Master project

Diffusion MRI: a non-invasive microscope into brain disease

During an MRI experiment, water molecules in the brain diffuse over a few microns - a distance on the same order as major microstructural features of the tissue - and their mobility is largely governed by restrictions and hindrances related to the tissue architecture. In other words, the diffusion-weighted signal encodes information about length scales much smaller than the actual MR image resolution of millimeters, and thus about features of the underlying tissue microstructure that lie in the mesoscale and that we otherwise cannot spatially resolve in vivo.

Our group combines the sensitivity of the diffusion-weighted signal to tissue microstructure with biophysical modeling to:

- Infer properties of brain tissue microstructure such as axonal/neurite density, compartment diffusivities and membrane permeability. Goal: bring MRI to the level of a non-invasive in vivo microscope
- Apply these tools to inform about specific features of healthy and diseased tissue, and thereby identify biomarkers of disease progression and response to treatment.

The project will involve the translation and validation of biophysical models of brain tissue to characterize neurodegeneration in datasets of healthy and diseased brain.

Figure 1: Biophysical models of brain tissue are required to extract specific and relevant information about tissue microstructure from the diffusion MRI signal.

References


Main supervisor
Ileana Jelescu, Research Staff Scientist, CIBM MRI EPFL AIT Section, ileana.jelescu@epfl.ch

Collaborators
Kim Do, Professor, Center for Psychiatric Neurosciences, CHUV, kim.do@chuv.ch
Valerio Zerbi, Group Leader, Neural Control of Movement Lab, ETHZ, valerio.zerbi@hest.ethz.ch

Qualification, previous experience and background
This master project is suitable for students with a background in physics, engineering or data science, and with an interest in biomedical imaging and data analysis.

Requested Skills
Previous programming experience (Matlab, Python, bash...)

Desirable
Experience with medical image analysis tools or image visualization tools.

How to apply: Please send your CV and motivation letter to the main supervisor: ileana.jelescu@epfl.ch

About CIBM
The CIBM Center for Biomedical Imaging was founded in 2004 and is the result of a major research and teaching initiative of the partners in the Science-Vie-Société (SVS) project between the Ecole Polytechnique Fédérale de Lausanne (EPFL), the Université de Lausanne (UNIL), Université de Genève (UNIGE), the Hôpitaux Universitaires de Genève (HUG) and the Centre Hospitalier Universitaire Vaudois (CHUV), with the generous support from the Fondation Leenaards and Fondation Louis-Jeantet.
CIBM brings together highly qualified, diverse, complementary and multidisciplinary groups of people with common interest in biomedical imaging.

We welcome you in joining the CIBM Community.