Master or Semester project

Location : EPFL AVP-CP CIBM-AIT, Bâtiment CH F.
Dates: Spring/Autumn 2022 or 2023
Duration: 4 – 6 months.

Brain microstructure, modelling of diffusion MRI and MRS at 14.1T: application in type C hepatic encephalopathy

Type C hepatic encephalopathy (HE) is a severe complication of chronic liver disease leading to brain metabolic and cognitive dysfunctions. At the biochemical level, glutamine (Gln) accumulates in the brain[1]. The direct consequences of this accumulation on cellular structures are of key importance for disease understanding and diagnosis but remain unexplored *in vivo*. In this project, we will test whether the excessive synthesis of Gln results in microstructure alteration, involving astrocyte and neuronal changes, in the cerebellum of a rat model of type C HE.

Diffusion magnetic resonance imaging (MRI) or spectroscopy (MRS) allow one to measure the diffusion properties of molecules[2] (water for MRI and metabolites for MRS), which are linked to the geometry of the cellular compartment in which they are found. Because metabolites are located within specific cells in the gray matter and water both in the intra and extracellular space in the gray and white matter, a dual modeling of diffusion MRI and MRS could provide complementary information on the cerebellar structure at the cellular scale.

The aims of this project will be first to develop a biophysical model to be fitted to *in vivo* diffusion MRI and MRS data acquired at 14.1T in control rats and second, to compare model-estimated parameters (such as the cell-body radius, the fraction of intra/extra cellular water…) between control and sick rats and confirm or infirm the hypothesis of microstructure alteration in HE.

The project will involve data processing and modelling. The student involved can also participate during the MRI/MRS experiments.

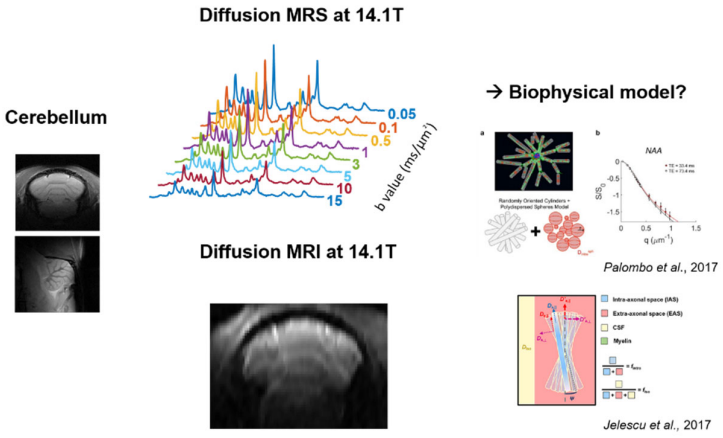

Figure 1: Paradigm of the project and example diffusion MRS and MRI acquisitions 14.1T in the cerebellum of a rat model of type C HE

References

[1] Braissant, O. et al. Longitudinal neurometabolic changes in the hippocampus of a rat model of chronic hepatic encephalopathy. *J. Hepatol.* **71**, 505–515 (2019)
[2] Basser, P. J., et al. MR Diffusion Tensor Spectroscopy and Imaging. *Biophysical Journal* **66**, no 1 (1994)

Supervisors

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Skills

This project is suitable for students with a background/knowledge in physics or biomedical physics, signal processing, machine learning or computer science who are interested in biomedical applications of magnetic resonance imaging (MRI), and image processing. Experience in programming (Matlab and/or Python), machine learning & image processing is desirable.

How to apply:

Please send your CV and motivation letter: cristina.cudalbu@epfl.ch, and jessie.mosso@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.

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