test the robustness of one such Bayesian approach by applying it to simulated noisy data, and obtain clearer parameter maps with much lower estimation uncertainty than least-squares fitting. However, certain features are found to disappear completely, indicating that a level of caution is required when implementing such techniques.

Oral

Metabolism

Summit 2 16:00 - 18:00 *Moderators:*Claude Sirlin

1050 16:00

Evaluation of Renal Blood flow in subjects with Diabetic Nephropathy using ASL Perfusion MRI
Lu-Ping Li[1,2], Huan Tan[1], Jon Thacker[3], Wei Li[1,2], Ying Zhou[4], Orly Kohn[5], Stuart Sprague[2,6], and Pottumarthi V Prasad[1,2]

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Renal blood flow is thought to be reduced in subjects of diabetic nephropathy (DN). However, there is limited amount of quantitative data on renal blood flow in patients with DN. In this study, ASL MRI data was acquired in 28 patients with diabetes and stage-3 CKD along with 30 healthy controls. Renal blood flow was found to be significantly lower in subjects with DN with a large Cohen's d value. Renal blood flow also showed a significant correlation with eGFR and age was not found to be a significant confounder in this relationship.

1051 16:12

Are Renal Lipids Increased in Overweight Diabetic Patients? A MR Spectroscopy and Dixon Fat/Water Imaging Study
Gaëlle Diserens[1], Waldo Valenzuela[2], Maryam Seif[1], Laila Mani[3], Daniel Fuster[3], Christoph Stettler[4], Bruno Vogt[3], Mauricio Reyes[2], Chris Boesch[1], and Peter Vermathen[1]

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Renal ectopic lipid accumulation may lead to kidney dysfunction. The study purpose was to determine (1) renal ectopic lipid content in overweight type-2 diabetic patients compared to (a) overweight non-diabetic patients and (b) lean volunteers by 1H-MRS and (2) renal sinus fat content by DIXON-MRI in the same three patient groups. This study demonstrates that renal ectopic lipids appear to be not higher in overweight diabetic patients compared to overweight non-diabetic subjects, while ectopic lipids are higher in both groups compared to healthy subjects. Significantly higher renal sinus bulk lipids were detected for overweight diabetic patients compared to BMI-matched non-diabetics.

1052 16:24

Simultaneous quantification of intragastric secretion and fat distribution
Dian Liu[1], Helen Louise Parker[2], Jelena Curcic[1,2], Sebastian Kozerke[1], and Andreas Steingoetter[1,2]

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Simultaneous assessment of both intragastric secretion and fat is important in food science but has hitherto been hampered by the bi-exponential relaxation behavior of fat emulsions. In combination with IDEAL, this work introduced a fat correction for rapid T_1 mapping, which enabled the simultaneous measurement of the intragastric distribution and temporal development of gastric secretion and fat. Results revealed the interaction between these two components by dilution and mixing, making this method a promising tool to non-invasively assess the emulsification and emptying of ingested fat.

1053 16:36

Non-invasive postprandial fatty acid tracking with 1H-[13C] Magnetic Resonance Spectroscopy in the human liver

Lucas Lindeboom[1,2,3], Robin A. de Graaf[4], Christine I. Nabuurs[1,2,3], Matthijs K.C. Hesselink[2], Joachim E. Wildberger[1], Patrick Schrauwen[2,3], and Vera B. Schrauwen-Hinderling[1,2,3]

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We here show that postprandial ^{13}C fatty acid tracking is feasible in the human liver using ge-HSQC. Experiments in two human volunteers revealed that intake of 5 or 7 grams of ^{13}C-labeled fatty acids resulted in two- or threefold increase in hepatic ^{13}C-enrichment after 3 hours. It is estimated that 3% of the oral load is stored in the liver at this time point. The ge-HSQC sequence can be used to reveal the contribution of dietary fat to the development of hepatic steatosis.

1054 16:48

Detection of human brown adipose tissue by MRI with hyperpolarized Xe-129 gas and validation by FDG-PET/MRI

Rosa Tamara Branca[1,2], Le Zhang[3,4], Alex Burant[1,4], Laurence Katz[5], and Andrew McCallister[1,4]

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Despite histological evidence that all humans have brown adipose tissue, the detection of this tissue in overweighs and obese subjects has proven to be a challenge. A recent study showed that MRI by hyperpolarized xenon gas (HP129Xe) enables the detection of this tissue in both lean and obese animal phenotype, with enhanced sensitivity in the latter with respect to the gold standard, FDG-PET. Here we demonstrate that HP129Xe gas MRI can also be used to detect human BAT with better sensitivity than FDG-PET.

1055 17:00

Diffusion Spectroscopy of White and Brown Adipose Tissues

Sanjay Kumar Verma[1], Kaz Nagashima[1], Swee Shean Lee[1], Tian Xianfeng[1], Jadegoud Yaligar[1], Venkatesh Gopalan[1], Bhanu Prakash KN[1], and S. Sendhil Velan[1]

[1]Laboratory of Molecular Imaging, Singapore Bioimaging Consortium, Singapore

There are two types of fat tissues, white adipose tissue (WAT) and brown adipose tissue (BAT), which essentially perform opposite functions in whole body energy metabolism. There is a large interest in development of MR Imaging techniques that will be suitable for separating white and brown fat. In this work we have implemented diffusion NMR spectroscopy to differentiate these two types of tissues. Water diffused faster than the fat in both WAT and BAT. Fat diffusion was faster in WAT compared to BAT. Our findings also suggest restricted behavior of fat molecules in BAT and not in WAT.

1056 17:12

Deep subcutaneous adipose tissue lipid unsaturation associates with intramyocellular lipid content

Jesper Lundbom[1,2], Alessandra Bierwagen[1,2], Kálmán Bodis[1,2], Jaakko Kaprio[3,4,5], Aila Rissanen[6,7], Nina Lundbom[8], Michael Roden[1,2,9], and Kirsi Pietiläinen[4,6,10]

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The present study uses non-invasive MRS to examine whether MZ twins discordant for BMI display depot specific differences in adipose tissue unsaturation (DSAT and SSAT), and how the unsaturation relates to body fat distribution and ectopic fat. The main finding of the twin study is that DSAT lipid unsaturation associates with intramyocellular lipid content, which was further confirmed in a general population study and for the repeated sampling of one volunteer. These results highlight the role of fatty acid composition in adipose tissue - skeletal muscle crosstalk.

1057 17:24

MR-derived indices for identification of quantity and distribution of adipose tissue – age- and gender related differences in a cohort at increased risk for metabolic diseases

Jürgen Machann[1], Malte Niklas Bongers[2], Andreas Fritsche[3], Norbert Stefan[3], Hans-Ulrich Häring[3], Konstantin Nikolaou[4], and Fritz

Schick[2]

[1]*Section on Experimental Radiology, Department of Diagnostic and Interventional Radiology, IDM of the Helmholtz Center Munich at the University Tübingen, German Center for Diabetes Research (DZD), Tuebingen, Germany,* [2]*Section on Experimental Radiology, Department of Diagnostic and Interventional Radiology, University Hospital Tuebingen, Tuebingen, Germany,* [3]*Department of Endocrinology and Diabetology, Angiology, Nephrology and Clinical Chemistry, IDM of the Helmholtz Center Munich at the University Tübingen, German Center for Diabetes Research (DZD), Tuebingen, Germany,* [4]*Department of Diagnostic and Interventional Radiology, University Hospital Tuebingen, Tuebingen, Germany*

MR-based phenotyping is of increasing interest for cross-sectional and interventional studies on large cohorts. Quantification of adipose tissue (AT) compartments – e.g. by T1-weighted MRI – has mainly been performed by giving the absolute amounts in litres. However, this does not directly reflect the distribution and quantity (e.g. for people with different size). Thus, the percentage of AT compartments are given as percent of total AT and new fat indices, corrected for height (comparable to BMI) are introduced and age- and gender related differences are determined in a large cohort of people at increased risk for metabolic diseases.

1058 17:36

magna cum laude

Hepatic lipid alterations monitored by ^{1}H-MRS *in vivo* in the ontogeny of obesity-related metabolic dysregulation.
Ana Francisca Soares[1], João M. N. Duarte[1], Blanca Lizarbe[1], and Rolf Gruetter[1,2,3,4]

[1]*Laboratory of Functional and Metabolic Imaging (LIFMET), Swiss Federal Institute of Technology Lausanne (EPFL), Lausanne, Switzerland,* [2]*Center for Biomedical Imaging (CIBM), Lausanne, Switzerland,* [3]*Department of Radiology, University of Geneva (UNIGE), Geneva, Switzerland,* [4]*Department of Radiology, University of Lausanne (Unil), Lausanne, Switzerland*

Obesity is associated with a loss of metabolic control, largely driven by alterations in whole-body lipid distribution. Impaired insulin action leads to hepatic lipid accumulation and, conversely, high levels of liver lipids also cause insulin resistance. We followed the loss of glucose homeostasis in mice fed a high-fat diet for 18 weeks. In parallel, we assessed their hepatic lipids by ^{1}H-MRS *in viv*o. In this model, glucose intolerance preceded hepatic lipid accumulation that then contributed to aggravate the phenotype. Moreover, fasting-induced hepatic lipid dynamics was hampered with high-fat diet feeding.

1059 17:48

TOFI – Thin Outside, Fat Inside – identifying non-obese subjects at high risk for metabolic diseases based on MRI and MRS
Jürgen Machann[1], Malte Niklas Bongers[2], Norbert Stefan[3], Andreas Fritsche[3], Konstantin Nikolaou[4], Hans-Ulrich Häring[3], and Fritz Schick[5]

[1]*Section on Experimental Radiology, IDM of the Helmholtz Center Munich at the University Tübingen, German Center for Diabetes Research (DZD), Tuebingen, Germany,* [2]*Department of Diagnostic and Interventional Radiology, Section on Experimental Radiology, Tuebingen, Germany,* [3]*Department of Endocrinology and Diabetology, Angiology, Nephrology and Clinical Chemistry, IDM of the Helmholtz Center Munich at the University Tübingen, German Center for Diabetes Research (DZD), Tuebingen, Germany,* [4]*Department of Diagnostic and Interventional Radiology, University Hospital Tübingen, Tuebingen, Germany,* [5]*Section on Experimental Radiology, University Hospital Tübingen, Tuebingen, Germany*

Axial T1-weighted MRI and volume selective ^{1}H-MRS were performed in a cohort of almost 500 non-obese subjects at increased risk for metabolic diseases. Adipose (AT) and lean tissue (LT) compartments from different body regions were quantified and are expressed as percentage of the entire volume in order to display tissue distribution and to differentiate metabolically healthy (insulin sensitive, IS) and unhealthy (insulin resistant, IR) subgroups. Additionally, intrahepatic lipids (IHL) were quantified. It could be shown that IS subjects are characterized by lower percentage of AT in abdominal regions but higher amounts in the extremities whereas IHL are almost doubled in IR subjects.

Educational Course

Overuse Injuries: Too Much of a Good Thing

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 13:30 - 15:30 *Moderators:*Karen Chen & James Griffith

13:30

Overhead Athlete
Joon-Yong Jung[1]

[1]*Radiology, Seoul St. Mary's hospital, The Catholic University of Korea, Korea, Republic of*

Athletes who engage in repetitive overhead motions are predisposed to distinct subset of shoulder injuries. In this talk, functional anatomy of the rotator cuff and labroligamentous structures frequently injured in overhead athletes will be reviewed. And kinematic of the throwing and related injury patterns in shoulder and elbow joints will be discussed with typical MR images.

14:00

Stress fractures in the lower extremity
James Teh

This lecture covers the pathophysiology of stress fractures and relates this to the MRI findings. The role of imaging in the diagnosis of stress injuries is discussed.

The specific features of common stress fractures of the lower extremity are illustrated.

Various pitfalls are discussed.

14:30 Ankle Impingement Syndromes
Edwin Oei[1]

[1]*Radiology & Nuclear Medicine, Erasmus MC Rotterdam, Netherlands*

In this lecture the most common etiologies of ankle impingement syndromes will be discussed. This is followed by an outline of the the most common sites and patterns of ankle impingements along with the anatomic structures involved. Of each ankle inpingement pattern (anterior, anteromedial, anterolateral, posterior, posteromedial, posterolateral) characteristic MR findings will be discussed.

15:00 Imaging of tendon injuries
Wilfred CG Peh[1]

[1]*Diagnostic Radiology, Khoo Teck Puat Hospital, Singapore, Singapore*

15:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Quantitative Biomarkers of Chest Disease: Role of MRI in a Multimodality Practice?

Organizers: Ivan Pedrosa, M.D., Lorenzo Mannelli, M.D., Ph.D., Scott B. Reeder, M.D., Ph.D. & Edwin J.R. van Beek, M.D., Ph.D., M.Ed., FRCR

Nicoll 2 13:30 - 15:30 *Moderators:*Talissa Altes & Jim Wild

13:30 Introduction

13:33 Chronic Obstructive Pulmonary Disease: What Does MRI Offer Compared to CT?
Yoshiharu Ohno[1,2]

[1]*Division of Functional and Diagnostic Imaging Research, Department of Radiology, Kobe University Graduate School of Medicine, Kobe, Japan,* [2]*Advanced Biomedical Imaging Research Center, Kobe University Graduate School of Medicine, Kobe, Japan*

This lecture covers 1) state of the art pulmonary MR techniques for morphological and functional assessment, 2) its clinical applications in COPD and 3) future direction of pulmonary functional MR imaging. We believe that the findings of further basic studies as well as clinical applications of this new technique will validate the real significance of pulmonary MRI for the future of COPD assessment and its usefulness for diagnostic radiology and pulmonary medicine.

979 13:48 magna cum laude
Comparison of 3He and 129Xe MRI for Evaluation of Lung Microstructure and Ventilation in Healthy Volunteers and COPD Patients at 1.5 T
Neil James Stewart[1], Ho-Fung Chan[1], Guilhem Jean Collier[1], Felix Clemens Horn[1], Graham Norquay[1], Juan Parra-Robles[1], Denise Yates[2], Paul Collini[3], Rod Lawson[4], Helen Marshall[1], and Jim Michael Wild[1]

[1]*Academic Unit of Radiology, University of Sheffield, Sheffield, United Kingdom,* [2]*Novartis Institutes for Biomedical Research, Cambridge, MA, United States,* [3]*Academic Unit of Immunology and Infectious Diseases, University of Sheffield, Sheffield, United Kingdom,* [4]*Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, United Kingdom*

^{3}He and ^{129}Xe ventilation and diffusion-weighted MR images were acquired at 1.5T in healthy volunteers and, at multiple time-points, in COPD patients in order to compare the functional sensitivity and assess the repeatability of MR-derived measures of ventilated volume (VV%) and apparent diffusion coefficient (ADC) from each of the two gases. ADC values from both nuclei exhibited excellent agreement and significant correlations with pulmonary function tests (PFTs) ($p<0.001$), whilst VV% values were less comparable. ADC and VV% metrics derived from both nuclei were also shown to be repeatable, with coefficient of variation values similar to those of PFTs.

980 14:00 Discrimination of COPD Patients, Healthy Smokers and Age-matched Normals with Hyperpolarized Xenon-129 MR Spectroscopy
Kai Ruppert[1,2], Kun Qing[2], Talissa A. Altes[2,3], and John P. Mugler III[2]

[1]*Cincinnati Children's Hospital, Cincinnati, OH, United States,* [2]*University of Virginia, Charlottesville, VA, United States,* [3]*University of Missouri, Columbia, MO, United States*

Chemical Shift Saturation Recovery (CSSR) MR Spectroscopy permits the in-vivo measurement of the alveolar septal wall thickness (SWT) by quantifying the uptake of hyperpolarized xenon-129 by lung parenchyma on a millisecond timescale. In this study we correlated the

SWT with apparent diffusion coefficient (ADC) measurements in patients with chronic-obstructive pulmonary disease (COPD), healthy smokers and age-matched normals. While the ADC measurements and conventional pulmonary function tests could detect statistically significant differences between the COPD and non-COPD subjects, only CSSR spectroscopy could, in addition, discriminate healthy smokers from the age-matched normals.

