Internship Proposal

Reproducible segmentation of white matter tractograms using artificial intelligence and spatial fuzzy sets

Keywords: Segmentation, white matter tractograms, artificial intelligence, mathematical modeling and fuzzy set theory

Context Tractography from diffusion magnetic resonance imaging is the only non-invasive technique capable to trace in vivo the wiring architecture of the human brain white matter. It is widely employed for both clinical and research purposes. It produces millions of 3D polylines, usually called fibers, which are estimates of the trajectories of large groups of neural axons.

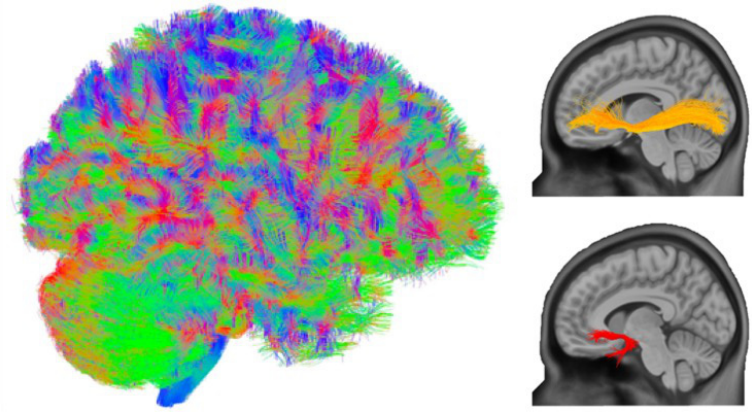

Figure 1: Example of whole brain tractogram and segmentation of two brain tracts.

In many cases, clinicians or researchers want to isolate precise white matter tracts in order to test hypotheses related to a certain condition or pathology. Segmenting white matter tractograsms into anatomically-relevant and reproducible tracts is a difficult task. The huge number of fibers makes it computationally expensive and the anatomical definition of a tract is mostly qualitative.

Objectives The goal of the internship will be to to incorporate qualitative anatomical definitions into a multi-resolution segmentation algorithm using the theory of fuzzy sets. The internship will be based on previous works of the team [1–3] and several research directions are possible depending on the background of the student.

Starting date First semester 2019

Required background Master student in applied mathematics, computer science, engineering and with a strong interest in medical imaging.

How to apply Candidates are invited to send a CV to pietro.gori@telecom-paristech.fr and isabelle.bloch@telecom-paristech.fr detailing their academic background with courses and grades.

References

[1] Delmonte, A., et al. Segmentation of white matter tractograms using fuzzy spatial relations. *Organization for Human Brain Mapping* (2018). 1

[2] Gori, P., et al. Parsimonious Approximation of Streamline Trajectories in White Matter Fiber Bundles. *IEEE Transactions on Medical Imaging* (2016). 1

[3] Mercier, C., et al. Progressive and efficient multi-resolution representations for brain tractograms. *Eurographics Workshop on Visual Computing for Biology and Medicine (EG VCBM)* (2018). 1