

DIFFUSION IMAGING: FROM PHYSICS TO PHYSIOLOGY

ESMRMB EDUCATIONAL PROGRAM

14-16 OCTOBER 2010
WORCESTER COLLEGE, OXFORD, UK

THURSDAY, 14 OCTOBER 2010 DIFFUSION IMAGING TECHNIQUES

09:00-10:00

Introduction to diffusion imaging

Derek K Jones, Cardiff

- Diffusion in tissue: a qualitative description
- ADC, b-value and the diffusion tensor
- Basic experiment types: trace, multiple directions, multiple diffusion times
- Examples of key applications

10:00-11:00

Basic acquisition techniques

Karla L Miller, Oxford

- Diffusion-encoding gradients
- Single-shot, multi-shot & navigated sequences
- Parallel imaging
- Eddy-current compensation

Coffee/Tea (30 minutes)

11:30-12:30

Data in practice: Artifacts, confounds and pitfalls

Derek K Jones, Cardiff

- Artifacts: ghosting, distortion, chemical shift, eddy currents, cardiac pulsation
- Optimizing diffusion measurements: b-value, directions, resolution, SNR
- Pitfalls in analysis: pre-processing, parameter estimation
- Pitfalls in interpretation: what can be inferred from diffusion data?

Lunch (1 hour)

13:30-14:30

Advanced acquisition techniques

Klaus Scheffler, Basel

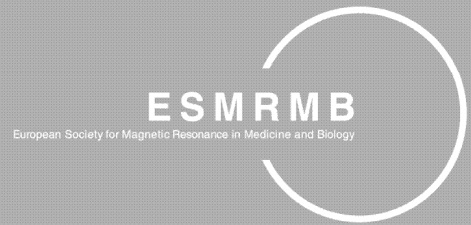
- Stimulated echoes, SSFP and hyperechoes
- Double wave vector encoding
- Influence of diffusion on sequences not intended for diffusion imaging

Coffee/Tea (30 minutes)

15:00-16:30

Lectures on MR

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Exercises: Data acquisition **Day 1 Lecturers**

16:30-17:30

Plenary: Diffusion and microstructure: What are we measuring? **Christian Beaulieu, Alberta**

- White matter microstructure: key players in diffusion
- Sources of diffusion anisotropy
- Restricted and hindered diffusion: the tissue perspective

Welcome Dinner

FRIDAY, 15 OCTOBER 2010 **DIFFUSION MODELING AND ANALYSIS**

09:00-10:00

Models of tissue orientation **Saad Jbabdi, Oxford**

- The tensor model and its limitations
- Higher order and multiple tensors
- "Model-free" methods

10:00-11:00

Fibre tractography **Geoffrey Parker, Manchester**

- Deterministic tractography
- Uncertainty and probabilistic tractography
- Multi-fibre methods
- Validation

Coffee/Tea (30 minutes)

11:30-12:30

Exercises: Orientation and tractography **Day 2 Lecturers**

Lunch (1 hour)

13:30-14:30

Models of tissue microstructure **Valerij Kiselev, Freiburg**

- The diffusion propagator, diffusion time and q
- Non-Gaussian diffusion and cumulants
- Models of restricted and hindered diffusion
- Lessons from Monte Carlo simulations

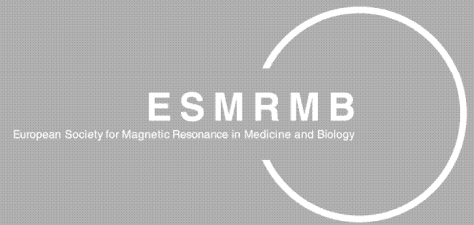
14:30-15:30

Extracting microstructural parameters **Daniel Alexander, University College London**

- Microstructure models in practice
- Experimental requirements
- Sequence optimization

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Coffee/Tea (30 minutes)

16:00-17:00

Exercises: Diffusion and microstructure

Day 2 Lecturers

17:00-18:00

Plenary: What unique insights can diffusion MRI offer?

Denis Le Bihan, Orsay

- Water transport: what can it tell us about the brain?
- The role of water in neuronal architecture and function
- Perspectives and future possibilities for diffusion MRI

SATURDAY, 16 OCTOBER 2010 DIFFUSION IMAGING IN THE NEUROSCIENCES

09:00-10:00

Voxel-wise analysis of diffusion data

Stephen M Smith, Oxford

- Voxel-wise regression analysis and registration confounds
- Local estimation of diffusion-derived parameters
- Interpretation, confounds and future directions

10:00-10:30

Diffusion imaging in basic neuroscience

Timothy EJ Behrens, Oxford and University College London

10:30-11:00

Diffusion imaging in anatomical investigations

Marco Catani, Institute of Psychiatry

Coffee/Tea (30 minutes)

11:30-12:00

Diffusion imaging of development, learning and recovery

Heidi Johansen-Berg, Oxford

12:00-12:30

Diffusion imaging in clinical neuroscience

Chris Clark, University College London

12:30-13:00

Panel discussion: The present and future role of diffusion in neuroscience

Day 3 Lecturers

Adjourn