14:12

Imaging Lung Cancer: MRI, PET or Both?

Nina F Schwenzer[1]

[1]*Dept. of Radiology, University Hospital Tübingen*

Whereas CT is mainly used for local staging, PET/CT offers additional information about tumor metabolism and distant metastases. Although MRI is still limited in the detection of small lung nodules it offers additional functional information about diffusion and perfusion of tumor masses. In the framework of personalized medicine imaging has evolved from localizing disease towards prognostic and predictive biomarkers as well as treatment response. Hybrid modalities (PET/CT and PET/MRI) have the potential to offer a broad variety of parameters (i.e. textural parameters and multiparametric information) which can be used for further analyses such as radiomics or radiogenomics.

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981 14:27

A comparison between free-breathing radial VIBE in 3T MR and endoscopic ultrasound for preoperative T staging of potentially resectable esophageal cancer with histopathological correlation

Jinrong Qu[1,2], Hui Liu[3], Zhaoqi Wang[2], Ihab R Kamel[4], Kiefer Berthold[5], Robert Grimm[5,6], Jianjun Qin[7], and Hailiang Li[1]

[1]*Radiology, Henan Cancer Hospital, Zhengzhou, China, People's Republic of,* [2]*Radiology, the affiliated Cancer Hospital of Zhengzhou University, Zhengzhou, China, People's Republic of,* [3]*MR Collaboration, Siemens Healthcare, Shanghai, China, People's Republic of,* [4]*Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States,* [5]*MR Pre-development, Siemens Healthcare, Erlangen, Germany,* [6]*Erlangen, Germany,* [7]*Thoracic surgery, Henan Cancer Hospital, Zhengzhou, China, People's Republic of*

Contrast-enhanced free-breathing r-VIBE is superior to EUS in T staging of potentially resectable EC, not only for T1 and T2, but also for T3 and T4.

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982 14:39

Evaluating tumor biology of lung adenocarcinoma: multimodality-multiparametric approach

Ho Yun Lee[1], Seong-Yoon Yun Ryu[1], Ji Yun Jeong[2], Kyung Soo Lee[1], and Young Mog Shim[3]

[1]*Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of,* [2]*Pathology, Kyungpook National University Medical Center, Kyungpook National University School of Medicine, Daegu, Korea, Republic of,* [3]*Thoracic Surgery, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea, Republic of*

Our purpose is to investigate tumor biology of lung adenocarcinoma such as tumor cellularity, characteristics of invasion, histologic subtype, and tumor differentiation using multimodality and multiparametric imaging approach.

SUVmax was significantly greater in the solid subtype and poorly differentiated tumor when compared to other subtypes or differentiations. f tended to increase as tumor differentiation changed more poorly, whereas D and D * showed a trend of decrease in poorly differentiated tumors. Tumor size, the size of the solid portion within the tumor, and ADC showed significant correlation with extent of tumor invasion. SUVmax showed significant correlation with tumor cellularity.

14:51

Imaging of Pulmonary Vascular Disease: Can MRI Replace CT?

Mark Schiebler[1]

[1]*UW=Madison*

MRI methods have become increasingly relied upon by pulmonary medicine and cardiovascular medicine to help diagnose pulmonary hypertension and monitor the effects of therapy on the right ventricle. Recently selected sites have begun using MRA for the primary diagnosis of pulmonary embolism. This symposium will discuss the highlights and difficulties in the use of MRI for the diagnosis and follow up of pulmonary vascular diseases.

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983 15:06

Quantification of lung parenchyma perfusion in small animal imaging with Flow-sensitive Alternating Inversion Recovery (FAIR) 2D UTE

Marta Tibiletti[1], Andrea Bianchi[2], Detlef Stiller[2], and Volker Rasche[1,3]

[1]*Core Facility Small Animal MRI, Ulm University, Ulm, Germany,* [2]*Target Discovery Research, In-vivo imaging laboratory, Boehringer Ingelheim Pharma GmbH & Co. KG, Biberach an der Riss, Germany,* [3]*Department of Internal Medicine II, Ulm University, Ulm, Germany*

Functional information of the lung is of great importance for staging and monitoring lung disease. In this context, perfusion is conventionally addressed by systemic injection of contrast agent (CA) with subsequent quantitatively monitoring of the wash-in of the CA, or more frequently qualitatively assessment of the lung intensity pattern during the CA steady-state phase. Especially in small animal imaging, quantification of the respective perfusion dynamics is difficult due to the rather coarse temporal resolution achievable. In this work, the application of the non-invasive FAIR technique is combined with a 2D UTE readout thus enabling non-invasive quantification of lung perfusion.

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984 15:18 Comparison of Pulmonary Magnetic Resonance Angiography (MRA) and free-breathing Ultra short time to echo (UTE) for the comprehensive evaluation of the vascular and non-vascular anatomy of the chest

Julie A Bauml[1], Mark L Schiebler[1], Christopher J Francois[1], Kevin M Johnson[2], and Scott K Nagle[1,2,3]

[1]Radiology, University of Wisconsin Madison, Madison, WI, United States, [2]Medical Physics, University of Wisconsin Madison, Madison, WI, United States, [3]Pediatrics, University of Wisconsin Madison, Madison, WI, United States

MR imaging of the chest is challenging due to the low proton density, the short T2* of the lungs and cardiorespiratory motion. Many patients suspected of pulmonary embolism are short of breath, which can limit the utility of breath-held techniques. Free-breathing ultrashort echo time (UTE) approaches (TE < 0.10 ms) help to overcome some of these difficulties. In this prospective pilot clinical study, we demonstrate that UTE provides better overall depiction of chest structures when compared to MRA. We conclude that UTE is complementary to MRA of the chest in the analysis of both vascular and non-vascular thoracic structures.

15:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Tissue Characterisation: Brain, Heart & Body

*Organizers:*Garry E. Gold, M.D. & Nicole E. Seiberlich, Ph.D.

Nicoll 3 13:30 - 15:30 *Moderators:*Tetsuya Yoneda

13:30 Tissue Characterization: Brain
Sean Deoni

MRI offers of wealth of information that indirectly informs ontissue microstructure and organization. Imaging methods, including qualitative T1, T2 and proton density weighted imaging provide a foundation for assessing gross brain morphology and cortical morphometry. Beyond this, quantitative methods, including diffusion tensor, magnetisation transfer, and relaxometry can be used to assess more specific attributes of tissue microstructure and architecture. In this presentation, we will briefly overview these methods, with emphasis on relaxometry analysis to interrogate brain microstructure

13:50 Tissue Characterisation: Heart
Reza Nezafat[1]

[1]Harvard

14:10 Extra-Hepatic Steatosis: New Opportunities and Challenges in Quantitative MR
Takeshi Yokoo[1]

[1]UT Southwestern Medical Center

Abnormal lipid metabolism is associated with obesity, resulting in accumulation of fat in non-adipose tissues – a process called steatosis. Steatosis has long been known to occur in the liver and skeletal muscle, but also occurs in other organs including the pancreas, heart, and the kidneys, with potential significant pathophysiological implications. In this educational session, we will discuss the clinical significance of extra-hepatic steatosis and the value of quantitative MR in its noninvasive evaluation, as well as future research opportunities and technical challenges.

985 14:30 Structural and hemodynamical contributions to brain T2* relaxation in schizophrenia, bipolar disorder and siblings

Jie Wen[1], Daniel Mamah[2], Jie Luo[3], Xialing Ulrich[1], Deanna Barch[4], and Dmitriy Yablonskiy[1]

[1]Radiology, Washington University, Saint Louis, MO, United States, [2]Psychiatry, Washington University, Saint Louis, MO, United States, [3]Research Lab of Electronics, MIT, Cambridge, MA, United States, [4]Psychology, Washington University, Saint Louis, MO, United States

Investigating brain structure and functioning by means of tissue-specific T2* relaxation properties in vivo can potentially guide the uncovering of neuropathology in psychiatric illness. In this abstract, R2* (=1/T2*) relaxation rate constant was separated into tissue-specific ($R2^*_t$) and hemodynamic BOLD contributions. 17 control, 17 bipolar disorder, 16 schizophrenia, and 12 unaffected schizophrenia sibling participants were scanned. A MANOVA of 38 gray matter regions showed significant group effects for BOLD but not for $R2^*_t$. Our results suggest that increased baseline activity in certain brain regions is part of the underlying pathophysiology of specific psychiatric disorders.

986 14:42 Radial MOLLI sequence for fast, precise and accurate myocardium T1 mapping

Benjamin Marty[1,2], Bertrand Coppa[1,2], and Pierre G Carlier[1,2]

[1]NMR laboratory, Institute of Myology, Paris, France, [2]NMR laboratory, CEA, I2BM, MIRCen, Paris, France

Quantitative cardiac NMR imaging, and more particularly T1 mapping has become a popular modality to characterize myocardial tissue. In this work, we developed and validated a radial variant of the MOLLI acquisition (raMOLLI) that allows to significantly decrease the acquisition time down to 5 heart beats, while keeping high precision on T1 estimation due to a large number of acquired data-points along the T1 relaxation recovery curve. Insensitivity of measured T1 values to heart rate was also demonstrated with this sequence.

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987 14:54

Cardiac Magnetic Resonance Reveals Signs of Subclinical Myocardial Inflammation in Asymptomatic HIV-infected Patients

Julian Alexander Luetkens[1], Jonas Doerner[1], Carolynne Schwarze-Zander[2], Jan- Christian Wasmuth[2], Christoph Boesecke[2], Alois M Sprinkart[1], Frederic C Schmeel[1], Rami Homsi[1], Juergen Gieseke[3], Hans H Schild[1], and Claas P Naehle[1]

[1]Radiology, University of Bonn, Bonn, Germany, [2]Internal Medicine I, University of Bonn, Bonn, Germany, [3]Philips Research, Hamburg, Germany

People living with chronic human immunodeficiency virus (HIV) infection are at an increased risk for cardiovascular disease. In the present study we investigated HIV-infected patients, which were controlled for the disease, using multiparametric cardiovascular magnetic resonance (CMR). With this CMR approach we could demonstrate that HIV-infected patients without cardiac symptoms not only have subtle evidence of impaired myocardial function, but also elevated markers of myocardial inflammation and increased myocardial fibrosis. These findings indicate subclinical myocardial inflammation in HIV-infected patients despite effective antiretroviral therapy, and therefore may contribute to the persistently increased cardiovascular morbidity and mortality observed in these patients.

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988 15:06

MR Imaging of Liver Microstructure in Hepatic Fibrosis and Cirrhosis at 11.7 T

Mark Valasek[1], Qun He[2,3], Claude Sirlin[2], Graeme M. Bydder[2], and Nikolaus M. Szeverenyi[2]

[1]Pathology, University of California, San Diego, San Diego, CA, United States, [2]Radiology, University of California, San Diego, San Diego, CA, United States, [3]Ningbo Jansen NMR Technology Co., Ltd., Cixi, Zhejiang, China, People's Republic of

We performed MR microscopy at 11.7 T to examine the tissue structure of normal, fibrotic and cirrhotic liver samples. Images having 100-1,000 times the spatial resolution of clinical MR images were obtained in small tissue samples using an animal imaging system with appropriately small custom T/R solenoid coils. Diffusion imaging with three direction of sensitization revealed sheet like fibrous structures, exhibiting high signal intensity in regions where the sensitization direction was orthogonal to a sheet.

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989 15:18

An Automatic Machine learning Approach for multi-parametric MR based Brown adipose tissue characterization and Segmentation in mice and rats

Bhanu Prakash KN[1], Hussein Srour [1,2], Sanjay Kumar Verma[1], Jadegoud Yaligar[1], Venkatesh Gopalan[1], Swee Shean Lee[1], Kai Hsiang Chuang [1,2], and Sendhil Velan S[1,3]

[1]Laboratory of Metabolic Imaging, Singapore Bioimaging Consortium, Singapore, Singapore, [2]Queensland Brain Institute, Brisbane, Australia, [3]MRS & Metabolic Imaging Group, Singapore Institute for Clinical Sciences, Singapore, Singapore

We have utilized multiparametric MR images (fat-fraction (FF), T_2 and T_2*) of adipose tissues and evaluated different segmentation algorithms like multidimensional thresholding, region growing, clustering, and machine learning approach for its suitability and efficacy to separate WAT from BAT depots. A machine learning algorithm i.e. Neural Network based segmentation provided increased specificity compared to other algorithms. This methodology can be easily extended for multi-parametric human images and longitudinal studies.

15:30 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Rapid Three-Dimensional (3D) MSK Imaging

*Organizers:*Jenny T. Bencardino, M.D., Eric Y. Chang, M.D., Christine Chung, M.D., Ravinder R. Regatte, Ph.D., Philip Robinson, M.D. & Siegfried Trattnig, M.D.

Nicoll 1 16:00 - 18:00 *Moderators:*Xiaojuan Li & Riccardo Lattanzi

16:00

Rapid 3D-MSK Imaging: Techniques & Challenges

Martijn Cloos[1]

[1]Bernard and Irene Schwartz Center for Biomedical Imaging, and Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, New York University School of Medicine, New York, NY, United States

In this talk we will discuss the pros and cons of 3D MSK imaging from a technical prospective. Using select examples, we will explore how the transition from 2D (slice-selective) to 3D (volumetric) imaging influences the contrast, resolution and acquisition time. The presentation will start with the fundamental principles of 3D imaging from which we will buildup to the latest developments, such as compressed sensing and magnetic resonance fingerprinting.

16:30 Clinical Applications of 3D-MSK Imaging

Richard Kijowski

This lecture will review the clinical applications of three-dimensional sequences FSE sequences in musculoskeletal MR imaging.

1060 17:00

Fast single sequence comprehensive 4D pediatric knee MRI with T2 Shuffling
Shanshan Bao[1], Jonathan I. Tamir[2], Umar Tariq[3], Martin Uecker[4], Peng Lai[5], Weitian Chen[5], Michael Lustig[2], and Shreyas S. Vasanawala[1]

[1]Radiology, Stanford University, Stanford, CA, United States, [2]University of California, Berkeley, Berkeley, CA, United States, [3]Geisinger Medical Center, Danville, PA, United States, [4]University Medical Center Göttingen, Göttingen, Germany, [5]GE Healthcare, Menlo Park, CA, United States

Clinical application of volumetric joint MR imaging has been hampered by blurring due to T2 decay. A redesigned volumetric fast spin-echo acquisition technique termed T2 shuffling corrects for T2 decay and yields effectively a four-dimensional reconstruction with varying degrees of T2 weighting. Our work assesses the clinical application of T2 shuffling for pediatric knee MRI. Our results show that T2 shuffling has the potential to suffice as a single sequence MR examination. This is especially relevant for pediatric imaging where streamlined protocols greatly improve clinical operations and patient experience.

1061 17:30

Rapid Three-Dimensional Fast Spin-Echo Knee Imaging Using Compressed Sensing
Fang Liu[1], Humberto Rosas[1], James Holmes[2], Kevin King[2], Rob Peters[2], and Richard Kijowski[1]

[1]Department of Radiology, University of Wisconsin-Madison, Madison, WI, United States, [2]Applied Science Laboratory, GE Healthcare, Waukesha, WI, United States

A Cube 3D-FSE sequence was performed with and without compressed sensing (CS) twice on the knees of 10 asymptomatic volunteers to assess signal-to-noise- ratio (SNR) and once on the knees of 25 symptomatic patients to assess diagnostic performance for detecting knee joint pathology. CS k-space acceleration provided a 30% reduction in scan time without a corresponding decrease in SNR. The use of CS resulted in mild increased image blurring which did not influence diagnostic performance with near perfect to perfect agreement between Cube and Cube-CS for detecting knee joint pathology.

