Universitat Pompeu Fabra Barcelona

Master in Bioinformatics for Health Sciences

Master project 2024-2025

Personal Information

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Project

Computational systems biology

Project Title:

Quantitative Susceptibility Mapping in Neurodegenerative Diseases

Keywords:

Quantitative Susceptibility Mapping, Neurodegenerative Disorders, Neuroimaging, MRI, Preprocessing pipeline

Summary:

Quantitative Susceptibility Mapping (QSM) is a novel MRI technique that provides information about the magnetic susceptibility of tissues, and is used to detect iron deposits in the brain. Cortical iron deposits have been associated with pathological changes in neurodegenerative diseases, including deposition of pathological proteins and cognitive decline. However, the use of QSM in neurodegenerative diseases is still in its earliest stages and the preprocessing pipeline needs to be optimized to facilitate its potential clinical use. The aim of this project is to implement and compare different pipelines to preprocess QSM in the context of different neurodegenerative diseases, including Alzheimer's disease, Lewy body and frontotemporal lobe dementias. This will include to compare the accuracy and reliability of QSM metrics extracted using distinct preprocessing, pipelines, assess their ability to distinguish different neurodegenerative diseases, and establish their relationship with pathological markers using the data from >200 individuals. Specifically, the master student will: (1) Acquire knowledge about the pathophysiology of different neurodegenerative diseases in a highly interdisciplinary environment (e.g., alongside PhD researchers, engineers, neurologists, neuropsychologists, nurses, and biologists). (2) Learn about the principles underlying Quantitative Susceptibility Mapping (QSM). (3) Contribute to the implementation of state-of-art preprocessing pipelines for QSM adapted to different diseases. (4) Learn programming skills (e.g., R, Python, Matlab) to manipulate data, display results and perform descriptive and inferential statistics (e.g., two-sample t-tests, regressions, linear models). Note that other projects related to neuroimaging in neurodegenerative diseases are also available. Please contact us if you would like additional information.

References:

10.1186/s12868-022-00725-9; 10.3389/fnins.2021; 10.1016/j.neuroimage.2020

Expected skills:

Ability to interact in English, interest about the brain and neurosciences, curiosity regarding neurodegenerative diseases.

Possibility of funding:

No

Possible continuity with PhD:

To be discussed

Comments:

(1) Possibility of hybrid work: Yes (2) Remuneration: No. But the Memory Unit provides a highly stimulating research environment with interaction with clinicians, researchers, biologists, etc., as well as a wide range of opportunities including attending clinical activities and weekly scientific session. (3) A previous student from the MSc in Bioinformatics for Health Sciences is doing the PhD with us, and another is planning to start the PhD: they will be available to help with specific questions related to the project and team. (4) Focus on producing publishable work by the end of the TFM that will strengthen applications for a PhD or other research-related work. (5) Vibrant and collaborative working environment.