

Master or Semester project

Location: EPFL AVP-CP CIBM-AIT, Bâtiment CH F.

Dates/Duration: spring 2024 – 4-6 months.

Automatic quality control for metabolic imaging using advanced machine learning approaches

CIBM MRI EPFL has high-end multimodal imaging infrastructure allowing the development of cutting-edge acquisition and processing techniques in preclinical imaging, being thus an international leader in preclinical MRI and MRS at UHF.

Proton magnetic resonance spectroscopic imaging 1H-MRSI is a powerful tool that allows the in vivo acquisition of MR spectra from multiple spatial positions simultaneously. 1H-FID-MRSI sequences has seen an increased usage in clinical setting at ultra-high field, leading to successful investigations of numerous neurodegenerative pathologies and psychiatric disorders. However, 1H-FID-MRSI has not yet been implemented in preclinical context due to highly challenging issues such as the low concentration of metabolites, low signal-to-noise ratio (SNR), long measurement times and advanced pulse sequences and processing methods that need to be implemented. Furthermore, an increase number of spectra are acquired in each scan (more than 900) which need to be processed. Among these acquired individual spectra an important number will contain artifacts due to lipid contamination, poor B0 shimming, water suppression, etc. As such, there is a need for a good preprocessing pipeline which would filter out the bad quality spectra prior to the quantification step.

Therefore, we aim to implement an automated pipeline, based on an ensemble of deep learning (DL) classifiers for an automatic quality control in MRSI spectra acquired at 14.1T in the rat brain. Building upon a previous work were a Multi Layer Perceptron (MLP) was implemented, this project aims at integrating more advanced unsupervised DL models as well as exploring data augmentation methods that will be able to cope with the lack of labelled data as well as the extremely imbalanced data that may lead to biased predictions.

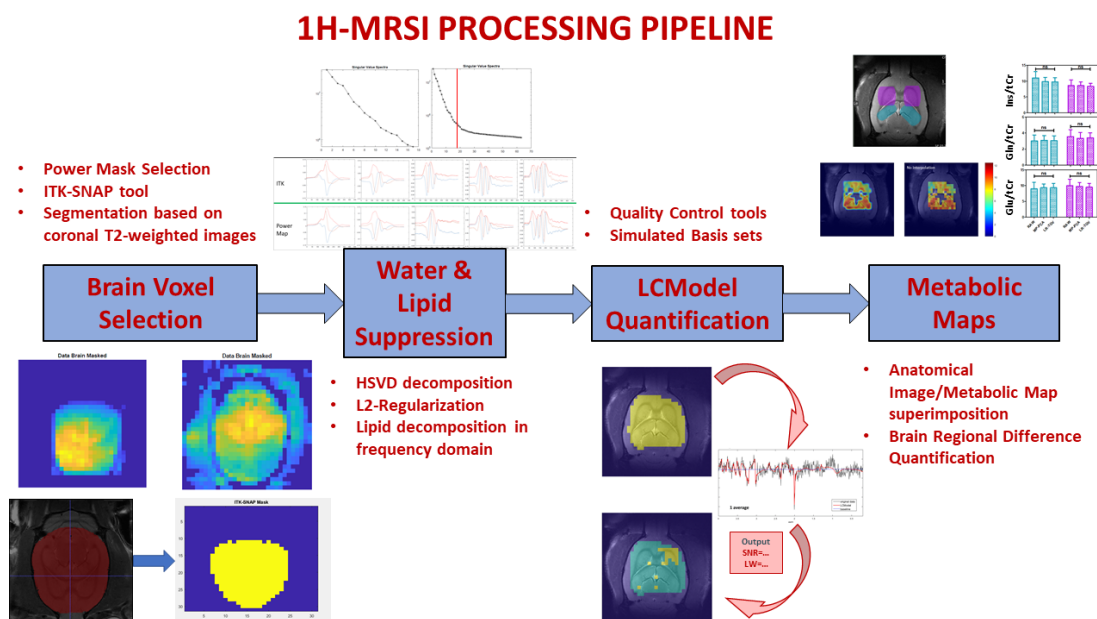


Figure 1: Schematic view of our existing pipeline for preclinical proton MRSI processing with some detailed examples of acquired data and their processing. This pipeline will be enriched with the automatic quality control steps which will be implemented in this project.

Supervisor

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- Brayan Alves, CIBM MRI EPFL AIT, brayan.alves@epfl.ch
- Dr. Elda Fischi-Gomez, CIBM SP CHUV EPFL, elda.fischi@epfl.ch

Skills

Qualifications, previous experience and background: 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, brayan.alves@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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