

# Master or Semester project

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

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

## MRS4Brain Toolbox: an harmonized and accessible workflow for preclinical MRSI data processing

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.

The development of MRS toolboxes has arisen due to expert consensus recommendations, driven by the necessity for harmonizing the steps involved in reconstruction, preprocessing, fitting and quantification of MRS data. In the clinical realm, the diversity of available software is valuable (Osprey, Fid-A, FSL, Gannet, Oryx-MRSI, MRSpa, ...). However, for preclinical studies, there is still a notable absence of harmonized software, especially in the MR spectroscopic imaging (MRSI) context. 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. However, MRSI acquisitions are characterized by a huge amount of spectra acquired at once, low SNR due to smaller voxel size, possible lipid contaminations and distortions due to imperfect water suppression.

The *MRS4Brain Toolbox* ([MRS4Brain toolbox – MRS4BRAIN - EPFL](#)) was designed to offer advanced functionalities for Bruker preclinical MRSI data, encompassing preprocessing, fitting, quantification, semi-automatic quality control, co-registration and segmentation of metabolic maps using anatomical images, statistical analysis all conveniently integrated within a single open-source graphical user interface (GUI) ([LIVE Demos – MRS4BRAIN - EPFL](#)). In addition to its MRSI capabilities, the toolbox accommodates the processing of SVS and diffusion MRS data, each with its own specialized analysis workflow and supplementary features like biophysical modeling. The development of this user-friendly toolbox aims to streamline the processing workflow and enhance the accessibility of MRSI for researchers in the preclinical field.

The current project aims at further developing the *MRS4Brain toolbox* by implementing additional modules like compressed sensing and low rank reconstruction, MP-PCA denoising, X-nuclei workflow, together with the combination with other multimodal approaches (e.g. PET) for advanced metabolic imaging applications.

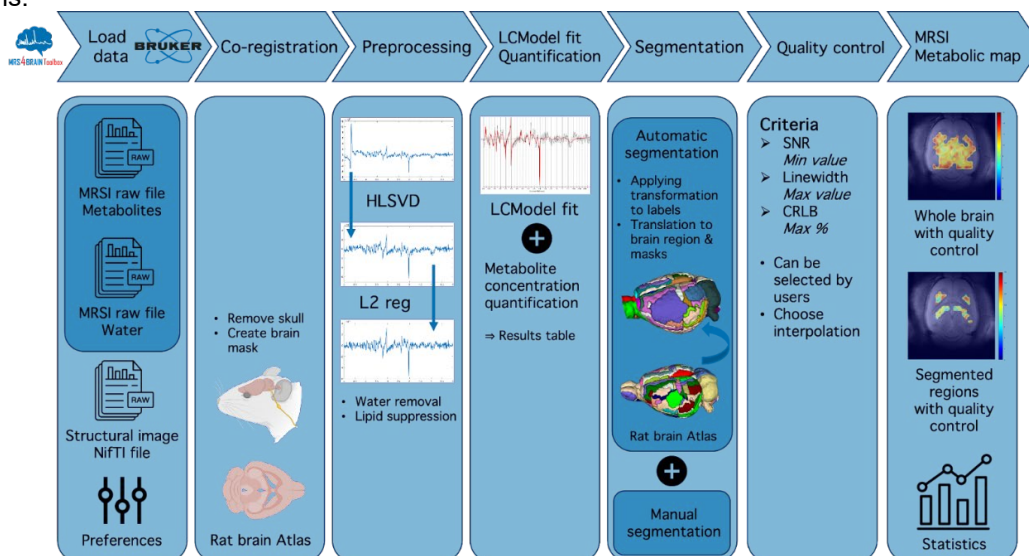


Figure 1: MRS4Brain Toolbox featuring the MRSI processing workflow with the key steps: loading data from Bruker (metabolites, water, MRI image), co-registration with an in-house developed brain atlas, preprocessing (HLSVD, L2 regularization), spectral fitting, quantification, quality controls (SNR, FWHM, ...), segmentation with atlas labels, metabolic mapping.

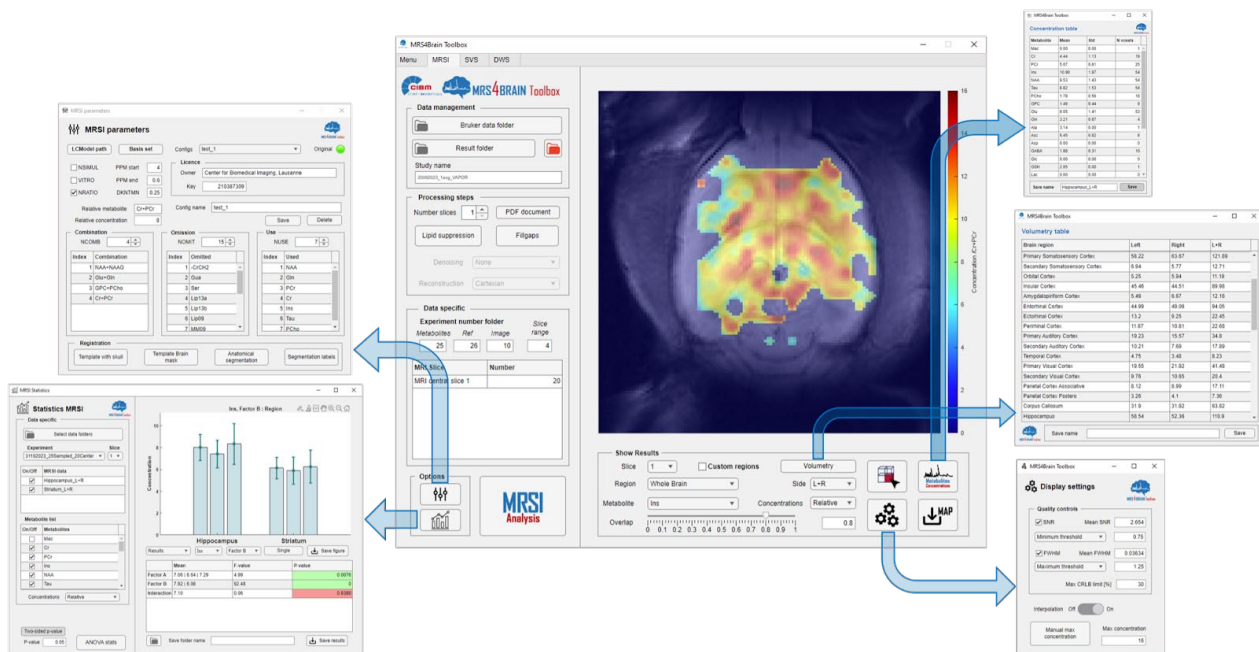


Figure 2: MRS4Brain Toolbox with MRSI functionalities.

## Supervisor

- Dr. Cristina Cudalbu, CIBM MRI EPFL AIT, <https://cibm.ch/people/>, [cristina.cudalbu@epfl.ch](mailto:cristina.cudalbu@epfl.ch)
- Brayan Alves, CIBM MRI EPFL AIT, [brayan.alves@epfl.ch](mailto: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](mailto:cristina.cudalbu@epfl.ch), [brayan.alves@epfl.ch](mailto: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.**

[cibm.ch](http://cibm.ch)