

MR Diffusion Imaging: From the Basics to Advanced Applications

Organizers:

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Diffusion weighted imaging (DWI) is a non-invasive MRI technique that is sensitive to the micro-structure and the structural connectivity of the brain. Recent technological advancements in commercially available MR scanners has enabled a large number of neuroscientists and clinicians to acquire advanced diffusion-weighted data of very high quality but has made also this a very fast evolving field of neuroimaging. To fully exploit all the opportunities given by these new technologies it is therefore essential to fully understand what are the main strategies to acquire, process and analyse diffusion imaging data. By following an ideal diffusion imaging pipeline, all lectures will review the current state of the art of diffusion imaging methods and the possible pitfalls and limitations that need to be taken into account before getting to the final results. Examples will be provided on how advanced analysis methods benefit from the technological advancements in data acquisition and how these analysis methods help to address relevant clinical and scientific questions ranging from brain plasticity, development, brain disorders or neurodegeneration. The course will also present techniques for investigating the microstructure properties in white and gray matter tissue within and across brains. At a systems level, the course will demonstrate techniques for diffusion-based connectomics analyses and parcellations of the human cortex. Finally, the course will try to link structural connectivity with functional MRI and quantitative MRI. Each technique will be presented by practical examples and dedicated time will be allocated for discussion with the audience.

Course Schedule

8:00- 8:40

Diffusion MRI data acquisition

Karla Miller, University of Oxford, Oxford, United Kingdom

8:40- 9:10

Methodological considerations on analyzing diffusion MRI data

Alexander Leemans, Image Sciences Institute – UMC Utrecht, Netherlands

9:10-9:50

Diffusion imaging models 1: from DTI to HARDI models

Flavio Dell'Acqua, King's College London, London, United Kingdom

9:50 – 10:30

Break

10:30-11:10

Diffusion imaging models 2: from DTI to microstructure quantification

Gary Zhang, University College London, London, United Kingdom

11:10-11:50

Diffusion tractography

Maxime Descoteaux, Université de Sherbrooke, Sherbrooke, Canada

11:50-12:00

Q & A / Discussion

12:00-13:00

Lunch

13:00-13:40

Preclinical and Post-Mortem Diffusion Imaging

Tim Dyrby, Danish Research Centre for Magnetic Resonance, Copenhagen, Denmark

13:40-14:10

Group comparison with diffusion imaging and application to brain plasticity

Anton Beer, Universität Regensburg, Regensburg, Germany

14:10-14:50

Connectomics analysis and Parcellation of the brain based on diffusion-weighted fiber tractography

Alfred Anwander, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

14:50-15:20

Break

15:20-15:50

Combining quantitative MRI measures to model brain development

Jason Yeatman, University of Washington, Seattle, United States

15:50-16:30

Track-weighted functional connectivity: structure meets function

Fernando Calamante, The Florey Institute of Neuroscience and Mental Health, Melbourne, Australia