1062 18:00

A Variable-TE Stack-of-Spirals Sequence for 3D UTE Imaging
Samuel Fielden[1], John Mugler[2], Wilson Miller[2], Alto Stemmer[3], Josef Pfeuffer[3], Berthold Kiefer[3], and Craig Meyer[1,2]

[1]Biomedical Engineering, University of Virginia, Charlottesville, VA, United States, [2]Radiology & Medical Imaging, University of Virginia, Charlottesville, VA, United States, [3]Application Development, Siemens Healthcare, Erlangen, Germany

While 3D radial-based methods have become established in recent years for ultrashort-echo-time (UTE) imaging, these acquisitions are generally slow due to the inefficiency of radial k-space trajectories. The purpose of this work was to implement a fast UTE acquisition based on an optimized 3D stack-of-spirals acquisition and to perform a proof-of-concept evaluation of the method for bone imaging of the skull and cartilage imaging of the knee.

1063 18:30

High spatial and temporal resolution DCE-MRI of intervertebral disc endplates using GRAPPA accelerated 3D-Linogram acquisition
L. Tugan Muftuler[1,2], Ali Ersoz[3], and Volkan Emre Arpinar[1]

[1]Department of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Center for Imaging Research, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Department of Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States

It is suggested that disruption of nutrient delivery through the intervertebral disc endplates could lead to physiological and morphological changes in the discs. Our earlier DCE-MRI studies demonstrated major changes in endplate regions. However, we had to sacrifice temporal resolution to obtain high spatial resolution to image the thin endplates. Higher temporal resolution is needed for quantitative analysis of tracer kinetics. Therefore, we developed and tested 3D-Linogram acquisition technique that allowed higher temporal resolution and reduced motion artifacts. Tofts' tracer kinetic model was implemented and Ktrans values from vertebral endplates were estimated.

19:00 Adjournment & Meet the Teachers

Combined Educational & Scientific Session

Neurovascular: Hemorrhage

*Organizers:*Toshiaki Taoka, M.D., Ph.D. & Greg Zaharachuk, M.D., Ph.D.

Nicoll 2 16:00 - 18:00 *Moderators:*Toshiaki Taoka

16:00 Approach to Intracranial Hemorrhage.
Jalal B. Andre[1]

[1]Radiology, University of Washington, Seattle, WA, United States

Intracranial hemorrhage (ICH) has been traditionally classified as intra- versus extra-axial in location, and can arise from a variety of etiologies. This talk will focus on the importance of location, timing, and source of hemorrhage through a case-based exploration of ICH and associated complications as they pertain to the following locations: 1) Intraventricular 2) Intraparenchymal 3) Subarachnoid 4) Subdural 5) Epidural

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1064 16:30

Multi-contrast joint intra- and extracranial artery wall imaging – a feasibility study

Lei Zhang[1], Jun Wu[2], Lijie Ren[3], Tingting Wang[2], Xin Liu[1], and Yiu-Cho Chung[1]

[1]Paul C. Lauterbur Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, Chinese Academic of Sciences, Shenzhen, China, People's Republic of, [2]Neurology, Peking University Shenzhen Hospital, Shenzhen, China, People's Republic of, [3]Neurology, Shenzhen Second People's Hospital, Shenzhen, China, People's Republic of

In this study, we evaluated multi-contrast three dimensional (3D) high resolution black blood vessel wall imaging technique for joint intra- and extracranial artery wall imaging in 8 stroke patients. The new techniques covered both the intra- and extracranial segments in one scan. T1w, T2w scans were performed. MPRAGE was included when hemmorrhage was suspected. 8 plaques were identified. Two of them had high signal in all three sequences, suggestive of intraplaque hemorrhage. The 3D multi-contrast large coverage black blood techniques would be a promising tool to the study on the association between atherosclerotic plaques and ischemic stroke.

1065 16:45

A multiple comparison between 3T intracranial vessel wall sequences

Arjen Lindenholz[1], Anita Harteveld[1], Jeroen Siero[1], Jaco Zwanenburg[1], and Jeroen Hendrikse[1]

[1]Medical Imaging, UMC Utrecht, Utrecht, Netherlands

In this study we optimized high resolution magnetic resonance vessel wall imaging regarding scan duration signal-to-noise (SNR) and contrast-to-noise (CNR). We compared the SNRs and CNRs two clinically used intracranial vessel wall sequences with 5 variants with various trade-offs between scan time, resolution and contrast between vessel wall and cerebrospinal fluid (CSF). Compared to the clinically used sequences, we developed a sequence which was considerably faster and had comparable or higher SNRs and CNRs that resulted in a good visibility of the intracranial vessel wall.

17:00

Neurovascular Imaging Techniques

Kevin M Johnson[1]

[1]Medical Physics, University of Wisconsin - Madison, WI, United States

This overview talk discusses current imaging techniques used for the evaluation of patients at risk for or following hemorrhage. In particular, it provides insight into the state of imaging techniques used to image vascular origins and the growing abilities to correlate vascular structure interactions.

1066 17:30

The performances evaluation of 32-channel coil system for extracranial and intracranial artery wall imaging at 3T

Xiaoqing Hu[1], Lei Zhang[1], Xiao Chen[1], Xiaoliang Zhang[2,3], Xin Liu[1], Hairong Zheng[1], Yiu-Cho Chung[1], and Ye Li[1]

[1]Paul C. Lauterbur Research Center for Biomedical Imaging, Shenzhen Institutes of Advanced Technology, CAS, Shenzhen, China, People's Republic of, [2]Department of Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [3]UCSF/UC Berkeley Joint Graduate Group in Bioengineering, San Francisco, CA, United States

Atherosclerosis is a major cause of ischemic stroke. The high resolution magnetic resonance imaging (MRI) of vessel wall can detect nonstenotic atherosclerotic plaque missed by luminal angiography. To develop a multi-channel radiofrequency (RF) coil system with high spatial resolution and large longitudinal coverage for the intracranial and extracranial arteries vessel wall imaging in one setting. The high resolution images with 0.6 mm^3 are obtained with the proposed "24+8" channel coil system from a patient in vivo.

1067 17:45

summa cum laude

Vessel wall thickness measurements of the circle of Willis using 7.0T MRI

Anita A. Harteveld[1], Anja G. van der Kolk[1], Nerissa P. Denswil[2], Jeroen C.W. Siero[1], Hugo J. Kuijf[3], Aryan Vink[4], Wim G.M. Spliet[4], Peter R. Luijten[1], Mat J. Daemen[2], Jaco J.M. Zwanenburg[1,3], and Jeroen Hendrikse[1]

[1]Radiology, University Medical Center Utrecht, Utrecht, Netherlands, [2]Pathology, Academic Medical Center, Amsterdam, Netherlands, [3]Image Sciences Institute, University Medical Center Utrecht, Utrecht, Netherlands, [4]Pathology, University Medical Center Utrecht, Utrecht, Netherlands

In the last decade, several MRI sequences have been developed for direct visualization of the intracranial vessel wall. Although much is known about vessel wall (intima-media) thickness of extracranial arteries, less is known about the intracranial arterial vessel wall. In the current study, vessel wall thickness of major intracranial arteries was measured in *ex vivo* samples of the circle of Willis, using 7T MRI and histological validation, to ultimately provide a reference guide for normal intracranial vessel wall thickness. The results show that ultrahigh-resolution MRI at 7T enables accurate measurement of vessel wall thickness in *ex vivo* CoW specimens.

18:00 Adjournment & Meet the Teachers

Educational Course

MR Physics & Techniques for Clinicians

*Organizers:*Marcus T. Alley, Ph.D., Brian Hargreaves, Ph.D., Michael Markl, Ph.D., Bernd Jung, Ph.D. & Nicole Seiberlich, Ph.D.

Nicoll 3 | 16:00 - 18:00 | *Moderators:*Mariya Doneva & Bernd Jung

16:00 Artifacts to Artefacts: Causes & Cures from Clinical Perspective
Vikas Gulani[1]

[1]*Radiology, Case Western Reserve University, Cleveland, OH, United States*

This talk will give a clinically oriented perspective on understanding, using and if desirable, avoiding MR artifacts.

16:30 Contrast Agents
Bernd Jung[1]

[1]*University Hospital Bern*

The purpose of this talk is presentation of an overview of commonly used contrast agents in MRI. The active principle of Gadolinium-based contast agents and its impact on different types of MR images is explained. Furthermore, T1 and T2 effects with respect to certain imaging sequences are illustrated. The difference of extra-cellular and intravascular (blood pool) contrast agents is presented as well as the difference of Gadolinium-based contrast agents ("positive" agents with dominent T1 effect, increased signal intensity) and iron-based contrast agents ("negative" agents with dominent T2* effect, decreased signal intensity). Finally, the deposition of Gadolinium in patients is briefly discussed.

17:00 (Ultra-) High Field Imaging
Sebastian Schmitter[1,2]

[1]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States,* [2]*Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany*

Most of the ultra-high field systems are being used for research purposes, but the transition into hospitals for dedicated applications is expected. The reasons for using high and ultra-high field compared to standard field strength are multifold and will be outlined in this presentation. Along with these benefits go a larger range of challenges, which are among the reasons for the rather slow transition of UHF into clinical routine. Solutions to most of these challenges will be presented and applications will be highlighted.

17:30 Adjournment & Meet the Teachers

Other

Closing Party

Makansutra Glutton's Bay | 18:30 - 22:00

Friday, May 13, 2016

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Plenary Session

Hyperpolarisation: Past, Present & Future

*Organizers:*Martin J. Graves, Ph.D. & Edwin J. van Beek, M.D., Ph.D., M.Ed., FRCR

Plenary Hall | 10:30 - 11:30 | *Moderators:*Edwin van Beek & Ferdia Gallagher

Methods & Applications of Hyperpolarized Xe-129
Jim M Wild[1]

[1]*University of Sheffield*
Jim Wild

Methods & Applications of Hyperpolarized He-3
Talissa Altes
Talissa Altes

Methods & Applications of Hyperpolarized C-13
Dan Vigneron[1]

[1]*UCSF*
Dan Vigneron

Adjournment

Oral

MR Angiography

Room 300-302 8:00 - 10:00 *Moderators:*Dariusch Hadizadeh

1068 8:00

Time-Resolved Non-Contrast-Enhanced MR Angiography with Static Tissue Suppression using Velocity-Selective Pulse Trains
Qin Qin[1,2], Guanshu Liu[1,2], Ye Qiao[1], and Dexiang Liu[1,2,3]

[1]Radiology, 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]Radiology, Panyu District Central Hospital, Guangzhou, China, People's Republic of

Time-resolved non-contrast-enhanced MR angiography (NCE-MRA), by providing hemodynamic flow patterns, is promising for many vascular disorders. Conventional techniques remove tissue background using various arterial spin labeling (ASL) approaches with paired subtraction of control and label scans. Here a new multi-phase MRA method is introduced that achieves background suppresstion by applying a tissue mask, which is derived from thresholding a velocity-selective MRA (VSMRA) obtained at the end of the cycle. The feasibility of this new single-scan dynamic approach was demonstrated on extracranial and intracranial vasculatures of healthy volunteers at 3T.

1069 8:12

Nonenhanced hybridized arterial spin-labeled magnetic resonance angiography of the extracranial carotid arteries at 3 Tesla using a fast low-angle shot readout
Ioannis Koktzoglou[1,2], Matthew T Walker[1,2], Joel R Meyer[1,2], Ian G Murphy[1,3], and Robert R Edelman[1,3]

[1]Radiology, NorthShore University HealthSystem, Evanston, IL, United States, [2]University of Chicago Pritzker School of Medicine, Chicago, IL, United States, [3]Northwestern University Feinberg School of Medicine, Chicago, IL, United States

Nonenhanced hybridized arterial spin labeling (hASL) magnetic resonance angiography (MRA) using a fast low-angle shot (FLASH) readout was used to image the extracranial carotid arteries at 3 Tesla. Comparisons were made with 2D time-of-flight (TOF) MRA and contrast-enhanced MRA. Image quality obtained hASL FLASH MRA was found to be superior to that 2D TOF, with the method also providing improved inter-rater agreement, quantification of arterial cross-sectional area, and vessel sharpness.

1070 8:24

Isotropic 3D Black Blood MRI of Abdominal Aortic Aneurysm: Comparison with CT Anigography
Chengcheng Zhu[1], Bing Tian[2], Florent Seguro[1], Joe Leach[1], Qi Liu[2], Jianping Lu[2], Luguang Chen[2], Michael Hope[1], and David Saloner[1]

[1]Radiology, University of California, San Francisco, San Francisco, CA, United States, [2]Radiology, Changhai Hospital, Shanghai, China, People's Republic of

Computed Tomography angiography (CTA) is the gold standard for abdominal aortic aneurysm (AAA) imaging, but requires radiation and iodinated contrast. We previously developed an isotropic 3D black blood technique (DANTE-SPACE) for AAA imaging. In this study we validated 3D MRI against CTA for AAA diameter and volume measurement, and found excellent accuracy and reproducibility. Features of intra-luminal thrombus (ILT) composition that are possibly related to faster AAA growth can be identified on 3D MRI but not on CTA. 3D black blood MRI can be used as a non-invasive tool for AAA serial monitoring and ILT evaluation and has the potential to improve patient risk stratification.

1071 8:36

High Resolution MRI for Characterization of Inflammation within Abdominal Aortic Aneurysm
Chengcheng Zhu[1], Thomas Hope[1], Henrik Haraldsson[1], Farshid Faraji[1], David Saloner[1], and Michael Hope[1]

[1]Radiology, University of California, San Francisco, San Francisco, CA, United States

Abdominal aortic aneurysms (AAAs) with focal inflammation (identified by USPIO uptake) have been reported to predict faster growth. Previous 2D T2* mapping method is limited by spatial resolution. This study evaluated 3D high-resolution techniques (up to 1.3mm isotropic) for inflammation imaging of AAAs. Experiments were preformed using both USPIO phantoms and in vivo patient studies. We found the signal characteristics of 3D DANTE-SPACE images had good agreement with T2* value drop, and it provided higher resolution and possible information on USPIO concentration. Therefore, 3D high resolution methods may help risk stratify patients with AAA disease by characterizing and quantifying inflammation.

1072 8:48

Robust large-volume fat suppression in whole-heart free-breathing self-navigated coronary MR angiography at 3T using lipid insensitive binomial off-resonant excitation (LIBRE) pulses

Jessica AM Bastiaansen[1], Davide Piccini[1,2], Ruud B van Heeswijk[1,3], and Matthias Stuber[1,3]

[1]Department of Radiology, University hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Advanced Clinical Imaging Technology, Siemens Healthcare, Lausanne, Switzerland, [3]Center for Biomedical Imaging, Lausanne, Switzerland

Large volume fat suppression is increasingly challenging at high magnetic field strengths due to B_0 and B_1 inhomogeneities. In this study, we developed a novel lipid-insensitive binomial off-resonant (LIBRE) radiofrequency excitation pulse to achieve near-complete fat suppression in large 3D volumes and applied it to whole-heart coronary imaging at 3T. In 6 healthy volunteers, we performed free-breathing self-navigated whole-heart 3D radial coronary MRA, and quantitatively compared the results to more commonly used methods for lipid nulling. We show that LIBRE significantly improves the signal nulling of lipid resonances resulting in both improved blood pool delineation for self-navigation and increased vessel conspicuity in the final images.

1073 9:00

An Iterative Approach to Respiratory Self-Navigation Allows for Improved Image Quality and 100% Scan Efficiency in Contrast-Enhanced Inversion-Recovery Whole-Heart Coronary MRA at 3T; a First Patient Study

Giulia Ginami[1], Davide Piccini[1,2], Pierre Monney[3], Pier Giorgio Masci[3], and Matthias Stuber[1,4]

[1]University Hospital (CHUV) and University of Lausanne (UNIL), Lausanne, Switzerland, [2]Advanced Clinical Imaging Technology, Siemens Healthcare, Lausanne, Switzerland, [3]Division of Cardiology and Cardiac MR Center, University Hospital of Lausanne (CHUV), Lausanne, Switzerland, [4]Center for Biomedical Imaging (CIBM), Lausanne, Switzerland

The performance of Self-Navigation (SN) for respiratory motion compensation in 3T whole-heart coronary MRA may be compromised by contrast variations secondary to slow-infusion of a contrast agent. In this study, we quantitatively and successfully tested the hypothesis that an Iterative approach to SN (IT-SN) leads to improved performance during slow infusion.

