ST 1: Medizinische Bildgebung I

Time: Monday 9:30–13:00 Location: Ch 12.0.16

Invited Talk ST 1.1 Mon 9:30 Ch 12.0.16

Multimodale Medizinische Bildgebung: Integration von Funktion und Morphologie — •Stephan Nekolla — Nuklearmedizinische Klinik der TU München Ismaningerstr. 22 81675 München

Die medizinische Bildgebung hat im Lauf der letzten Dekade entscheidende Impulse aus der Kombination und Integration verschiedener Bildgebungsverfahren erhalten. Insbesondere die Verbindung von Verfahren der morphologischen (*Wo ist was ?*) und funktionellen Bildgebung (*Wie funktioniert was ?*) hat die Treffsicherheit in den Bereichen Neurologie, Kardiologie und vor allem der Onkologie (resp. Tumorbildgebung) entscheidend verbessert. In erster Linie beruhen diese Erfolge auf der Verbesserung von Softwaremethoden zur Bildregistrierung und Bildfusion und insbesondere auf der Integration radiologischer und nuklearmedizinischer Tomographen in eine neue Generation kombinierter Bildgebungssysteme. In diesem Übersichtvortrag werden die prinzipiellen Ansätze beider Methoden vorgestellt und hinsichtlich der technischen und logistischen Anforderungen sowie ihrer Vor- und Nachteile diskutiert.

ST 1.2 Mon 10:00 Ch 12.0.16

Performance results from a high resolution, dual layer LSO-APD PET tomograph for small animals — •Virginia Spanoudaki, Irene Torres-Espallardo, and Sibylle Ziegler — Klinikum rechts der Isar der TU München, Nuklearmedizin, Ismaninger Str 22, 81675, München, Germany

MADPET-II is a high resolution positron emission tomograph aimed at radiopharmaceutical studies in small animals. The detector architecture is based on the individual readout of minute LSO scintillation crystals by Avalanche Photodiodes (APDs). A dual radial detector layer assures uniformity of the spatial resolution along the radial Field of View while maintaining the system's sensitivity. In total, the system consists of 1152 independent electronic channels. The tomograph performs list mode data acquisition, recording the energy and time stamp for every detected singles event. Coincident sorting and system calibration is done post acquisition in software.

The measured mean energy resolution of the system is 22 % and the system-wide time resolution is 9 nsec. The individual detector readout assures a maximum count rate of 10000 cps per channel. First phantom studies exhibit a spatial resolution of 1.25 mm along a central slice of the scanner. For the image reconstruction a 3D MLEM algorithm based on a Monte Carlo System Matrix is used. Results from performance evaluation measurements and the first animal studies will be presented.

ST 1.3 Mon 10:15 Ch 12.0.16

Normalization and Randoms Corrections for MADPET-II small animal PET scanner using Monte Carlo techniques — •Irene Torres-Espallardo[1], Virginia Spanoudaki[1], Magdalena Rafecas[2], and Sibylle Ziegler[1] — [1]Klinikum rechts der Isar der TU München, Ismaningerstr. 22, 81675 München — [2]IFIC, Edificio Institutos de Investigación, Aptdo. Correos 22085, 46071 Valencia, Spain

PET offers the possibility of quantitative measurements of tracer concentration. However, there are several corrections which must be addressed in order to fully exploit this potential. Using Monte-Carlo simulation techniques through GATE software, we are investigating normalization and randoms corrections applied to MADPET-II. In general, corrections are applied before image reconstruction. We want to explore the possibilities of including these corrections as part of the system matrix in an EM algorithm. In order to obtain higher sensitivity, the low energy threshold (LET) should be reduced. In this situation, inter-crystal (IC) scatter takes place (25% at 150 keV LET). We have observed that randoms obtained using standard methods are higher than randoms found in simulation for lower LET (37% increase at 150 keV LET). We are interested to see how this overestimation affects quantification of the images. Related to normalization, we plan to study the feasibility of using singles for estimating the intrinsic efficiencies of the crystals. This would reduce the number of unknowns that must be obtained and the statistics would be increased (measured singles are always higher than coincidences). The time aligment of the channels would be considered as part of the normalization factors.

