Master or Semester project

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

Dates/Duration: Autumn 2024/Spring 2025 – 4-6 months.

Noise-reduction techniques for Magnetic Resonance Spectroscopic Imaging

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 (Magnetic Resonance Imaging) and MRS (Magnetic Resonance Spectroscopy) at UHF.

Proton magnetic resonance spectroscopic imaging (1H-MRSI) is a powerful tool that enables the multidimensional non-invasive mapping of the neurochemical profile at high-resolution over the entire brain. The constant demand for higher spatial resolution in 1H-MRSI led to increased interest in post-processing-based denoising methods aimed at reducing noise variance. We have recently implemented two noise-reduction techniques, the Marchenko-Pastur principal component analysis (MP-PCA) based denoising and the low-rank total generalized variation (LR-TGV) reconstruction, and to test their potential and impact on preclinical 14.1T fast in vivo 1H-FID-MRSI datasets together with Monte Carlo simulations ([2309.11204] Noise-reduction techniques for 1H-FID-MRSI at 14.1T: Monte-Carlo validation & in vivo application (arxiv.org)).

The current project aims at further develop/test these two denoising techniques on FID-MRSI data sets (proton, deuterium, phosphorous) by implementing a sliding window as done for diffusion MRI datasets (https://pubmed.ncbi.nlm.nih.gov/27523449/).

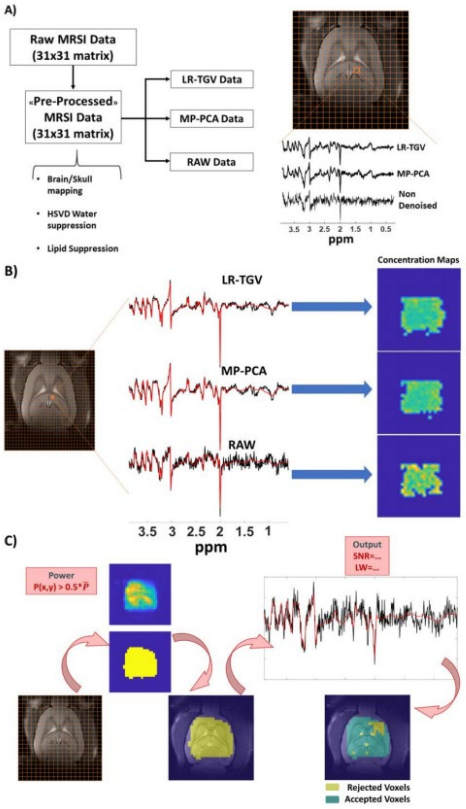

Figure 1: A) Sketch of the processing pipeline used for this study. B) Output in vivo spectra after LCModel quantification. The concentration results are then transferred in 31×31 matrices to represent the MRSI slice. C) Quality control process.

The first step uses the water power mask calculated during pre-processing. The SNR and FWHM (LW-linewidth) criteria estimated by LCModel are then used to generate a "quality control" mask.

Supervisor

- Dr. Cristina Cudalbu, CIBM MRI EPFL AIT, https://cibm.ch/people/, cristina.cudalbu@epfl.ch
- Brayan Alves, CIBM MRI EPFL AIT, brayan.alves@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. Students should be enrolled in one of the partner institutions (EPFL, UNIGE, UNIL).

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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