Cost B21
Szeged - Hungary 18.-19.03.2005

Plenary Meeting

WG I: Measuring Techniques:

Tissue Parameters and Physiological Data

Objectives of WG I:

- To progress developments in physiologic MRI to maximize diagnostic information
- To carefully study the optimal MR data collection strategies for the interpretation of tissue structure and physiology
- To carefully investigate the dependency of all variables (diffusion, perfusion, BOLD etc.) studied in phantoms, animals, and humans

Goals:

- To design and test reliable and accurate test objects and/or animal models that allow the detailed assess-ment of physiological analysis methods in MRI.
- To simulate tissue-like properties, i.e. NMR relaxation times, diffusion, perfusion etc.
- To test the developed physiological imaging under a range of different MRI measuring sequences and imaging conditions on different scanners throughout the consortium to determine their stability and utility.

Goals:

- To gain a deeper insight into the physics of MR signal formation in living tissues.
- To provide methods to glean information about biological structures below the achievable MRI resolution (~ mm).

Where do we stand ?

- Development and construction of physiological test objects
  capillary phantoms (Jena, Vienna), perfusion phantom (Heidelberg), ...
- Animal studies
  mouse model (Aarhus), mouse and rat (Trondheim, Bergen), high-resolution neuro-imaging (Antwerpen, Belgium) ...
- Development of pulse sequences and imaging protocols
  multi-echo gradient-echo sequence (Jena, Vienna), spin-echo,gradient-echo sequence (Heidelberg), dynamic 3D perfusion sequences (Trondheim) ...
- Testing of different techniques: diffusion, perfusion, BOLD ...
  SWI (Jena, Vienna), Perfusion (Bergen, Trondheim), BOLD-related Imaging (Heidelberg), ^{23} Na Imaging (Vienna, Heidelberg) ...
- Reports and Publications
  upcoming ...

STSM within WG 1:

COST-STSM-B21-00305
High resolution susceptibility weighted imaging at 3 T using a MR-compatible capillary phantom
Jan Sedlacik: Jena - Vienna

COST-STSM-B21-00690
Implementation and testing of a novel high resolution phase unwrapping algorithm
Stefan Witoszynskjy: Vienna - Jena

COST-STSM-B21-00861 :
Modelling of DWI / DTI data and application to in vitro and in vivo experiments
Sune Jespersen: Aarhus - Jena

COST-STSM-B21-... :

Non-STSM funded visits within WG 1:

MR imaging of liver
Dan Jirak: Prague - Jena

STSM between WG 1 and WG 2

Submitted or planned STSM:

Image processing of rat manganese data
N.N.: Bergen - Surrey

Investigation on the influence of scanning protocols to the gradients of higher-order image statistics
Vassili Kovalev: Surrey - Jena

Exploring the feasibility to extract the venous vessel tree from high-resolution SWI data
Andreas Deistung: Jena - Lodz

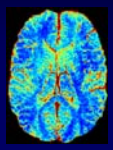
....

What's next ?

Plans for the Action in 2005

Project: Susceptibility Weighted Imaging

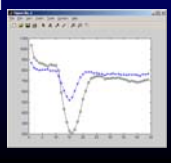
- Further development and testing of phantoms mimicking single vessels and capillary bed for modeling and measuring signal decays at 1.5 T and 3 T or higher fields (7 T ?)
- Improvement of phase processing
- Simulation of signal decays
- Extracting physiological parameters (Y, λ, $\Delta\chi$, ...)
- Challenging the physiology with carbogen, oxygen, caffeine, etc.
- Functional SWI
- Combining SWI with contrast agents (intravascular?)
- Application of the technique to animal models and clinical cases



Project: Perfusion

- Quantification of Flow and Perfusion Parameters Using Phantoms (Schad)
- Optimization of RF-Pulses for Inversion in ASL (Schad)
- Optimization of 3D perfusion sequences (Brekken, Haraldseth)

- Improved Simulation Techniques (Lundervold, Malyshev)
  A tracer kinetic model from first principles applied to MR Perfusion imaging
  Further investigation of a 3D tissue perfusion model
  A Malyshev and A Lundervold (NO)
- Improved Analysis of First-Pass Perfusion Data Based on Sophisticated Statistical Methods (Neuronal Networks) (Jena)



Project: Diffusion

Diffusion Weighted Imaging, Diffusion Tensor Imaging

- optimization of acquisition, minimization of tensor element variation
- combining with other modalities --> MEG, extraction of conductivity tensor
- diffusion spectral imaging ?? (high field machines)
- tractography

COST-STSM-B21-00861

Project: ^{23}Na-Imaging

- high-field applications (3 T) (examples by Vienna-group)
  The use of Na-23 MRI in monitoring cartilage degeneration
  Michal Bittsansky (SK)
- ^{23}Na imaging at 1.5 T (Heidelberg group)
  Radial techniques for sodium magnetic resonance imaging
  Lothar Schad (D)
- application in brain, cartilage, (cardiac)

Project: Spectroscopy

- Quantification of CSI measurements (E. Moser)
- Correlation of Texture Analysis with ^{31}P MR Spectroscopy (M. Hajek)

Challenges

- Phantoms

  capillary phantom modelling the human cerebral vasculature

  perfusion phantom for quantitative evaluation of flow and perfusion parameters

  diffusion phantom mimicking the in vivo situation of fiber tracks and for investigating anisotropy features in a controlled manner

- Refinement between experimental results and simulations
- Transfer of techniques into animal models and clinical applications

Workplan for WG 1 in 2005

- continuing and extending STSMs
- development and construction of physiological test objects
- development of pulse sequences and imaging protocols
- testing of different techniques and linking it to modelling and simulations (WG 2)
- animal studies and clinical applications (WG 3)
- reports and publications

  submission of abstracts (ISMRM 2005, ESMRMB 2005, ...) and manuscripts (e.g., Z Med Phys, JMRI, MRM, MAGMA, ...)
- invitation of an external expert in 2005 ?

Upcoming Contributions ...

- Olav Haraldseth
- Anders Karlsson
- Andres Santos
- Ewald Moser
- Milan Hajek
- .... many, many more

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single voxel - multidimensional data