MAX PLANCK INSTITUTE
FOR HUMAN COGNITIVE AND BRAIN SCIENCES

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Zoom Meeting

Institute Colloquium

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Characterisation of microstructural properties of the human corpus callosum based on light and electron microscopy images

Have you ever wondered what is actually inside all those magnetic resonance imaging (MRI) voxels you are looking at? In white matter axons and their lipid-rich insulation, i.e. myelin sheaths, are the main components of the microstructural composition. Structure determines function, that is axon diameters and their myelination contribute considerably to signal propagation times between different brain areas and are thus crucial for function and brain connectivity. Novel biophysical models aim to estimate axonal diameter and g-ratio (the ratio of the outer to the inner diameter of a myelinated axon) from in vivo MRI data. However, these MRI-based models are controversial, still under development and need validation by comparison to gold-standard references. Anatomical reference data in ex vivo human tissue is frequently based on a small field of view microscopy image (30x30µm) from a region of interest (ROI) and might not be representative of the axon-ensemble measured within typical in vivo MRI-voxel cross-sections (1-2mm). In this talk I will present reference data from large field of view electron microscopy images (120x120µm) and high-resolution light microscopy images (4x4mm) from 19 ROIs within the human corpus callosum, I will also show how microstructural properties derived from these data i.e. the axon diameter, g-ratio, myelin volume fraction, and axon volume fraction vary within and between ROIs of the corpus callosum, and different subjects. Particularly ROIs with axons from a variety of functionally diverse grey matter regions show a higher variability in those measurements, showing that small field of view reference data might not be sufficient to represent an ROI.