1074 9:12

Six month clinical outcomes following pulmonary contrast enhanced magnetic resonance angiography for the primary workup of pulmonary embolism

Mark L. Schiebler[1], Michael D. Repplinger[2], Christopher Lindholm[3], John Harringa[2], Christopher J. François[1], Karl K. Vigen[1], Azita G. Hamedani[2], Thomas M. Grist[1,4,5], Scott B. Reeder[1,2,4,6], and Scott K. Nagle[1,5,7]

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The aim of this study was to determine the effectiveness of pulmonary magnetic resonance angiography (PE-MRA) for the primary diagnosis of pulmonary embolism (PE). We retrospectively reviewed the electronic medical records of 675 consecutive patients who underwent PE-MRA. Adverse events (venous thromboembolism (VTE), bleeding or death) that were potentially related either to over or under treatment of PE during the subsequent 6 months were extracted from the electronic medical record. The negative predictive value for this test was found to be 97%. Based upon these outcomes, PE-MRA performs similarly to CTA as a primary test to exclude clinically significant pulmonary embolism in patients presenting acutely with dyspnea.

1075 9:24

Model-based characterization of the transpulmonary circulation by DCE-MRI

Salvatore Saporito[1], Ingeborg H.F. Herold [1,2], Patrick Houthuizen[3], Jacques A. den Boer[1], Harrie C.M. van den Bosch[4], Hendrikus H.M. Korsten [1,2], Hans C. van Assen[1], and Massimo Mischi[1]

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Objective measures to assess pulmonary circulation status would improve heart failure patient care. We propose a method for the characterization of the transpulmonary circulation by DCE-MRI. Parametric deconvolution was performed between contrast agent first passage time-enhancement curves derived from the right and left ventricular blood pool. The transpulmonary circulation was characterized as a linear system with impulse response modelled as local density random walk model. We tested the method on 32 heart failure patients and 19 healthy volunteers; patients presented longer transpulmonary transit times and more skewed transpulmonary impulse responses.

1076 9:36

Predictive Bolus Tailoring of Gd-Based Contrast Agents for Optimized Contrast-Enhanced MRA

Jeffrey H Maki[1] and Gregory J Wilson[1]

[1]Radiology, University of Washington, Seattle, WA, United States

Gadolinium contrast for CE-MRA is typically injected at a fixed, relatively fast (1.5 – 2.0 mL/s) rate. This results in a peaked bolus profile such that vascular signal intensity (SI) decays during latter k-space acquisition, leading to blurring and ringing artifacts. A “tailored” test bolus-based predictive algorithm was developed to determine a patient-individualized multi-phase injection to achieve any arbitrary arterial SI “plateau” duration. This technique was tested on 10 patients and compared to 10 patients receiving a fixed 1.6 mL/s contrast injection. The tailored bolus plateau duration was 24 vs. 9 s ($p < 0.01$) with only a 20% SI loss.

1077 9:48

Cardiac and Respiratory Self-Gated 4D Multi-Phase Steady-State Imaging with Ferumoxytol Contrast (MUSIC)

Fei Han[1], Ziwu Zhou[1], Takegawa Yoshida[1], Kim-Lien Nguyen[1,2], Paul J Finn[1], and Peng Hu[1]

[1]Radiology, University of California, Los Angeles, Los Angeles, CA, United States, [2]Division of Cardiology, Veterans Affairs Greater Los Angeles Healthcare System, Los Angeles, CA, United States

We proposed a cardiac and respiratory self-gated, 4D multi-phase steady-state imaging with contrast (MUSIC) technique for detailed evaluation of cardiovascular anatomies. A rotating cartesian k-space sampling pattern was designed that integrates frequently sampled k-space centerline as self-gating signal and allows retrospective data-binning based on derived motion signal. Phantom and in-vivo results on 7 clinical indicated pediatric CHD patients show that the proposed self-gated MUSIC could potentially eliminates the need of external physiological signal for motion gating, has increased scan efficiency while maintaining or exceeding the image quality of the original MUSIC.

Oral

Diffusion: Making Use of Microstructure Information

Room 324-326 8:00 - 10:00 *Moderators:*Roger Bourne

1078 8:00

Multi-compartment microscopic diffusion anisotropy imaging brought into clinical practice
Enrico Kaden[1], Nathaniel D. Kelm[2], Robert P. Carson[3], Mark D. Does[2], and Daniel C. Alexander[1]

[1]Centre for Medical Image Computing, University College London, London, United Kingdom, [2]Institute of Imaging Science, Vanderbilt University, Nashville, TN, United States, [3]Departments of Neurology and Pediatrics, Vanderbilt University, Nashville, TN, United States

This work introduces a multi-compartment model for microscopic diffusion anisotropy imaging using an off-the-shelf pulse sequence achievable on standard clinical scanners. In particular, we will provide estimates of microscopic features specific to the intra- and extra-neurite compartments unconfounded by the effects of fibre crossings and orientation dispersion, which are ubiquitous in the brain. The new imaging technique is demonstrated in a large cohort of healthy young adults as well as for the detection of microstructural tissue alterations in a preclinical animal model of tuberous sclerosis complex.

1079 8:12

The lifespan trajectory of white matter microstructure detected by NODDI
Jiaying Zhang[1], Aurobrata Ghosh[1], Daniel C Alexander[1], and Gary Hui Zhang[1]

[1]Computer Science and Centre for medical image computing, University College London, London, United Kingdom

The structure and function of human brain evolve across the lifespan. The microstructural white matter changes across lifespan have been studied using Diffusion tensor imaging. Whilst sensitive, DTI parameters have no direct tissue specificity. Here, given the availability of high-quality HCP lifespan dataset, we aim to study the lifespan trajectory of microstructural WM changes using NODDI and evaluate another NODDI fitting framework - Accelerated microstructure imaging via convex optimization (AMICO). We found U-shaped neurite density changes across lifespan and feasibility of AMICO NODDI parameters in capturing the similar lifespan trajectory as the standard fitting.

1080 8:36

WITHDRAWN
Nicholas G Dowell[1], Simon L Evans[2], Sarah L King[2], Naji Tabet[3], and Jennifer M Rusted[2]

[1]Clinical Imaging Sciences Centre, Brighton and Sussex Medical School, Brighton, United Kingdom, [2]Psychology, University of Sussex, Brighton, United Kingdom, [3]Centre for Dementia Studies, Brighton and Sussex Medical School, Brighton, United Kingdom

The APOE-e4 gene is the best known genetic risk factor for late-onset Alzheimer's Disease. However, carriers of this gene have demonstrated behavioural differences compared to non-carriers on a number of cognitive tasks at young age. In this study, we demonstrate for the first time using the advanced diffusion imaging technique, NODDI, that there are detectable genotype-dependent structural differences in the brain of young healthy volunteers. The strongest differences are in the measure of orientation dispersion (ODI) of neurites, where e4 carriers show higher ODI than non-e4 carriers in the white matter.

1081 8:48

Microscopic Anisotropy Imaging at 7T Using Asymmetrical Gradient Waveform Encoding
Filip Szczepankiewicz[1], Carl-Fredrik Westin[2], Freddy Ståhlberg[1], Jimmy Lätt[3], and Markus Nilsson[4]

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Diffusion MRI that goes beyond DTI is challenging at 7T due to the short transverse relaxation time. We address this inherent limitation of 7T by employing asymmetric gradient waveforms for diffusion encoding, and demonstrate that imaging of microscopic diffusion anisotropy is feasible at a 7T system.

1082 9:00

Chronic mild stress induces changes in neurite density in the amygdala as revealed by diffusion MRI and validated with novel histological analyses
Ahmad Raza Khan[1], Andery Chuhutin[1], Ove Wiborg[2], Christopher D Kroenke[3], Jens R Nyengaard[4], Brian Hansen[1], and Sune Nørhøj

Jespersen[1,5]

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Biophysical modelling of diffusion MRI data allows detection of specific tissue microstructures such as neurite density. However, histological validation of MR-derived indication of microstructural alteration is limited due extensive time labour and invasive character, even though histological validation is crucial because it remains the gold standard. The present study applies Matlab based image processing and analysis tools to compute histological neurite density to validate diffusion MRI based neurite density changes in the amygdala of chronic mild stress rat brains. The image processing and analyses provides novel tools to validate diffusion data robustly.

1083 9:12

Altered hippocampal microstructure in the epileptogenic rat brain revealed with diffusion MRI using oscillating field gradients
Manisha Aggarwal[1], Olli Gröhn[2], and Alejandra Sierra[2]

[1]Department of Radiology, Johns Hopkins University School of Medicine, Baltimore, MD, United States, [2]Department of Neurobiology, A. I. Virtanen Institute for Molecular Sciences, University of Eastern Finland, Kuopio, Finland

We investigate changes in the temporal diffusion spectrum sampled using oscillating gradient spin-echo (OGSE) acquisitions at increasing gradient frequencies in the epileptogenic rat brain. PGSE and OGSE data at discrete oscillation frequencies were acquired from pilocarpine-treated and control rat brains (n=5 each) with a spectral resolution of 60 Hz (f = 60 Hz, 120 Hz, 180 Hz). Our findings reveal significant changes in the frequency-dependent modulation of apparent diffusion coefficient (ADC) in specific areas of the pilocarpine brain, which were found to correspond to region-specific gliosis and neuronal loss respectively. Using comparison with histological findings, our results show unique sensitivity of OGSE diffusion MRI to probe specific cellular-level alterations in the epileptogenic brain.

1084 9:24

Detecting Disrupted-in-Schizophrenia-1 Gene Related Microstructural and Molecular Alterations using Diffusion Kurtosis Imaging and Quantitative Susceptibility Mapping
Nan-Jie Gong[1], Russell Dibbs[2], Kyle Decker[2], Mikhail V. Pletnikov[3], and Chunlei Liu[1]

[1]Brain Imaging and Analysis Center, Duke University, Durham, NC, United States, [2]Center for In Vivo Microscopy, Duke University, Durham, NC, United States, [3]Behavioral Neurobiology and Neuroimmunology Laboratory, Johns Hopkins University, Baltimore, MD, United States

DKI method provided sensitive metrics for reflecting microstructural changes in not only the anterior commissure but also relatively isotropic gray matter regions of hippocampus, cerebral cortex and caudate putamen. Further relating DKI findings to molecular compositions measured by QSM enabled clearer interpretations of myelin content and cellular density related mechanisms. Further validations that establish the relationship between imaging metrics and histological measurements such as neuronal cell body density, myelin thickness and g-ratio are needed.

1085 9:36

White Matter Changes in Elderly Patients Suffer from Post-operative Cognition Disorders : Evidence from Diffusion Kurtosis Magnetic Resonance Imaging
Bing Yu[1], Na Chang[1], Xiaoxue Ge[1], Yueren Wang[1], and Qiyong Guo[1]

[1]Shengjing Hospital of China Medical University, Shenyang, China, People's Republic of

In the present study, we reconstructed the white matter skeleton of the brain using tract-based spatial statistics (TBSS) and compared differences in diffusion kurtosis imaging (DKI) parameters within the skeleton between patients sufferde from postoperative cognitive dysfunction (POCD) and healthy controls to detect white matter abnormalities in POCD.

1086 9:48

Rapid Estimation of Spinal Cord Injury Severity in Rats using Double Diffusion Encoded Magnetic Resonance Spectroscopy
Nathan P Skinner[1,2,3], Shekar N Kurpad[3,4], Brian D Schmit[5], L Tugan Muftuler[3], and Matthew D Budde[3,4]

[1]Biophysics Graduate Program, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Medical Scientist Training Program, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Department of Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States, [4]Clement J. Zablocki Veteran's Affairs Medical Center, Milwaukee, WI, United States, [5]Department of Biomedical Engineering, Marquette University, Milwaukee, WI, United States

Diffusion tensor imaging (DTI) is frequently applied to spinal cord injury, yet suffers from poor detection of axonal integrity changes caused by conflicting extracellular processes. A double diffusion encoding (DDE) sequence was developed for the spinal cord to remove non-neuronal signal contribution by applying a strong diffusion weighting perpendicular to the spinal cord. A parallel diffusion gradient then sampled diffusivity along the spinal cord. Application in a rat model showed DDE parameters outperformed DTI in sensitivity to injury severity with substantially reduced acquisition and post-processing time. Thus, this technique shows potential for rapid, sensitive determination of spinal cord injury severity.

1087 9:48

Measurement of restricted and hindered anisotropic diffusion tissue compartments in a rat model of Wallerian degeneration
Benoit Scherrer[1], Damien Jacobs[2], Maxime Taquet[1,2], Anne des Rieux[3], Benoit Macq[2], Sanjay P Prabhu[1], and Simon K Warfield[1]

[1]Department of Radiology, Boston Children's Hospital, Harvard Medical School, Boston, MA, United States, [2]ICTEAM, Universite catholique de

Louvain, Louvain-La-Neuve, Belgium, [3]LDRI, Université catholique de Louvain, Brussels, Belgium

The DIAMOND model has been recently proposed to model the heterogeneity of tissue compartments in diffusion compartment imaging. However, it did not enable the characterization of the intra-axonal volume fraction (IAVF), a critical measure to more accurately characterizing axonal loss in abnormal tissues. In this work we investigated mathematical extensions to DIAMOND that model both the IAVF and the heterogeneous nature of in-vivo tissue. We validated our approach using both Monte-Carlo simulations and histological microscopy with an animal model of Wallerian degeneration. We show that our novel model better predicts the signal and provides additional parameters to further describe tissues.

Oral

New Frontiers in Image Reconstruction

Room 331-332 8:00 - 10:00 *Moderators:*Joseph Cheng & Justin Haldar

1088 8:00

Learning a Variational Model for Compressed Sensing MRI Reconstruction
Kerstin Hammernik[1], Florian Knoll[2], Daniel K Sodickson[2], and Thomas Pock[1,3]

[1]Institute for Computer Graphics and Vision, Graz University of Technology, Graz, Austria, [2]Center for Biomedical Imaging and Center for Advanced Imaging Innovation and Research (CAI2R), Department of Radiology, NYU School of Medicine, New York, NY, United States, [3]Safety & Security Department, AIT Austrian Institute of Technology GmbH, Vienna, Austria

Compressed sensing techniques allow MRI reconstruction from undersampled k-space data. However, most reconstruction methods suffer from high computational costs, selection of adequate regularizers and are limited to low acceleration factors for non-dynamic 2D imaging protocols. In this work, we propose a novel and efficient approach to overcome these limitations by learning a sequence of optimal regularizers that removes typical undersampling artifacts while keeping important details in the imaged objects and preserving the natural appearance of anatomical structures. We test our approach on patient data and show that we achieve superior results than commonly used reconstruction methods.

1089 8:12

SENSE-LORAKS: Phase-Constrained Parallel MRI without Phase Calibration
Tae Hyung Kim[1], Kawin Setsompop[2], and Justin P. Haldar[1]

[1]Electrical Engineering, University of Southern California, Los Angeles, CA, United States, [2]Radiology, Harvard Medical School, Boston, MA, United States

We introduce a novel framework called SENSE-LORAKS for partial Fourier phase-constrained parallel MRI reconstruction. SENSE-LORAKS combines classical SENSE data modeling with advanced regularization based on the novel low-rank modeling of local k-space neighorhoods (LORAKS) framework. Unlike conventional phase-constrained SENSE techniques, SENSE-LORAKS enables use of phase constraints without requiring a prior estimate of the image phase or a fully sampled region of k-space that could be used for phase autocalibration. Compared to previous SENSE-based and LORAKS-based reconstruction approaches, SENSE-LORAKS is compatible with a much wider range of sampling trajectories, which can be leveraged to achieve much higher acceleration rates.

1090 8:24

k-t ESPIRiT: Efficient Auto-Calibrated Parallel Imaging Reconstruction by Exploiting *k-t* Space Correlations
Claudio Santelli[1], Adrian Huber[1], and Sebastian Kozerke[1]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland

Using eigen-decomposition of a modified *k-t* SPIRiT operator, computationally optimized reconstruction formally translating into auto-calibrated SENSE-like reconstruction of a coil-combined *x-f* image (*k-t* ESPIRiT) is proposed. 2D and 3D in-vivo experiments show equivalence of *k-t* SPIRiT and *k-t* ESPIRiT, and significant reconstruction time speed-up's of the proposed relative to the standard technique.

