Master 2 Internship

Evaluation of the impact of the change of MRI scanner on the quality of acquired images

Duration: 5 to 6 month, starting in early 2023

Salary: around 550 euros/month + financial help for lunches (cost of a full meal ~2€50)

Location: Empenn team (Inria/IRISA, UMR CNRS 6074), located at IRISA, Campus de Beaulieu, Rennes (France).

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Keywords: Medical imaging, MRI, image processing, statistics

Context and motivation

Magnetic resonance imaging (MRI) is nowadays a tool of choice for the diagnosis of various brain diseases such as multiple sclerosis (MS). This autoimmune disease is characterised by the appearance of lesions visible on MRI in the brain and spinal cord. MRI allows the temporal evolution of these lesions to be imaged, as well as different characteristics of the tissues, such as the myelin content (a sheath wrapped around axons and neurons), which can be quantified with magnetization transfer or the cortical thickness (Figure 1).

In this context, the Empenn team has set up a research protocol called "EMISEP" in which MS patients undergo an MRI scan every year. The objective of this protocol is to study the evolution of the disease over 5 years in order to better understand the evolution of the lesions observed on MRI. A major feature of this project is the annual acquisition of images of the brain but also of the spinal cord, the latter being more rarely studied. First results related to data from the first two years of follow-up have already been published by our group [1, 2].

In the third year of patient follow-up, a change of MRI scanner was made in the image acquisition centre. This change has an influence on the quality of the acquired images (signal to noise ratio, signal stability, etc.). In order to study the impact of this change on the biomarkers extracted from the imaging (in particular, cortical thickness and magnetization transfer), healthy subjects were scanned on the two MRI scanners. Analysis of these data will test whether the images from the two scanners are comparable and could be included in the same statistical models or whether corrections are needed to account for the change of scanner.

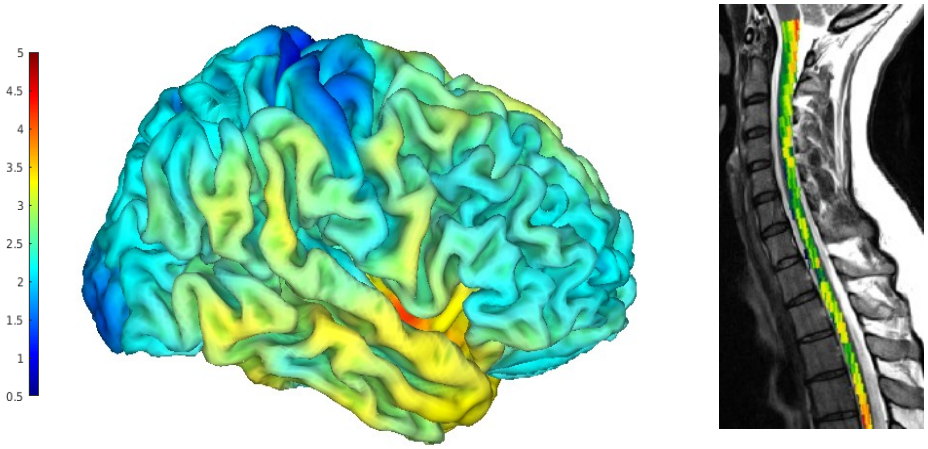

***Figure 1**: Example of cortical thickness in right hemisphere (left) and of magnetization transfer in the spinal cord (right) in a patient with MS*

Project

The objective of this internship will be to become familiar with MRI data, the different sequences produced with MRI, in particular T1-weighted and magnetization transfer images, and to process these images in order to understand the different biomarkers that can be extracted. Then, the data before and after the change of machines will be compared using evaluation measures that the student will have set up. Finally, and depending on the progress of the student and the results of the previous questions, corrections of variability between machines could be studied by the student and applied to the MS patient data.

The results of this internship will have a direct impact on the research of the Empenn team by providing answers to questions of researchers about the impact of changing MRI machines.

The student will manipulate medical image processing and statistical tools developed within Empenn (Anima, MedInria) or in other laboratories (SPM, FSL or SCT for the spinal cord). Depending on the student's knowledge and wishes, additional tools may be developed to facilitate processing (automation) and to evaluate the comparison of images before/after changing the machine.

Pre-requisites

Programming (notably Python, R, bash) and basic statistics knowledge is a plus but not mandatory.

The student will have to show scientific curiosity, especially for neuro-imaging, strength of proposal, autonomy and organisation.

How to apply?

Send your CV and a motivation letter to both contacts (see above)

References

[1] Combès B, Kerbrat A, Ferré JC, et al. Focal and diffuse cervical spinal cord damage in patients
with early relapsing–remitting MS: a multicentre magnetisation transfer ratio study. Mult Scler 2018; 1352458518781999.

[2] Combès B, Monteau L, Bannier E, et al. Measurement of magnetization transfer ratio (MTR) from cervical spinal cord: multi-center reproducibility and variability. J Magn Reson Imaging. 2019;49:1777-1785.