Invited Talk ST 1.4 Mon 10:30 Ch 12.0.16

Ultraschallanwendungen in der Medizin — •Georg Schmitz — Lehrstuhl für Medizintechnik, Ruhr Universität Bochum

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30 Min break

ST 1.5 Mon 11:30 Ch 12.0.16

Significant influence of ultrasound on the Hahn-echo-amplitude in soft matter — •Ole Oehms, Nouri Elmiladi, André Engelbertz, Bernd Habenstein, Carmen Morar, and Karl Maier — Helmholtz-Institut für Strahlen- und Kernphysik, Bonn

Nuclear Magnetic Resonance (NMR) and Ultrasound (US) are both methods that are very commonly used over decades in medical diagnostics for the visualization of the inner parts of the body. Both methods are highly developed and are close to their physical limits. There are only a few efforts in combining US and NMR in soft matter. A new surprising result is that the Hahn echo amplitude can be dramatically changed by applying low-energetic US-pulses. In this talk the experimental setup for this research is presented and the effect of a variation of the US parameters (pulse length, pulse amplitude, pulse position in the sequence, US-frequency) on the echo-amplitude is demonstrated. According to our present knowledge, a viscous momentum transfer in the medium is responsible for the effect. This novel tool can deliver additional contrasts in magnetic resonance imaging.

ST 1.6 Mon 11:45 Ch 12.0.16

Ultrasound creates Magnetic Resonance Imaging contrast — •Marcus Radicke[1], André Engelbertz[1], Bernd Habenstein[1], Meinert Lewerenz[1], Ole Oehms[1], Peter Trautner[2], and Karl Maier[1] — [1]Helmholtz-Institut für Strahlen- und Kernphysik, Bonn — [2]LIFE & BRAIN GmbH

Magnetic Resonance Imaging is extremely important in medical diagnostics. Image contrasts are based on three mean weightings: T1, T2 and proton density. To emphasise tissue properties magnetic contrast agents are used. The influence of Ultrasonic (US) pulses on a Magnetic Resonance Image sequence enables completely new contrasts that scales e.g. with the viscosity of the tissue. We used a Siemens Avanto 1,5T tomograph at the research centre life & brain in Bonn with standard image sequences combined with US-pulses. Pressure amplitude and pulse length were varied from 0 to 1 bar and 10 to 60ms. Recent experiments on systems having several viscosities and in various geometries are discussed.

ST 1.7 Mon 12:00 Ch 12.0.16

Aging Effects in BOLD MRI of the Human Calf Muscles during Reactive Hyperemia — •Anja-Carina Schulte[1], Hans Peter Ledermann[2], and Deniz Bilecen[2] — [1]Universitätsklinik Ulm, Klinik für Strahlentherapie, Ulm — [2]Universitätsspital Basel, Institut für Diagnostische Radiologie, Basel, Schweiz

The blood oxygenation level-dependent (BOLD) effect that relies on the different magnetic properties of oxy- and deoxyhemoglobine can be applied to measure signal changes in skeletal muscles. This muscle BOLD effect is not yet completely understood but is assumed to primarily reflect blood oxygenation changes at tissue level.*Our study compares the muscle BOLD effect in the calf of 11 elderly and 17 young healthy volunteers during reactive hyperemia, which was provoked by 360 s of suprasystolic thigh compression. A fat-suppressed multi-echo GE-EPI sequence (TR=1 s) was used to acquire 360 s of hyperemia. Our comparison was based on 3 characteristic parameters of the BOLD signal time-course: hyperemia-peak-value, time-to-peak, and end-value.*The BOLD signal rapidly increased after cuff deflation reaching a maximum, which was significantly reduced ($p<0.005$) and earlier ($p<0.05$) in the elderly. After the maximum, the BOLD signal remained rather constant, whereas it nearly returned to baseline in the young ($p<0.001$).*Calf muscle BOLD MRI revealed statistically significant differences. The reduced and shortened increase in elderly reflects decreased oxygenation of muscle tissue probably due to age-related impairment of inflow. The following reduced decrease may be explained by diminished outflow and thus delayed clearance of oxygenated blood.

ST 1.8 Mon 12:15 Ch 12.0.16

Detailed Studies of Proton NMR Relaxation Times in the Presence of Magnetic Nanoparticles — •Christian Höhl[1], Nouri Elmiladi[1], André Engelbertz[1], Maurice Schlichtenmayer[1], Fritz Vögtle[2], and Karl Maier[1] — [1]Helmholtz - Institut für Strahlen- und Kernphysik Bonn — [2]Kekulé-Institut für Organische Chemie und Biochemie Bonn

In magnetic resonance imaging (MRI) small magnetic particles of iron oxide (SPIO) are used as an additional contrast agent. The contrast is obtained by a decrease of the relaxation times T_1 and T_2, varying with the concentration of the SPIO. We did detailed measurements on the influence on T_1 and T_2 in the presence of SPIO at various concentrations and particle sizes. We observed huge differences of $\Delta T_1/\Delta T_2$ at particles sizes between 20nm and 1000nm. The influence of resonant ultrasound pulses on T_1 and T_2 in presence of SPIO is discussed.

Invited Talk ST 1.9 Mon 12:30 Ch 12.0.16

Nuklearmedizinische Kleintierbildgebung — •Klaus Schäfers — Klinik für Nuklearmedizin, Universität Münster

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