1091 8:36

Motion-Resolved Golden-Angle Radial Sparse MRI Using Variable-Density Stack-of-Stars Sampling
Li Feng[1], Tiejun Zhao[2], Hersh Chandarana[1], Daniel K Sodickson[1], and Ricardo Otazo[1]

[1]Center for Advanced Imaging Innovation and Research (CAI2R), New York University School of Medicine, New York, NY, United States, [2]Siemens Medical Solutions, New York, NY, United States

This work proposes a 3D free-breathing MRI technique called variable-density XD-GRASP, which employs stack-of-stars sampling with variable-density k_z-undersampling and motion-resolved sparse reconstruction. The new sampling scheme combines the advantages of conventional stack-of-stars sampling and kooshball-type 3D radial sampling, enabling 3D continuous MRI with flexible slice resolution, robust fat suppression and low sensitivity to eddy currents. The performance of variable-density XD-GRASP is demonstrated for free-breathing liver MRI.

1092 8:48

Non-Iterative Motion-Error Regularized Reconstruction for Efficient Respiratory Gating with Auto-Calibrating Parallel Imaging
Peng Lai[1], Joseph Yitan Cheng[2], Shreyas S Vasanawala[2], and Anja C.S Brau[3]

[1]Global MR Applications and Workflow, GE Healthcare, Menlo Park, CA, United States, [2]Radiology, Stanford University, Stanford, CA, United States, [3]Global MR Applications and Workflow, GE Healthcare, Munich, Germany

Respiratory gating (RG) is commonly used for free-breathing 3D MRI. Conventional RG based on acceptance/rejection performs hard-threshholding on acquired data and suffers from either increased motion corruption with a large acceptance window or long scan time/increased undersampling artifacts with a small window. This work developed a non-iterative respiratory soft-threshholding method by incorporating the motion-induced error into autocalibrating parallel imaging (ac-PI). The proposed method showed more effective motion suppression on free-breathing 3D cine than conventional respiratory gating on the same datasets. This method can be generalized to suppress other types of motion with full acquisition or ac-PI as well.

1093 9:00

Towards a Parameter-Free ESPIRiT: Soft-Weighting for Robust Coil Sensitivity Estimation

Siddharth Srinivasan Iyer[1], Frank Ong[1], and Michael Lustig[1]

[1]Electrical Engineering and Computer Sciences, University of California, Berkeley, Berkeley, CA, United States

ESPIRiT is a robust, auto-calibrating approach to parallel MR image reconstruction that estimates the subspace of sensitivity maps using an eigenvalue-based method. While it is robust to a range of parameter choices, having parameters that result in a tight subspace yields the best performance. We propose an automatic, parameter free method that appropriately weights the subspace using a shrinkage operator derived from Stein's Unbiased Risk Estimate. We demonstrate the efficacy of our technique by showing superior map estimation without user intervention in simulation and in-vivo data compared to the current default method of subspace estimation.

1094 9:12

Self-Calibrated Phase-Correction for Superresolution of RASER at 7 T

Ute Goerke[1]

[1]CMRR/Radiology, University of Minnesota, Minneapolis, MN, United States

RASER (rapid acquisition with sequential excitation and refocusing) is an ultrafast imaging technique based on spatiotemporal encoding (SPEN). The excitation with a chirp-pulse with a low bandwidth-time product (R-value) introduces blurring in the SPEN dimension. Superresolution (SR) which removes the blurring fails as a result of the spatially varying B_1-phase produced by radio-frequency coils at ultrahigh fields. A novel iterative phase-correction of the SR-algorithm is presented. It is shown that the spatial resolution and the SNR of blurred RASER images acquired at 7 T are significantly improved employing phase-corrected SR.

1095 9:24

A convex source separation and reconstruction methodology for filtering dynamic contrast enhancement MRI data

Sudhanya Chatterjee[1], Dattesh D Shanbhag[1], Venkata Veerendranadh Chebrolu[1], Uday Patil[1], Sandeep N Gupta[2], Moonjung Hwang [3], Jeong Hee Yoon[4], Jeong Min Lee[4], and Rakesh Mullick[1]

[1]GE Global Research, Bangalore, India, [2]GE Global Research, Niskayuna, NY, United States, [3]GE Healthcare, Seoul, Korea, Republic of, [4]Seoul National University Hospital, Seoul, Korea, Republic of

Main aim of this research is to investigate a source separation based approach to remove noise from true signal, while maintaining original tissue enhancement signature. It is based on the hypothesis that there exists overlapping temporal information in the DCE-MRI data, which if identified, can be used for filtering noise out of the true concentration data. We demonstrate the utility of source separation and subsequent weight estimation methodology to filter “noise” from DCE concentration data and impact on the pK model parameters in liver DCE-MRI.

1096 9:36

3D motion corrected SENSE reconstruction for multishot multislice MRI

Lucilio Cordero-Grande[1], Emer Hughes[1], Anthony Price[1], Jana Hutter[1], A. David Edwards[1], and Joseph V. Hajnal[1]

[1]Centre for the Developing Brain, King's College London, London, United Kingdom

A framework for retrospectively motion corrected reconstruction of multislice multishot MRI in the presence of 3D rigid motion is developed. The method is able to cope both with within-plane and through-plane motion by estimating the motion states corresponding to the acquired shots and slices. It has been applied to 478 T1 and T2 newborn brain studies, including many severely motion corrupted examples, for which consistent structures have been recovered in more than 96% of cases. Due to its robustness and flexibility, our technique has wide potential application for both clinical and research examinations.

1097 9:48

4D radial fat-suppressed alternating-TR bSSFP MRI with compressed sensing reconstruction for abdominal imaging during free breathing.

Jasper Schoormans[1], Oliver Gurney-Champion[1], Remy Klaassen[2], Jurgen H. Runge[1], Sonia I. Gonçalves[3], Bram F. Coolen[1], Abdallah G. Motaal[1], Hanneke W.M. van Laarhoven[2], Jaap Stoker[1], Aart J. Nederveen[1], and Gustav J. Strijkers[4]

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We developed a 4D radial fat-suppressed alternating-TR bSSFP sequence with T2-like contrast for abdominal free-breathing imaging of pancreatic cancer patients. The sequence was tested in healthy volunteers and patients with pancreatic cancer and provided images of the abdomen during different respiratory motion states of diagnostic quality.

Oral

Cardiac & Muscle MRS

Room 331-332 8:00 - 10:00 *Moderators:*Roland Kreis & S. Sendhil Velan

1098 8:00

1H-MRS of the myocardium at 3T applying a 60-channel body array coil – initial experiences

Jürgen Machann[1], Malte Niklas Bongers[2], Andreas Fritsche[3], Hans-Ulrich Häring[3], Mike Notohamiprodjo[4], Andreas Greiser[5], Konstantin Nikolaou[4], and Fritz Schick[2]

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^{1}H-MRS is increasingly applied in many organs for non-invasive tissue characterization, e.g. for quantification of ectopic lipids. Spectroscopic examinations of the myocardium often suffer from limited spectral dispersion, thus limiting the metabolic information content. Applying a new 60-channel body-array receive coil, high quality spectra with superior dispersion as compared to previous setups are shown in this work. A single voxel PRESS technique was applied in 10 subjects. After higher-order shimming, linewidths of <20 Hz were obtained with high SNR in a clinically acceptable measuring time. High reproducibility and performance of the method may promote 1H-MRS applications in metabolic research and sports medicine.

1099 8:12

magna cum laude

Adiabatic excitation for ^{31}P spectroscopy in the human heart at 7T

Ladislav Valkovič[1,2], William T Clarke[1], Benoit Schaller[1], Lucian A B Purvis[1], Stefan Neubauer[1], Ivan Frollo[2], Matthew D Robson[1], and Christopher T Rodgers[1]

[1]Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom, [2]Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia

^{31}P-MRS is of particular interest in cardiovascular medicine, as the PCr/ATP ratio can serve as a predictor of mortality. However, due to inherently low signal-to-noise ratio (SNR), cardiac ^{31}P-MRS is not yet practical in the clinic. To increase SNR, the use of 7T and dedicated receive arrays has been proposed. However, the peak B_1^+ was inadequate for the use of B_1 insensitive pulses, thus far. In this study, we demonstrate the feasibility of homogeneous adiabatic excitation for cardiac ^{31}P-MRS using a novel quadrature ^{31}P transceiver at 7T. This constitutes an important step towards absolute quantification of cardiac metabolites at 7T.

1100 8:24

magna cum laude

Improvement of Quantification of 1H Cardiac MR Spectra Acquired at 3T by the Use of Prior Knowledge

Ariane Fillmer[1,2], Andreas Hock[2,3], and Anke Henning[2,4]

[1]Physikalisch Technische Bundesanstalt (PTB), Berlin, Germany, [2]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [3]Department of Psychiatry, Psychotherapy and Psychosomatics, Hospital of Psychiatry, University of Zurich, Zurich, Switzerland, [4]Max Planck Institute for Biological Cybernetics, Tuebingen, Germany

^{1}H cardiac MRS is a promising tool for investigation of human heart disease. In this context the independent quantification of intramyocellular (IMCL) and extramyocellular lipids (EMCL) is desired. Quantification itself, however, remains challenging. This work investigates, whether quantification of metabolite signals within ^{1}H cardiac MR spectra could be improved by the use of prior knowledge about the behavior of metabolite signals in the quantification process.

1101 8:36

summa cum laude

3D resolved human cardiac creatine kinase rate by 31P-MRS at 7T.

William Thomas Clarke[1], Matthew D Robson[1], and Christopher T Rodgers[1]

[1]Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom

The creatine kinase (CK) forward rate constant k_f is a sensitive biomarker for heart failure. However, the low SNR of ^{31}P-MRS at 1.5T and 3T has only allowed it to be measured at low spatial resolution by 1D-CSI. Here, we show how cardiac 7T ^{31}P-MRS permits 3D resolved measurements for the first time. A 3D variant of the FAST k_f^{CK} method was combined with ^{31}P Bloch-Siegert B_1^+ mapping to enable 3D-resolved measurements at 7T. The first measurements of the creatine kinase rate in myocardium in the interventricular septum are obtained from four subjects. Our mean $k_f = 0.36\pm0.04$ s^{-1} was consistent with literature values.

1102 8:48

magna cum laude

Second-Order Motion-Compensated PRESS for Cardiac Spectroscopy

Maximilian Fuetterer[1], Christian Torben Stoeck[1,2], and Sebastian Kozerke[1,2]

[1]Institute for Biomedical Engineering, University and ETH Zurich, Zurich, Switzerland, [2]Division of Imaging Sciences and Biomedical Engineering, King's College London, London, United Kingdom

Second-order motion compensation for PRESS (PRESS^{mc}) is proposed to allow for robust single-voxel cardiac spectroscopy throughout

the entire cardiac cycle. Motion-compensated spoiler gradients were designed and implemented into a cardiac-triggered PRESS sequence. A numerical 3D model of cardiac motion was used to optimize and validate the gradient waveforms. In-vivo measurements in healthy volunteers were obtained to assess SNR and triglyceride-to-water ratio (TG/W). SNR gains and variability of TG/W of PRESS^{mc} were evaluated against a conventional PRESS sequence with optimized gradients. PRESS^{mc} effectively reduces cardiac-motion induced signal degradation during FID spoiling providing higher SNR and less variability for TG/W quantification.

1103 9:00

Mapping of pH in the human calf muscle at 7 T with 31P 3D echo–planar spectroscopic imaging

Andreas Korzowski[1] and Peter Bachert[1]

[1]*Medical Physics in Radiology, German Cancer Research Center, Heidelberg, Germany*

The tissue–pH value is an important parameter to assess physiological function. The purpose of this work was to explore the potential of three-dimensional $^{31}P–\{^{1}H\}$ echo–planar spectroscopic imaging at B_0 = 7 T for mapping of intracellular pH in the human calf muscle with high spatial resolution. The acquired data demonstrate that the proposed method allows the robust quantification of intracellular pH value of voxels with less than 1 ml volume and therefore may give insight into the pH heterogeneity of different muscle groups.

1104 9:12

summa cum laude

Rapid and Simultaneous Measurements for Reaction Kinetics and Metabolite Pool Size Ratios using 31P Magnetization Saturation Transfer Spectroscopy

Sang-Young Kim[1,2], Wei Chen[3], Dost Ongur[2], and Fei Du[1,2]

[1]*McLean Imaging Center, McLean Hospital, Harvard Medical School, Belmont, MA, United States,* [2]*Psychotic Disorders Division, McLean Hospital, Harvard Medical School, Belmont, MA, United States,* [3]*Center for Magnetic Resonance Research, University of Minnesota, Minneapolis, MN, United States*

We demonstrates a novel strategy to simultaneously measure metabolites pool sizes and kinetic constants of CK/ATPase reactions using 31P-MST spectroscopy. Our method enables the corrections for T_1 relaxation time and chemical exchanges effects due to short TR. The most important advantage of our proposed method is the reduction of TR for complete measurements of both metabolites ratios and reaction kinetics with high sensitivity. This can facilitate future applications requiring high temporal and/or spatial resolution.

1105 9:24

magna cum laude

Observation of 31P magnetization transfer at 3 Tesla using asymmetric adiabatic inversion and two different fitting strategies.

Bertrand Pouymayou[1], Tania Buehler[1], Roland Kreis[1], and Chris Boesch[1]

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^{31}P-MR spectroscopy inversion transfer (IT) is increasingly investigated as a complementary method to study ATP-synthesis and creatine kinase in vivo. Three aspects of the IT experiment are studied here, in a test-retest design (12 volunteers, resting vastus muscle): the ability to produce an efficient half band inversion in vivo with a short asymmetric adiabatic pulse, the repeatability of the kinetic parameters estimation at 3T and the impact of two different fitting strategies (individual spectrum vs. two-dimensional fitting). As a result, k[Pi>γ-ATP] can be reliably estimated within cohorts while k[PCr>γ-ATP] is accurate enough to be distinguished between individuals.

1106 9:36

Localized 31P magnetization transfer in the rat brain to measure ATP synthesis rate: inorganic phosphate comes in two pools

Brice Tiret[1,2], Vincent Lebon[1,2], Emmanuel Brouillet[1,2], and Julien Valette[1,2]

[1]*CEA/DSV/I2BM/MIRCen, Fontenay-aux-Roses, France,* [2]*CNRS Université Paris-Saclay UMR 9199, Fontenay-aux-Roses, France*

Localized ^{31}P MRS with progressive saturation transfer was performed in the rat brain to estimate the exchange rate between inorganic phosphate (Pi) and adenosine-tri-phosphate (ATP). It was found that two Pi pools, tentatively intra and extracellular pools, can be resolved at 11.7 T, and that only the intracellular Pi signal varies with progressive saturation, while the extracellular Pi signal remains constant. Not resolving this extracellular Pi can cause a significant bias in the estimation of the forward constant rate of ATP synthesis.

