

Validating MRI-based biophysical models with gold standard histology: potentials and limitations

Organizer:

Nikolaus Weiskopf

Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany

Recent breakthroughs in MRI methodology and biophysical modelling of the MR signal brought quantitative in vivo MRI markers with sub-millimeter resolution and high specificity to microscopic tissue compartments within reach (e.g. MRI markers for myelin, axon, or iron concentration). However, ex vivo histology remains the gold standard against which these MRI markers have to be validated before they can be reliably used for clinical research or studying neuroscientific questions. Today, several challenges need to be overcome to achieve quantitative validation of these MRI markers: (i) understanding and modelling the changes occurring post mortem, e.g. autolysis, temperature changes and fixation, which significantly alter the MRI signal and the tissue morphology, (ii) accounting for the scale gap between histological methods, which is typically performed on small 2D sections of tissue (millimeters to few centimeters) with a microscopic resolution (~ 1 micron), and macroscopic MRI, which is performed on the whole three-dimensional brain at a macroscopic resolution (~ 1 millimeter), (iii) finding the most reliable, reproducible, and quantitative histological techniques to serve as the gold standard measurement tools for automated quantification of tissue compartments, ideally over the entire brain. This symposium is comprised of four lectures that introduce a broad range of promising methods to tackle these challenges.

Symposia Schedule:

14:45-15:00

Quantitative iron mapping and 3D histology for quantitative MRI

Evgeniya Kirilina, Department of Neurophysics, Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany / Center for Cognitive Neuroscience Berlin, Free University Berlin, Berlin, Germany

15:00-15:15

Histological validation of myelin biomarkers in white matter

Nikola Stikov, École Polytechnique, Université de Montréal, Montreal, Canada

15:15-15:30

Volumetric mapping of cyto- and myelo-architectural features and fiber axis orientation with polarization sensitive optical coherence tomography

David Boas, The Optics Division, Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Boston, United States

15:30-15:45

From in vivo to ex vivo: the effect of autolysis and fixation on quantitative MRI markers

Gunther Helms, Department of Clinical Sciences, Lund University, Lund, Sweden

15:45-16:00

Questions and Answers