Applied MR Techniques
Advanced course

Course organiser:
Jacques Bittoun / Paris, FR

September 13–15, 2007
Innsbruck, AT

Local organisers:
Christian Kremser, Werner Jaschke
Innsbruck, AT

Course venue:
Landeskrankenhaus Innsbruck
Anichstraße 35
AT - 6020 Innsbruck

Preliminary faculty:
I. Berry, J. Bittoun, H. Bosmans,
S. Brockstedt, J. Bunke, W. Judmaier
K. Scheffler, Ch. Windischberger

Grants available for
Applied MR Techniques Advanced Course (Innsbruck)
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June 28–30, 2007
Toulouse, FR
(in French language)

Local organiser:
Isabelle Berry / Toulouse, FR

Course venue:
Faculté de Medecine Toulouse-Rangueil
133 route de Narbonne
FR - 31062 Toulouse cedex

Preliminary faculty:
I. Berry, J. Bittoun, H. Bosmans, E. Cassol, O. Clément,
Ph. Douek, J. A. Lotterie, R. Muller, J. Ph. Ranjeva,
H. Saint-Jalmes

The Advanced Course is an intense teaching course deepening all aspects discussed during the Basic Course and adding all new and fast imaging techniques, which are progressively integrated into daily practice. So a profound understanding of k-space, fast and ultrafast imaging techniques, diffusion, fMRI, perfusion and MR angiography are the key focus of the course programme. Participants will not only learn the mechanisms of such imaging strategies but also understand the impact of their parameters on contrast and image quality. Learning capacities are intensified by systematic recapitulation of all learning objectives in small groups together with didactically experienced experts. While lectures range from basic principles to imaging results, repetition cycles will start from images and interpret them back to basic principles. Knowledge of the basic principles of MRI is mandatory to follow the course. Thus participants should have familiarised themselves with these principles either in a Basic Course of the ESMRMB or from other sources. Participants having daily experience in MR imaging of at least 6 months will benefit most from the Advanced Course. If you wish to broaden and deepen your knowledge in the field of advanced MR techniques, the ESMRMB will be happy to welcome you to the Applied MR Techniques Advanced Course.

Participants should be physicians or technicians who have either attended the ESMRMB School of MRI Basic Course or who have acquired basic knowledge in MRI techniques from other sources and are experienced in MRI (6 months minimum).

City-information Toulouse:
France's fourth largest city is renowned for its high-tech industries, especially aerospace. At the same time, it is a lively place with over 110,000 students due to its excellent reputation of its university. Most older buildings in the city centre are in rose-red brick, earning the city its nickname *la ville rose* (the pink city).
Airport: Toulouse, many daily flights to major European cities, excellent connections via Paris
Hotel information: www.esmrmb.org

City-information Innsbruck:
Innsbruck, scenically squeezed in the Alps has been an important trading post since the 12th century and an important seat of the Habsburgs, particularly Maximilian I and Maria Theresia, who established many of the important buildings – first of them of course the Golden Roof! – that survived in the well-preserved old town. Innsbruck is also a popular city to start your skiing or hiking holidays.
Airport: Innsbruck, daily direct connections to Frankfurt, Hamburg, London, Amsterdam, excellent connections via Vienna (6 times daily) worldwide
Hotel information: www.esmrmb.org

Learning objectives

Reminder of the Basic Principles
- Magnetic field – Magnetic moment
- Nuclear spin and nuclear magnetic moment
- Magnetisation of a spin population
- Nuclear Magnetic Resonance (NMR)
- Precession and relaxation – relaxation times
- The NMR signal and its parameters
- Discrimination of space by a magnetic field gradient
- Selective excitation
- Frequency encoding

Theory of k-space
- Fourier transformation of a time signal
- Notion of spatial frequency
- 2D-Fourier transform of an image
- Definition and properties of k-space
- Rules of k-space scanning
- Examples of k-space scanning
- Frequency and phase encoding

Basic Sequences and Contrast
- Spin-echo phenomenon
- Spin-echo sequence, equation and parameters
- Proton density, T1 and T2 weighting
- Gradient echo technique and steady state free precession (SSFP)
- Spoiling techniques and T1 contrast
- Contrast-enhanced-SSFP and T2* contrast
- Saturation pulses

Ultrafast Imaging Part I (Theory of Sequences)
- RARE sequences and contrast
- Hybrid sequences (Half-Fourier, single shot RARE)
- Singleshot and segmented ultrafast sequences (Echoplanar, spiral...)
- Parallel imaging: parallel coils, calibration, reconstruction in real space or k-space, acceleration factor and signal-to-noise ratio

Ultrafast Imaging Part II (Application)
- Use of RARE sequences
- IR-based RARE sequences
- Hybrid sequences for clinical MRI
- Clinical use of conventional and EPI based GRE sequences
- Clinical use of parallel imaging

Contrast Agents
- Basic principles of T1 and T2 modification
- Different classes of contrast agents
- Molecules and chelates
- Doses and effects
- Main classes of application

MR Angiography
- Flow phenomena in MRI: time of flight, phase
- Time of flight (TOF) MR angiography
- Phase contrast MR angiography and velocity mapping
- MR angiography using contrast agents:
  · Principles
  · Fast 3D imaging
  · Synchronisation of imaging and injection
  · Methods of bolus chasing
  · Optimisation and k-space

Diffusion and Perfusion
- Principles of diffusion imaging
- Significance of the diffusion tensor
- Main applications of diffusion imaging (fibril orientation, stroke…)
- Principles of perfusion imaging
- Methods of perfusion imaging using a contrast bolus
- Methods of perfusion imaging using saturation pulses
- Main applications of perfusion imaging

Functional Brain MRI
- Physiological bases of brain activation
- Hemoglobin and T2*: BOLD contrast
- Block and event-like paradigms of activation
- Image processing methods
- Overview of the main results obtained by fMRI of the brain
- Using the BOLD-effect for pharmacological research

Perspectives: Overview about other Contrast Techniques
- Magnetisation transfer
- Elasticity imaging
- Imaging of hyperpolarised gases
- Imaging of other nuclei
- Interventional MRI
- MR imaging and spectroscopy at 3T and above