1107 9:48

summa cum laude

Dynamic ^{31}P MRSI with spiral readout for quantification of mitochondrial capacity in muscles of the calf during plantar flexion exercise at 7T

Ladislav Valkovič[1,2,3,4], Marek Chmelík[1,2], Martin Meyerspeer[1,5], Borjan Gagoski[6], Martin Kršňák[1,2,7], Christopher T Rodgers[4], Ivan Frollo[3], Ovidiu C Andronesi[8], Siegfried Trattnig[1,2,9], and Wolfgang Bogner[1,2]

[1]*High-field MR Centre, Medical University of Vienna, Vienna, Austria,* [2]*Department of Biomedical Imaging and Image-guided Therapy, Medical University of Vienna, Vienna, Austria,* [3]*Department of Imaging Methods, Institute of Measurement Science, Slovak Academy of Sciences, Bratislava, Slovakia,* [4]*Oxford Centre for Clinical Magnetic Resonance Research, University of Oxford, Oxford, United Kingdom,* [5]*Center for Medical Physics and Biomedical Engineering, Medical University of Vienna, Vienna, Austria,* [6]*Fetal Neonatal Neuroimaging and Developmental Science Center, Boston Children's Hospital, Boston, MA, United States,* [7]*Division of Endocrinology and Metabolism, Department of Internal Medicine III, Medical University of Vienna, Vienna, Austria,* [8]*Athinoula A. Martinos Center for Biomedical Imaging, Department of Radiology, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States,* [9]*Christian Doppler Laboratory for Clinical Molecular MR Imaging, Vienna, Austria*

Typically, only rough localization by the sensitive volume of the surface coil is used for dynamic ^{31}P-MRS. However, such localization often mixes signals from several muscle groups. Available single-muscle localization techniques (e.g., semi-LASER or DRESS) provide only limited coverage and current ^{31}P-MRSI techniques suffer from slow acquisition. To overcome the low temporal resolution of the

standard ^{31}P-MRSI, caused by slow Cartesian readout, we have developed, and tested in healthy subjects at 7T, a ^{31}P-MRSI sequence using spiral readout trajectory. This sequence enables spatially resolved quantification of mitochondrial capacity in several investigated muscles (e.g., GM, GL and SOL) simultaneously at 7T.

Oral

Electromagnetic Property Based Contrast

Summit 1 | 8:00 - 10:00 | *Moderators:*José Marques & Ferdinand Schweser

1108 | 8:00

magna cum laude

Volume-Parcellated Quantitative Susceptibility Mapping

Casey Anderson[1], Andrew Nencka[2], Tugan Muftuler[3], Kathleen Schmainda[2], and Kevin Koch[2]

[1]Biophysics, Medical College of Wisconsin, Milwaukee, WI, United States, [2]Radiology, Medical College of Wisconsin, Milwaukee, WI, United States, [3]Neurosurgery, Medical College of Wisconsin, Milwaukee, WI, United States

Quantitative susceptibility maps are routinely compromised by streaking artifacts. Here, we present a technique called volume-parcellated quantitative susceptibility mapping (VP-QSM), which performs independent susceptibility inversion on multiple reduced field-of-view parcels over the entire tissue field map. These parcels are combined to form a composite susceptibility map. In this algorithm, streaking artifacts are confined to individual parcels, improving the quality of the susceptibility map without a dependence on the underlying QSM inversion algorithm. In this study, VP-QSM is demonstrated on a 7T human volunteer, as well as on 30 subjects participating in sports concussion and brain cancer neuroimaging research protocols.

1109 | 8:12

Mapping of magnetic fields due to current injection in the human brain using MREIT: First measurements.

Aditya Kumar Kasinadhuni[1], Munish Chauhan[2], Christopher Anderson[1], Michael Schär[3], Aprinda Indahlastari[2], Paul Carney[1], Rosalind Sadleir[2], and Thomas Mareci[1]

[1]University of Florida, Gainesville, FL, United States, [2]Arizona State University, Tempe, AZ, United States, [3]Johns Hopkins University, Baltimore, MD, United States

Magnetic resonance electrical impedance tomography (MREIT) relies on phase changes resulting from electric-current-induced magnetic fields in the direction of static magnetic field of an MRI scanner. Therefore MREIT can be employed to estimate conductivity/current density within the object being imaged. Characterizing current density in the brain is vital to improving our understanding of neuromodulation techniques like transcranial direct current stimulation (tDCS). In this study, to our knowledge, we performed the first MREIT brain scans of healthy human volunteers to localize the current-induced magnetic field generated by tDCS-like currents. These measurements allow estimation of current density in the human brain.

1110 | 8:24

Relaxation based Conductivity Weighted Imaging (rCWI)

Jaewook Shin[1], Min-Oh Kim[1], Jun-Hyeong Kim[1], and Dong-Hyun Kim[1]

[1]Electrical and Electronic engineering, Yonsei University, Seoul, Korea, Republic of

To reduce the noise amplification of the conductivity imaging, the direct calculation of the Laplacian operator was substituted by appropriate k-space weighted sampling scheme by the combination of four TSE data with alternating PE directions.

1111 | 8:36

Phase Imaging with Multiple Phase-Cycled Pass-Band Balanced Steady-State Free Precession at 9.4T

Jae-Woong Kim[1], Seong-Gi Kim[2,3], and Sung-Hong Park[1]

[1]Korea Advanced Institute of Science and Technology, Daejeon, Korea, Republic of, [2]Center for Neuroscience Imaging Research, Institute for Basic Science, Suwon, Korea, Republic of, [3]Departments of Biomedical Engineering and Biological Sciences, Sungkyunkwan University, Suwon, Korea, Republic of

Phase images of pass-band bSSFP were investigated at multiple phase cycling (PC) angles at high field. Contrast between white matter and gray matter in phase images of pass-band bSSFP changed significantly with PC angle and was twice as high as that of phase images of gradient recalled echo at a specific PC angle. Phase images of pass-band bSSFP clearly demonstrated white matter and small structures presumed to be fiber bundles, which may not be easily visualized in the conventional methods. Phase imaging with pass-band bSSFP at multiple phase cycling angles may be a good anatomical imaging method at ultrahigh field.

1112 | 8:48

Whole brain in-vivo g-ratio mapping using neurite orientation dispersion and density imaging (NODDI) and GRE myelin water imaging (GRE-MWI)

Woojin Jung[1], Yoonho Nam[2], Hui Zhang[3], and Jongho Lee[1]

[1]Laboratory for Imaging Science and Technology, Department of Electrical and Computer Engineering, Seoul National University, Seoul, Korea, Republic of, [2]Department of Radiology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of, [3]Department of Computer Science & Centre for Medical Image Computing, University College London, London, United Kingdom

A new in-vivo g-ratio mapping method that combined neurite orientation dispersion and density imaging (NODDI) and GRE myelin water

imaging (GRE-MWI) is proposed. The method is substantially fast, taking 17 min for a 2 mm isotropic resolution whole brain g-ratio mapping. The resulting map reveals a reasonable range of g-ratio that has been reported in histology studies.

1113 9:00

In Vivo Detection of Short T2* Lipid 1H in Mouse Brain with a ZTE/UTE Subtraction Method (ZUS)

Yaotang Wu[1,2], Michael Marcotrigiano[3], Hui Xue[1,2,4], Robert V Mulkern[1,2], and Jeffrey Neil[2,5]

[1]Department of Radiology, Boston Children's Hospital, Boston, MA, United States, [2]Harvard Medical School, Boston, MA, United States, [3]Department of Research, Boston Children's Hospital, Boston, MA, United States, [4]Sichuan University, Chengdu, China, People's Republic of, [5]Department of Neurology, Boston Children's Hospital, Boston, MA, United States

A new method, ZUS, utilizes ZTE to detect all signals with T2* as short as a few hundred microseconds, including myelin proton signals, and UTE to selectively detect signals with longer T2* values, considered to be tissue water components. The difference of these two types of images is used to visualize signals from lipid 1H. In this study, the feasibility of ZUS was demonstrated on a cholesterol phantom (the major component of myelin) and on a live mouse. ZUS images highlighted lipid, particularly myelin in the corpus callosum, of mouse brain in vivo.

1114 9:12

Quantitative susceptibility mapping of magnetic quadrupole moments

Junghun Cho[1], Dong Zhou[2], Pascal Spincemaille[2], and Yi Wang[1,2]

[1]Biomedical Engineering, Cornell University, NEW YORK, NY, United States, [2]Radiology, Weill Cornell Medical College, NEW YORK, NY, United States

In the study of quantitative susceptibility mapping, dipole approximation is widely used where the magnetic field of each voxel is approximated as dipole field. In general, higher order field such as quadrupole field also exists, especially for voxels with non-uniform subvoxel magnetization/susceptibility distributions. We modeled the magnetic field in MRI experiment up to quadrupole term and used multiple orientation measurement to acquire both the dipole (average susceptibility) and quadrupole (susceptibility distribution) contributions. The feasibility of the proposed method is demonstrated in an experimental gadolinium water phantom study.

1115 9:24

Multi-sequence non-contrast MRI characterization of deep vein thrombosis in man

Alkystis Phinikaridou[1], Prakash Saha[2], Marcelo Andia[3], Alberto Smith[2], and René M Botnar[1]

[1]Biomedical Engineering, King's College London, London, United Kingdom, [2]Academic Surgery, King's College London, London, United Kingdom, [3]Radiology, Pontificia Universidad Católica de Chile, Santiago, Chile

Deep vein thrombosis (DVT) affects 1 in 1000 people. Its sequelae include post-thrombotic syndrome (PTS), which affects up to 75% of patients within 5 years and is characterised by persistent pain, swelling and ulceration. Thrombolysis can reduce PTS by a third and is attempted in patients with an ilio-femoral DVT and symptom onset of <3weeks. Determining age and thrombus structure by history alone is, however, subjective and there are no established methods to quantify the abundance of matrix proteins, which determines the response to lysis. This treatment is therefore only effective in ~60% of patients, which may unnecessarily exposes to haemorrhagic side effects. We have developed a non-contrast enhanced magnetic resonance, multi-sequence thrombus imaging (MSTI) technique that can provide information about the structural composition of experimental thrombus [1-2]. Here, we aim in translating the MRI approach into man and determine whether it can help guide venous intervention.

1116 9:36

Positive visualization of interventional devices with susceptibility mapping using the Turbo Spin Echo Sequence

caiyun shi[1], guoxi xie[1,2], xiaoyong zhang[1,3], min chen[1], shi su[1], hairong zheng[1], ying dong[4], jim Ji[4], and xin liu[1]

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Susceptibility-based positive contrast MR imaging exhibits excellent efficacy for visualizing the MR compatible metallic devices, by taking advantage of their high magnetic susceptibility. In this work, a novel method is developed to accelerate the susceptibility-based positive contrast MR imaging. The method is based on a modified turbo spin echo (TSE) sequence and a kernel deconvolution algorithm with a regularized ℓ1 minimization to achieve positive contrast imaging.

1117 9:48

Correlation between MRI-derived water content and conductivity in tumour and healthy tissue: how much cell water is active?

Ana-Maria Oros-Peusquens[1], Yupeng Liao[1], and N. Jon Shah[1]

[1]INM-4, Research Centre Juelich, Juelich, Germany

About 80% of brain water is found inside the cells and a large fraction of it is interfacial water with properties substantially different from those of bulk water. Evidence for a large osmotically unresponsive compartment, available from literature, is substantiated by the finding that a very large fraction of brain water does not contribute to its electrical conductivity. This is determined by investigating the correlation between conductivity and water content in tumour patients in vivo. More than 80% of brain water is found to be unresponsive, with variations reflecting tissue and tumour type. This work describes a noninvasive method for the characterisation of a deeply microscopic parameter of the living tissue.

Oral

Clinical Cancer Investigations & Methods

Summit 2 | 8:00 - 10:00 | *Moderators:* Yu-Ting Kuo

1118 | 8:00

Reconstruction and validation of T2-weighted 4D Magnetic Resonance Imaging for radiotherapy treatment planning

Zdenko van Kesteren[1], Daniël Tekelenburg[1,2], Oliver Gurney-Champion[1,3], Aart Nederveen[3], Eelco Lens[1], Astrid van der Horst[1], Aleksandra Biegun[2], and Arjan Bel[1]

[1]radiotherapy, Academic Medical Centre, Amsterdam, Netherlands, [2]KVI-Center for Advanced Radiation Technology, University of Groningen, Groningen, Netherlands, [3]radiology, Academic Medical Centre, Amsterdam, Netherlands

We developed a respiratory-correlated 4DMRI for abdominal imaging by retrospective sorting 2D T2-weighted TSE images. Each image is assigned to a respiratory state, which is either binned in phase or the amplitude domain. The diaphragm motion per image was determined by registering the diaphragm to the begin-inhale image of a series. Per slice and per bin multiple images were acquired and we defined the intra-bin variation as the standard deviation of diaphragm positions. Amplitude binning results in lower intra-bin variation with respect to phase binning, 0.8 versus 2.4 mm respectively.

1119 | 8:12

Clinical evaluation of ultra high field MRI for three-dimensional visualization of tumour size in uveal melanoma patients, with direct relevance to treatment planning.

Jan-Willem Beenakker[1], Teresa Ferreira[1], Karina Soemarwoto[1], Lorna Grech Fonk[1], Stijn Genders[1], Wouter Teeuwisse[1], Andrew Webb[1], and Gregorius Luyten[1]

[1]Leiden University Medical Centre, Leiden, Netherlands

Recent advances in ocular MRI make it possible to acquire high resolution three dimensional images of uveal melanoma in eye tumour patients, allowing a much better assessment of the maximal tumour prominence compared to conventional clinical ultrasound measurements. Nine uveal melanoma patients were examined on a 7 Tesla using a custom-built eye-coil. Eye-motion artefacts were minimized by the use of a cued-blinking protocol. For all patients the MR-images showed a slightly lower tumour prominence. For two of these patients this resulted in a substantial change in treatment planning, saving an eye that would otherwise have been removed.

1120 | 8:24

Non-muscle-invasive and Muscle-invasive Bladder Cancer: Image Quality and Clinical Value Compared between Reduced Field-of-view DWI and Single-shot Echo-planar-imaging DWI

Yanchun Wang[1], Zhen Li[1], Daoyu Hu[1], and Xiaoyan Meng[1]

[1]radiology, Tongji hospital, Wuhan, China, People's Republic of

Bladder cancer is the most common malignant tumor of the urinary tract, and the incidence rate of bladder cancer is 6% for men and 2% for women. Clinical treatment of bladder cancer depends on the level of muscle invasion (stage T2 or higher) or non-invasion of the muscle of the bladder wall (stage T1 or lower). Non-invasive tumors are mainly treated with transurethral resection (TUR), whereas invasive tumors are mainly treated with radical cystectomy . Therefore, it's important to precisely differentiate between non-muscle-invasive and muscle-invasive bladder cancer before treatment.

1121 | 8:36

Precise staging of preoperative 3.0-T MR imaging for esophageal carcinoma by using ex vivo MR imaging-matched pathologic findings as the reference standard

Yi Wei[1,2], Shao-Cheng Zhu[1,2], Sen Wu[1,2], Da-Peng Shi[1,2], and Dan-Dan Zheng[3]

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Magnetic resonance imaging (MRI) was reported to evaluate the esophageal layers invasion in vitro and demonstrated that high-resolution T2-weighted imaging can clearly depict 8 layers of esophagus. However, former studies were mostly carried on ultra-high-field scanner ex vivo, which can not satisfy the need of preoperative staging and provide essential information for clinic. In this study, an in vivo experiment was conducted on 3.0T clinical scanner to prospectively establish the MRI signal characteristics of the normal esophageal wall and to assess the diagnostic accuracy of high-resolution MR imaging for depicting the depth of esophageal wall invasion by corresponding to ex vivo MR imaging-matched certain histopathological slice.

1122 | 8:48

Comparison of Whole-body MRI and PET-CT for staging adult lymphoma: Preliminary result at 3.0T

Arash Latifoltojar[1], Natacha Rosa[1], Maria Klusmann[2], Mark Duncan[2], Kirit Ardeshna[2], Jonathan Lambert[2], Alan Bainbridge[2], Magdalena Sokolska[2], Sajir Mohamedbhai[2], and Shonit Punwani[1]

[1]University College London, London, United Kingdom, [2]University College London Hospital, London, United Kingdom

Whole body MRI (WB-MRI) offers a radiation-free imaging technique for staging lymphoma. However, there are conflicting reports concerning appropriate sequence(s) being used in various WB-MRI protocols. In this work we investigated diagnostic performance of different morphological and functional MRI sequences as part of a WB-MRI protocol.

