Master 2 internship

Automatic segmentation of cerebral structures in functional Magnetic Resonance and optical images for the analysis of functional connectivity at rest in intraoperative neuroimaging

Introduction

Intraoperative neuroimaging is developing as an indispensable means of **assistance for surgical procedures**. We are working on the development of innovative **optical imaging** methods for a **translational medical application** : the identification of brain functional areas during neurosurgery. These works are based on clinical collaborations with **Jacques Guyotat** (neurosurgeon in Hospices Civils de Lyon) and **Fabien Schneider** (researcher in Saint Etienne hospital) for the development of a **new optical imaging method** inspired from fMRI (functional Magnetic Resonance Imaging) : **the functional connectivity at rest (resting state)** [1, 2].

Objectives

The objective of this internship is the automatic segmentation of common brain structures in MRI and optical images to automatically register an optical image in a MRI volume. For this purpose, different approaches of colour image segmentation will be tested. This would allow to adapt fMRI resting state techniques to optical images obtained in the operative room with the device developed in CREATIS laboratory [3].

Resting state imaging is a new technique of public interest because it can identify functional brain areas without patient intervention and could be possibly used under general anaesthesia. The development of an optical method would make it possible to reduce the time of neurosurgery operations and improve the surgeon's operating comfort while guaranteeing the patient's well-being. Optical imaging is particularly adapted to an intraoperative context because intrinsic contrasts could be assessed in a non invasive and non ionising way. However, the use of optical imaging faces to several difficulties related to the quantification and understanding of biomarkers for the analysis of brain connectivity at rest. In order to validate this new imaging method, the fMRI and optical resting state maps will be compared to the electrical brain stimulation identifications performed by the neurosurgeon.

In this project, the work will be based on preliminary studies conducted with the collaboration of Jacques Guyotat, which have generated several publications [3, 4, 5]. The internship work will also rely on the expertise of Fabien Schneider on the analysis of brain connectivity at rest [6, 7]. A proof of concept has already been developed during Charly Caredda PhD thesis, see Fig. 1.

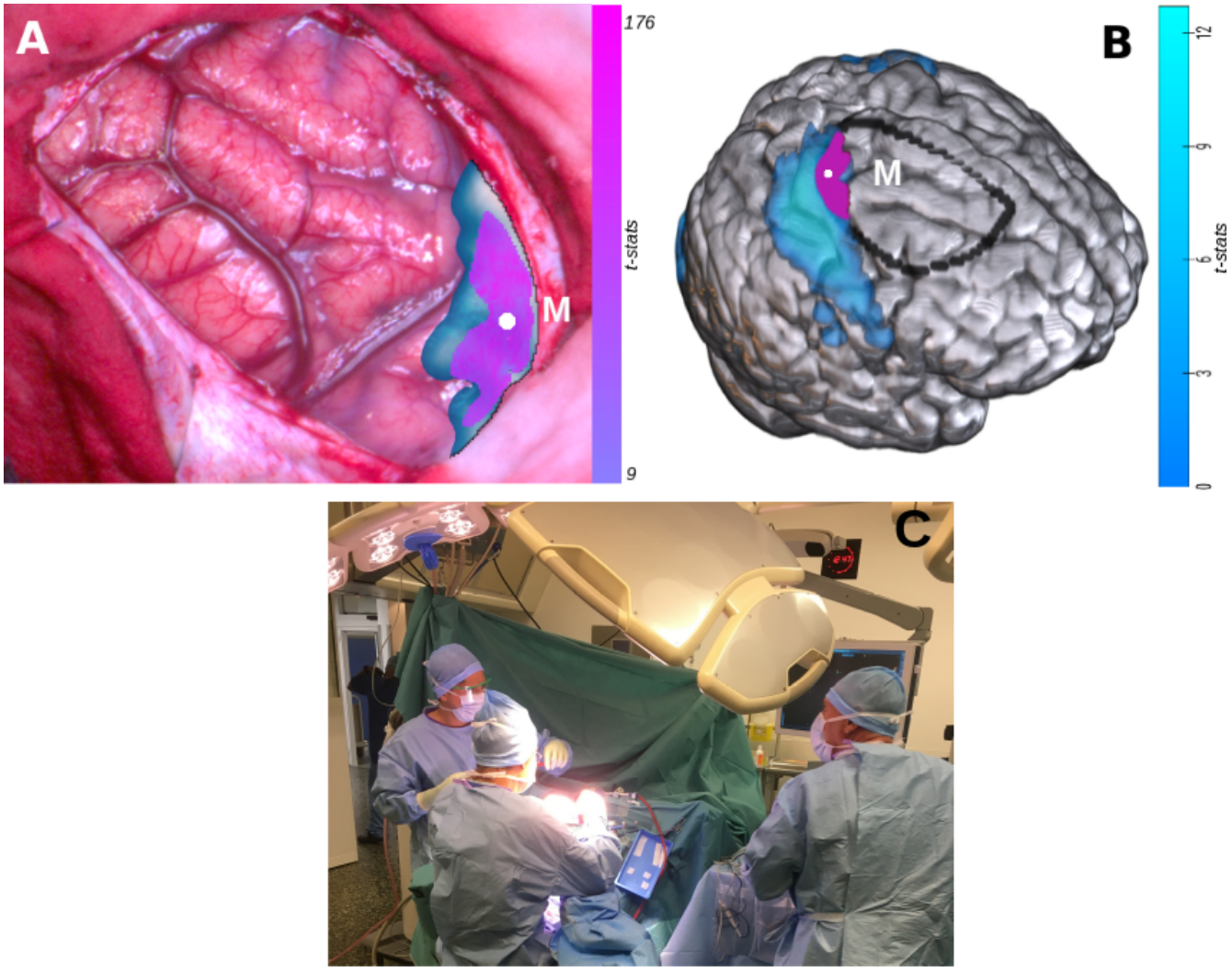

FIGURE 1 – Identification of the cerebral motor area related to patient's left hand movement identified by fMRI (blue map) and optical imaging (magenta map). The contour of the surgical window of image A is represented in black in image B. The letter M indicates the motor area identified by the neurosurgeon. C - Neurosurgery operating room in Hospices Civils de Lyon.

Internship objectives and candidate profil

The person recruited will mainly work on modelling and signal/image processing. He/she will perform *in vivo* experiments on humans in a neurosurgery operating room at the Hospices Civils de Lyon. The prerequisites are therefore those of a physicist and/or engineer with a specialisation in modelling and/or signal processing with a strong attraction for multidisciplinary in the medical and biomedical fields.

Scientific environment

In this project, three structures will be involved in the scientific supervision : CREATIS laboratory, Hospices Civils de Lyon and Saint-Etienne hospital.

The supervision committee will be composed of specialists in each component of this internship subject :
— Clinical medical optical setup (Bruno Montcel and Charly Caredda)
— 2D and 3D image registration (Eric Van Reeth)
— Resting state connectivity (Fabien Schneider)
— Medical practitioner (Jacques Guyotat and Fabien Schneider)

Contact

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Références

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