1123 9:00

magna cum Laude

The benefits of in vivo 2-hydroxyglutarate detection using semi-LASER at 7T and 3T: a comparative study

Adam Berrington[1], Natalie Voets[1], Sarah J Larkin[2], Nick de Pennington[2], James Mccullagh[3], Khalid Al-Qahtani[3], Richard Stacey[4], Peter Jezzard[1], Stuart Clare[1], Christopher J Schofield[3], Olaf Ansorge[2], Tom Cadoux-Hudson[4], Puneet Plaha[4], and Uzay E Emir[1]

[1]FMRIB Centre, University of Oxford, Oxford, United Kingdom, [2]Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford, United Kingdom, [3]Department of Chemistry, University of Oxford, Oxford, United Kingdom, [4]Department of Neurosurgery, University of Oxford, Oxford, United Kingdom

We assess the ability of semi-LASER to detect 2-hydroxyglutarate (2-HG), a metabolic product of mutation in the enzyme IDH, in gliomas at 3T and 7T. Robust detection could lead to increased patient stratification yet is hindered by signal overlap and compartmental artifacts. We find semi-LASER (TE=110ms), with broadband adiabatic refocussing, is able to correctly identify IDH-mutants at 3T and 7T in a sample of six patients. Fitting errors are greatly reduced at 7T and additional metabolites (GABA, Gly) are detected in some IDH-mutated tumours. We conclude semi-LASER provides a unique clinical opportunity for 2-HG detection at both 3T and 7T.

1124 9:12

ACRIN 6684: Multicenter, phase II assessment of tumor hypoxia in newly diagnosed glioblastoma using magnetic resonance spectroscopy

Eva-Maria Ratai[1,2], Zheng Zhang[3], James Fink[4], Mark Muzi[4], Lucy Hanna[3], Erin Greco[3], Todd Richards[4], Akiva Mintz[5], Lale Kostakoglu[6], Edward Eikman[7], Melissa Prah[8], Benjamin Ellingson[9], Kathleen Schmainda[8], Gregory Sorensen[1,2], Daniel Barboriak[10], David Mankoff[11], and Elizabeth Gerstner[12]

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The Phase II multi-center trial ACRIN 6684 conducted by the American College of Radiology Imaging Network was designed to assess tumor hypoxia in newly diagnosed glioblastoma (GBM) using [18F] Fluoromisonidazole (FMISO)-PET and MRI. Data from magnetic resonance spectroscopic imaging (MRSI) were available on 17 participants from four sites. The MRS marker of tumor burden (NAA/Cho) was a significant predictor of one-year survival (OS-1). Furthermore, the MRS marker of tumor hypoxia (Lac/Cr) was a significant predictor of six-month progression-free-survival (PFS-6) using receiver operating characteristic (ROC) analysis.

1125 9:24

Texture analysis of hepatocellular carcinomas in Contrast-enhanced MR images for malignant differentiation

Wu Zhou[1], Kaixin Wang[1], Lijuan Zhang[1], Zaiyi Liu[2], Guangyi Wang[2], and Changhong Liang[2]

[1]Key Laboratory for Health Informatics, Shenzhen Institutes of Advanced Technology, Shenzhen, China, People's Republic of, [2]Department of Radiology, Guangdong General Hospital, Guangdong Academy of Medical Sciences, Shenzhen, China, People's Republic of

Lesion characterization based on imaging features is essential to the successful treatment of hepatocellular carcinomas (HCC). In this work, we investigate the malignant of HCC from Contrast-enhanced MR images based on the analysis of texture features. Our study demonstrated that the texture feature (average intensity value and grey level nonuniformity) of HCC in contrast-enhanced MR images was a good predictor to characterize the malignant of HCC. By quantitatively comparing the texture parameters in well differentiated and moderately differentiated HCCs, the values of average intensity remarkably decreased and GLN significantly increased according to the increasing degree of malignant for HCCs.

1126 9:36

A feasibility study to perform combined MR Elastography, IVIM and DCE-MRI in pancreatic cancer patients.

Jurgen H Runge[1], Remy Klaassen[2], Oliver J Gurney-Champion[1,3], Hanneke WM van Laarhoven[2], Ralph Sinkus[4], Aart J Nederveen[1], and Jaap Stoker[1]

[1]Radiology, Academic Medical Center, Amsterdam, Netherlands, [2]Medical Oncology, Academic Medical Center, Amsterdam, Netherlands, [3]Radiation Oncology, Academic Medical Center, Amsterdam, Netherlands, [4]Biomedical Engineering, King's College London, London, United Kingdom

Pancreatic cancer remains one the most deadly cancers. New therapeutic agents cause confusion as prior morphological criteria to determine the presence of a response appear to be unreliable. MR Elastography (MRE) is uniquely able to determine tissue stiffness, a property potentially useful for therapy response monitoring. Here we present our first preliminary results of combining MRE with IVIM and DCE MRI.

1127 9:48

Estimate of liver functional reserve using T1 mapping on Gd-EOB-DTPA-enhanced MRI in HCC patients

Chenyang Chen[1], Jie Chen[1], Chunchao Xia[1], Panli Zuo[2], and Bin Song[1]

[1]Department of Radiology, West China Hospital, Sichuan University, Chengdu, China, People's Republic of, [2]Siemens Healthcare, MR Collaboration NE Asia, Beijing, China, People's Republic of

We found that liver tumors showed clearer borderline on T1 map during hepatobiliary phase of Gd-EOB-DTPA enhanced MRI. A significant correlation between the reduction rate of liver parenchyma with ICG-15 indicated that the T1 mapping is useful to estimate the liver functional reserve in HCCs patients.

Oral

Spine Imaging: Normal Structure/Novel Methods

Nicoll 1 | 8:00 - 10:00 | *Moderators:*Suchandrima Banerjee

1128 | 8:00

Towards accurate spinal cord morphometry with in situ grid phantom calibrated gradient non-linearity correction

Joseph Allan Borrello[1,2,3], Joo-won Kim[2,4], Mootaz Eldib[2,4], and Junqian Xu[2,4,5]

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Spinal cord cross sectional area (SCCSA) holds promise as a biomarker of neurological disorders. However, the large FOVs required to obtain SCCSA from a large portions of the spinal cord are accompanied by significant spatial distortions due to gradient nonlinearity. While MRI vendors supply spatial unwarping algorithms, site-specific variations in the gradient linearity are present, which affects the reproducibility of longitudinal and multi-site studies. We have fabricated an in situ phantom designed to provide a spatial point of reference, in conjunction with numerically optimizing the unwarping with measurements at two table positions, to provide scanner-specific gradient non-linearity unwarping.

1129 | 8:12

Fully-integrated T1, T2, T2*, white and gray matter atlases of the spinal cord

Benjamin De Leener[1], Manuel Taso[2,3], Vladimir Fonov[4], Arnaud Le Troter[2,3], Nikola Stikov[1,5], Louis Collins[4], Virginie Callot[2,3], and Julien Cohen-Adad[1,6]

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The spinal cord MRI community currently lacks a standard reference template covering the entire cord, therefore hindering the feasibility of large multi-center studies. Here, we propose the MNI-Poly-AMU50, the first MRI template of the entire spinal cord and brainstem, based on 50 subjects, available for multiple contrasts (T_1-, T_2- and T_2*-weighted), and integrating probabilistic atlases of the white and gray matter. These templates provide a common framework for co-registering multi-parametric data. All developments are freely available as part of the Spinal Cord Toolbox.

1130 | 8:24

High-resolution quantitative magnetic resonance imaging of the human cervical spinal cord at 7T

Aurélien Massire[1,2,3], Manuel Taso[1,2,3,4], Maxime Guye[1,2], Jean-Philippe Ranjeva[1,2,3], and Virginie Callot[1,2,3]

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A high-resolution multi-parametric MRI protocol dedicated to 7T cervical spinal cord (SC) investigation using a commercial prototype transceiver radiofrequency coil array is proposed. This work pushes forward SC quantitative MRI by reporting T_1/T_2/T_2^* relaxation times mapping as well as diffusion tensor imaging metrics at the C3 cervical level on a cohort of ten healthy volunteers. Automatic segmentation and registration of these multi-parametric acquisitions to SC templates enable group studies with quantitative evaluation within regional WM tracts and GM horns never reported so far at 7T. This study lays the groundwork for improved characterization of degenerative SC pathologies at ultra-high field.

1131 | 8:36

Validating Myelin Water Imaging with Electron Microscopy in Rat Spinal Cord

Henry Szu-Meng Chen[1], Nathan Holmes[2], Wolfram Tetzlaff[2,3], and Piotr Kozlowski[4,5]

[1]Physics and Astronomy, University of British Columbia, Vancouver, BC, Canada, [2]Zoology, University of British Columbia, Vancouver, BC, Canada, [3]ICORD, Vancouver, BC, Canada, [4]UBC MRI Research Centre, Vancouver, BC, Canada, [5]Radiology, University of British Columbia, Vancouver, BC, Canada

Quantitative T2 based myelin water imaging measures myelin content by probing the properties of the water trapped in myelin and therefore depends on its morphology. We compared MR myelin water fraction (MWF) to electron microscopy derived myelin content using a rat injury model and found that MWF correlates strongly with the amount of myelin lipid bilayers in both intact myelin and myelin debris and that myelin debris appears to consist of areas of either normally spaced myelin or large vacuous spaces. No significant differences were found in myelin spacing among normal, 3 week, and 8 weeks post injury time points.

1132 | 8:48

Fully-integrated framework for registration of spinal cord white and gray matter

Sara Dupont[1], Benjamin De Leener[1], Manuel Taso[2,3], Nikola Stikov[1,4], Virginie Callot[2,3], and Julien Cohen-Adad[1,5]

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The spinal cord (SC) white and gray matter can be affected by a large number of pathologies. Being able to segment precisely the SC internal structure would be useful to better understand SC diseases, improve diagnosis and assess treatment efficiency. We introduce a complete framework for *(i)* multi-atlas automatic segmentation of the gray-matter, *(ii)* accurate registration to the MNI-Poly-AMU template and *(iii)* extraction of quantitative metric using partial volume information. Results showed improved accuracy of template registration when adding prior automatic gray-matter segmentation. The proposed method is freely available and provides an unbiased framework for quantitative analysis of SC MRI data.

1133 9:00

magna cum laude

Fully automated grey and white matter segmentation of the cervical cord in vivo

Ferran Prados[1,2], Manuel Jorge Cardoso[1], Marios C Yiannakas[2], Luke R Hoy[2], Elisa Tebaldi[2], Hugh Kearney[2], Martina D Liechti[2], David H Miller[2], Olga Ciccarelli[2], Claudia Angela Michela Gandini Wheeler-Kingshott[2,3], and Sebastien Ourselin[1]

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We propose and validate a new fully automated spinal cord (SC) segmentation technique that incorporates two different multi-atlas segmentation propagation and fusion techniques: Optimized PatchMatch Label fusion (OPAL) and Similarity and Truth Estimation for Propagated Segmentations (STEPS). We collaboratively join the advantages of each method to obtain the most accurate SC segmentation. The new method reaches the inter-rater variability, providing automatic segmentations equivalents to inter-rater segmentations in terms of DSC 0.97 for whole cord for any subject.

1134 9:12

High-Resolution Single-Point qMT of the Lumbar Cord

Alex K. Smith[1,2], Richard D. Dortch[1,2,3], Samantha By[1,2], Robert L. Barry[2], Chris R. Thompson[2], Kristen George-Durrett[2], Bailey D. Lyttle[2], and Seth A. Smith[1,2,3]

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The spinal cord is responsible for mediating neurologic function, and in particular, the lumbar cord is integral to lower extremity function. However, lumbar cord quantitative MRI studies have been limited due to its size, location, and composition. A single-point quantitative magnetization transfer was recently developed, but has not been applied to the lumbar cord. Therefore, we have implemented an assessment of qMT at the thoracolumbar bulge to characterize the MT effect in the thoracolumbar cord in healthy volunteers.

1135 9:24

summa cum laude

White Matter Swelling Masked Axonal Loss Detected by Diffusion Basis Spectrum Imaging (DBSI)

Tsen-Hsuan Lin[1], Mitchell Hallman[1,2], Fay Hwang[1], Yong Wang[1,3,4,5], Sheng-Kwei Song[1,4,5], and Peng Sun[1]

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The extent of axonal loss plays a significant role in irreversible neurological impairment in spinal cord injury (SCI). We detected a 15% axonal loss in SCI mice using diffusion basis spectrum imaging (DBSI) that was masked by injury induced white matter swelling.

1136 9:36

In-vivo Characterization of Human Lumbar Intervertebral Discs by Magnetic Resonance Elastography: Diurnal Changes in Shear Stiffness and Relationship with Degeneration

Benjamin A Walter[1,2], Prasath Mageswaran[1,3], Hazem Mashaly[1,4], William Thoman [1,4], Daniel Boulter[5], Luciano Prevedello [5], Xuan Nguyen [5], Mo Xiaokui [6], Ehud Mendel [1,4], William Marras[1,3], and Arunark Kolipaka[1,2,5,7]

[1]Spine Research Institute, The Ohio State University, Columbus, OH, United States, [2]Biomedical Engineering, The Ohio State University, Columbus, OH, United States, [3]Integrated Systems Engineering, The Ohio State University, Columbus, OH, United States, [4]Neurological Surgery, The Ohio State University Wexner Medical Center, Columbus, OH, United States, [5]Radiology, The Ohio State University Wexner Medical Center, Columbus, OH, United States, [6]Biomedical Informatics, The Ohio State University, Columbus, OH, United States, [7]Cardiovascular Medicine, The Ohio State University Wexner Medical Center, Columbus, OH, United States

Magnetic resonance elastography (MRE) was used to assess intervertebral disc (IVD) shear properties in order to develop an objective biomarker for the IVD degeneration process. This study characterized the frequency response and repeatability of MRE assessment of IVD shear stiffness and how the shear stiffness of the nucleus pulposus (NP) region of the IVD changes during degeneration. Results suggest that MRE derived NP shear stiffness is a repeatable technique that can provide a relative and objective measurement of IVD degeneration that is independent of age.

1137 9:48

Developing In Vivo Perfusion Imaging Methods for Spinal Cord Using Hyperpolarized [13C]t-Butanol and [13C, 15N2]Urea

Ilwoo Park[1], Jeremy Gordon[1], Sarah Nelson[1,2], and Jason Talbott[1,3]

[1]Radiology and Biomedical Imaging, University of California San Francisco, San Francisco, CA, United States, [2]Bioengineering and Therapeutic Sciences, University of California San Francisco, San Francisco, CA, United States, [3]Brain and Spine Injury Center (BASIC), University of California San Francisco, San Francisco, CA, United States

This study has demonstrated the feasibility of using hyperpolarized ^{13}C MRI with [^{13}C]t-butanol and [^{13}C,$^{15}N_2$]urea for assessing in vivo perfusion in the cervical spinal cord. T-butanol rapidly crossed the blood-brain-barrier and diffused into spine and brain tissue, while urea predominantly remained in vasculature. The results from this study suggest that this technique may provide unique non-invasive imaging tracers that are able to directly monitor hemodynamic processes in the normal and injured spinal cord.

Oral

Lung/Mediastinum

Nicoll 2 8:00 - 10:00 *Moderators:*Jens Vogel-Claussen

1138 8:00

Clinical evaluation of the respiratory mechanics using accelerated 3D dynamic free breathing MRI reconstruction

Sampada Bhave[1], Sajan Goud Lingala[2], Scott Nagle[3], John D Newell Jr[4], and Mathews Jacob[1]

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Three-dimensional dynamic MRI (3D-DMRI) is a promising method to analyze respiratory mechanics. However, current 3D DMRI implementations offer limited temporal, spatial resolution and volume coverage. In this work we demonstrate the feasibility of three compressed sensing reconstruction methods along with view-sharing method with clinical evaluation on 8 healthy subjects by expert radiologists. BCS scheme provides better performance than other schemes both qualitatively and quantitatively. The preliminary results on lung volume changes demonstrate the clinical utility of the BCS scheme.

1139 8:12

Soft-gating and Motion Resolved Reconstructions for Free-Breathing Pulmonary Imaging

Wenwen Jiang[1], Frank Ong[2], Kevin M Johnson[3], Scott K Nagle[4], Thomas Hope[5], Michael Lustig[2], and Peder E.Z Larson[5]

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Structural pulmonary imaging with MRI has many potential applications including lung nodule detection and interstitial lung disease assessments, but is limited by the challenges of short T2*, low proton density, and respiratory and cardiac motion. We propose a combination of an optimized 3D UTE acquisition with advanced reconstruction methods, including motion correction, parallel imaging, and compressed sensing, aiming to make MRI become a clinical option for pulmonary imaging.

1140 8:24

Real-time dynamic fluorinated gas MRI in free breathing for mapping of regional lung ventilation in patients with COPD and healthy volunteers using a 16 channel receive coil at 1.5T

Marcel Gutberlet[1,2], Till Kaireit[1,2], Andreas Voskrebenzev[1,2], Julia Freise[3], Tobias Welte[3], Frank Wacker[1,2], and Jens Vogel-Claussen[1,2]

[1]Institute of Diagnostic and Interventional Radiology, Hannover Medical School, Hannover, Germany, [2]Plattform Imaging, German Centre for Lung Research (DZL), Hannover, Germany, [3]Clinic of Pneumology, Hannover Medical School, Hannover, Germany

Quantification of regional lung ventilation is of high relevance for several lung diseases like chronic obstructive lung disease (COPD) or asthma. In this study real-time dynamic fluorinated gas MRI in free breathing for mapping of regional lung ventilation was applied in patients with COPD and healthy volunteers. A significant difference of washout kinetics between healthy volunteers and COPD patients was found. Dynamic fluorinated gas MRI highly correlated with lung function test which is used for COPD classification.

1141 8:36

Quantitative Susceptibility Mapping of the Lungs with Multi-echo Radial MRI: Sensitivity to Pulmonary Oxygen Content

Zackary I. Cleveland[1,2], Jinbang Guo[1,3], Teckla Akinyi[1,2], Hongjiang Wei[4], S. Sivaram Kaushik[5], Jason C. Woods[1,3], Chunlei Liu[4], Vivian S. Lee[6], and Luke Xie[6]

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Magnetic susceptibility differences at gas-tissue interfaces within the lungs have long been considered a significant obstacle to performing high-resolution pulmonary MRI because of the resulting rapid T_2^* relaxation. However, susceptibility differences in the lungs

originate from regional differences in blood oxygenation and alveolar O_2 content. Thus, if these differences are mapped, they have the potential to provide fundamental information about regional lung function. Here we demonstrate that quantitative susceptibility mapping (QSM) of the lungs is possible in vivo using multi-echo radial MRI. Additionally, we demonstrate that the contrast observed in the lungs via QSM is sensitive to O2 partial pressure.

1142 8:48

CEST Imaging Targeted APT vs. FDG-PET/CT: Capability for Differentiating Malignant from Benign Pulmonary Lesions

Yoshiharu Ohno[1,2], Masao Yui[3], Mitsue Miyazaki[4], Yuji Kishida[2], Shinichiro Seki[2], Hisanobu Koyama[2], Katsusuke Kyotani[5], Takeshi Yoshikawa[1,2], and Kazuro Sugimura[2]

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Chemical exchange saturation transfer (CEST) imaging is suggested as a new technique for MR-based molecular imaging techniques *in vivo* and *in vitro* studies. We hypothesized that newly developed CEST imaging, may have a similar potential for differentiating malignant from benign pulmonary nodules and masses, when compared with FDG-PET/CT. The purpose of this study was to directly and prospectively compare the capability of CEST imaging targeted to amide groups (-NH) for differentiation of malignant from benign pulmonary lesions with FDG-PET/CT.

1143 9:00

magna cum laude

Ventilation Estimates in Severe Uncontrolled Asthma using 3D Single breath-hold Ultra-short Echo Time MRI

Khadija Sheikh[1], Fumin Guo[1], Alexei Ouriadov[1], Dante PI Capaldi[1], Sarah Svenningsen[1], Miranda Kirby[2], David G McCormack[3], Harvey O Coxson[2], and Grace Parraga[1]

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To accelerate clinical translation of pulmonary proton UTE MRI, the underlying structural determinants of UTE MR signal-intensity must be determined. We regionally evaluated multi-volume UTE maps with direct comparison to thoracic CT in subjects with asthma. UTE MRI signal-intensity was related to CT radio-density, with a trend towards significance for pulmonary function tests, suggesting that changes in signal-intensity may reflect gas-trapping. This is important, because UTE signal-intensity measurements may be used to identify regions of gas-trapping/ventilation abnormalities in severe asthma without the use of inhaled-gas contrast or ionizing radiation making this approach suitable for children where longitudinal monitoring may be required.

1144 9:12

Pulmonary Phase Imaging using Self-Gated Fourier Decomposition MRI in Patients with Cystic Fibrosis

Simon Veldhoen[1], Andreas Max Weng[1], Clemens Wirth[1], Andreas Steven Kunz[1], Janine Nicole Knapp[1], Daniel Stäb[1,2], Florian Segerer[3], Helge Uwe Hebestreit[3], Thorsten Alexander Bley[1], and Herbert Köstler[1]

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Fourier Decomposition MRI provides functional lung imaging. Perfusion-weighted data carries information regarding the delay of maximal signal increase in the lung parenchyma during a cardiac cycle (pulmonary phase). Purpose of the study is to compare the pulmonary phase dispersion of cystic fibrosis (CF) patients and healthy controls. Functional maps were visually compared, phase values of the parenchyma were plotted on histograms and a peak-to-offset ratio was calculated. Ratios of CF patients were correlated with the forced expiratory volume (FEV_1). CF patients showed more inhomogeneous maps and a significantly lower ratio (15.9±17.5 vs. 38.7±27.9, p=0.005), which correlated with their FEV_1 (r_s=0.72;p=0.001).

1145 9:24

magna cum laude

Invasive pulmonary fungal infection: assessment of antifungal treatment response with intravoxel incoherent motion diffusion-weighted MR imaging

Chenggong Yan[1], Jun Xu[2], Wei Xiong[1], Qi Wei[2], Yingjie Mei[3], and Yikai Xu[1]

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In this study, we evaluate the diffusion and perfusion characteristics of pulmonary invasive fungal infections (IFI), which were calculated using the intravoxel incoherent motion (IVIM) model. We found that a low perfusion fraction f might be a noninvasive imaging biomarker for unfavorable response.

1146 9:36

^{129}Xe pulmonary gas exchange spectroscopy in idiopathic pulmonary fibrosis

Scott H. Robertson[1,2], Elianna A. Bier[1,2], Rohan S. Virgincar[1,3], and Bastiaan Driehuys[1,2,3,4]

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Accurately characterizing the chemical shifts of ^{129}Xe in the lung, enables probing pulmonary gas exchange at the micron scale interface between the alveoli and capillary beds. Doing so requires decomposing the dissolved phase ^{129}Xe spectrum. Whereas previous work

identified only two dissolved-phase ^{129}Xe resonances associated with blood and barrier tissues, we now employ improved non-linear fitting techniques to decompose complex FIDs into three resonances. This enables us to report updated ratios of ^{129}Xe uptake in blood and barrier resonances, many of which differ significantly between control and IPF groups.

1147 9:48

magna cum laude

Assessing Functional Changes in Lungs with Idiopathic Pulmonary Fibrosis using Hyperpolarized Xenon-129 MRI
Kun Qing[1], Borna Mehrad[1], John P. Mugler, III[1], Kai Ruppert[1,2], Jaime F. Mata[1], Nicholas J. Tustison[1], Steven Guan[1], Y. Michael Shim[1], Iulian C. Ruset[3], F. William Hersman[3,4], and Talissa A. Altes[1,5]

[1]University of Virginia, Charlottesville, VA, United States, [2]Cincinnati Children's Hospital Medical Center, Cincinnati, OH, United States, [3]Xemed LLC, Durham, NH, United States, [4]University of New Hampshire, Durham, NH, United States, [5]University of Missouri, Columbia, MO, United States

Idiopathic pulmonary fibrosis (IPF) is a fatal disease leading to 40,000 deaths each year in the US. Current clinical tools are remarkably limited in their ability to discriminate between subsets of IPF patients. In this study, we demonstrated the ability of a recently developed imaging tool, hyperpolarized xenon-129 MRI, to detect pulmonary physiology highly relevant to pathology found in IPF with 3-D resolution. Xenon-129 MRI may represent a novel tool that can detect previously unrecognized subsets of patients with IPF relevant to treatment and prognosis of this disease.

Oral

B0 Shimming

Nicoll 3 8:00 - 10:00 *Moderators:*Jürgen Hennig & Hoby Hetherington

1148 8:00

An Efficient 3D RF Simulation Tool for Dielectric Shimming Optimization
Jeroen van Gemert[1], Wyger Brink[2], Andrew Webb[2], and Rob Remis[1]

[1]Circuits & Systems, University of Technology, Delft, Netherlands, [2]Radiology, Leiden University Medical Center, Leiden, Netherlands

High permittivity materials, in the form of “dielectric pads” are used in neuroimaging and body applications to improve B_1^+ homogeneity and intensity or to reduce corresponding SAR measures. In 3D, systematic pad design is computationally intensive with very long associated simulation times. We propose a hybrid solution to this problem by combining the flexibility of FDTD to model complex background configurations (coil/shield/subject) with an integral equation approach that takes the presence of a dielectric pad into account. This solution leads to speed up factors of 30 – 40 compared with conventional FDTD approaches and enables effective 3D dielectric pad design.

1149 8:12

A Comparison of Optimization Algorithms for Localized in-vivo B0 Shimming
Sahar Nassirpour[1,2], Paul Chang[1,2], Ariane Fillmer[3,4], and Anke Henning[1,3]

[1]Max Planck Institute For Biological Cybernetics, Tübingen, Germany, [2]IMPRS for Cognitive and Systems Neuroscience, Eberhard Karls University of Tübingen, Tübingen, Germany, [3]Institute for Biomedical Engineering, UZH and ETH Zürich, Zürich, Switzerland, [4]Physikalisch-Technische Bundesanstalt, Berlin, Germany

This work presents a study on the performance of several least-squares optimization algorithms used for localized in-vivo B_0 shimming. Seven different algorithms were tested in 4 different shim volumes in the brain: global shimming region, single slice, and single voxels in two different positions with 3rd order shimming at 7T. Each algorithm's robustness and convergence were tested against noisy inputs and different starting values. The results give an interesting overview of the properties of each algorithm and their applicability. The regularized iterative inversion algorithm proves to be the best algorithmic approach suited to this problem.

1150 8:24

magna cum laude

Full matrix pre-emphasis for higher-order dynamic shimming with 1 kHz bandwidth
Laetitia Vionnet[1], Yolanda Duerst[1], Signe Johanna Vannesjo[1,2], Simon Gross[1], and Klaas Paul Pruessmann[1]

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Full matrix pre-emphasis was used for slice-wise dynamic shimming.

1151 8:36

Multi-Coil B0 shimming of the Human Heart: A Theoretical Assessment
Wolfram Mattar[1], Christoph Juchem[2], Maxim Terekhov[3], and Laura Schreiber[3]

[1]Department of Radiology, Section of Medical Physics, Johannes Gutenberg University Medical Center, Mainz, Germany, [2]Departments of Radiology and Imaging Sciences, and Neurology, Yale University School of Medicine, New Haven, CT, United States, [3]Department of Cellular and Molecular Imaging, Comprehensive Heart Failure Center, Wuerzburg, Germany

This study entails a comprehensive, theoretical analysis of B_0 shimming capabilities in the human heart. Three-dimensional B_0 distributions over the in vivo human heart are addressed with various spherical harmonic and multi-coil shimming (shimming with individual placed magnetic coils to modify the B_0 field) approach in a static, dynamic and a hybrid fashion. The results of the study show that, as expected, the global standard static spherical harmonic shimming (clinical standard) are generally inferior in comparison with

the results of specifically tailored and customized shimming methods based on dynamic and multi-coil approaches.

1152 8:48

B0 shimming at 9.4T using a multicoil approach – coil design with genetic algorithm

Irena Zivkovic[1], Christian Mirkes[1,2], and Klaus Scheffler[1,2]

[1]High Field MRI Department, Max Planck Institute for Biological Cybernetics, Tuebingen, Germany, [2]Dept. for Biomedical Magnetic Resonance, University of Tuebingen, Tuebingen, Germany

It is a big challenge to produce as homogeneous as possible B0 static magnetic field. Susceptibility differences between the tissue and air introduce inhomogeneities especially pronounced at high fields. Recently proposed close fitting array of circular loops provide improvement in B0 shimming. Based on the same concept, we proposed coil elements with irregular shape. The shape of the coils was designed by using of genetic algorithm. Theoretical investigation showed that performance of the 16 channel array of irregular elements was comparable or better than 48 channel array consisting loop elements.

1153 9:00

Improving the efficiency of integrated RF-shim arrays using hybrid coil designs and channel placement and compression via a genetic algorithm

Jason P Stockmann[1], Bastien Guerin[1,2], and Lawrence L Wald[1,2]

[1]A. A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Charlestown, MA, United States, [2]Harvard Medical School, Boston, MA, United States

Integrated RF-shim coils combine RF receive arrays and matrix shim arrays into a single set of close-fitting loops, provide a promising alternative to spherical harmonic shim coils for compensating dynamic high-order B_0 offsets in the brain. However, the potentially large design space for optimizing these arrays remains little explored. In this work, we investigate ways to improve the efficiency of RF-shim coils by (a.) creating "hybrid" RF-shim arrays that use additional shim-only loops over the face for targeted shimming of the frontal lobes and (b.) using a genetic algorithm to choose optimal subarrays of coils for shimming, thus reducing hardware complexity.

1154 9:12

Optimization of geometry for combined RF/shim coil arrays for the spinal cord

Grégoire Germain[1], Jason Stockmann[2], Ryan Topfer[1], Lawrence L Wald[2,3], Nikola Stikov[1,4], and Julien Cohen-Adad[1,5]

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Spatial variations of B_0 in the region of the spinal cord are known to cause many artifacts. Local combined RF/shim coil array could provide an alternative to spherical harmonic shim coil. Here, we simulated several realistic coil array geometries for spinal cord imaging and demonstrated that arrays of 16 coils could outperform 3rd order spherical harmonic shimming in the ROI. Simulations also revealed that precise configurations for the coils can improve shimming performance without SNR loss.

1155 9:24

Generating unilateral field modulation for MRI using a pyrolytic-graphite-based Halbach array

Richard Bowtell[1]

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A flat Halbach array consisting of an array of long, thin permanent magnets whose magnetization orientation varies linearly with position, has the interesting property of generating a unilateral field perturbation. Such a pattern of field variation could be usefully employed in MRI, for example for attenuating signals from surface structures. Here we show that a Halbach array can be formed by exposing appropriately oriented strips of material with anisotropic magnetic susceptibility to a strong static field, and also validate the predicted behaviour in experiments carried at 3T using a 40-element structure formed from pieces of pyrolytic graphite sheet.

1156 9:36

A two-stage RF shimming method for 7T human first-pass myocardial perfusion

Yuehui Tao[1], Aaron T. Hess[1], and Matthew D. Robson[1]

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RF shimming usually aims at uniform transmit field. For 7T human first-pass myocardial perfusion, maximizing the lowest transmit field strength is beneficial. The shimming optimization cost function corresponding to the lowest strength is not smooth, leading to impractically long shimming calculation if all transmit magnitudes and phases are optimized simultaneously. We evaluate several optimization strategies for static RF shimming for maximizing the lowest transmit field strength within a practical duration, and propose a two-stage method to accelerate in situ shimming calculation. In our experiments, this proposed method consistently found near optimal solutions in less than 10 seconds.

1157 9:48

Open-source, low-cost, flexible, current feedback-controlled driver circuit for local B0 shim coils and other applications

Nick Arango[1], Jason P Stockmann[2], Thomas Witzel[2,3], Lawrence Wald[2,3], and Jacob White[1]

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We demonstrate a low-cost (<$75/channel), open source, scalable, multi-channel current supply board that can provide up to 8 amps per channel for driving inductive loads such as local B_0 shim coils. The design shows excellent stability while retaining sufficient gain in the audio frequency range to reject disturbances (e.g. gradient switching) and maintain stable output current.