M2 Neuroscience internship proposal

Title: Automated localization of epileptic foci in magnetoencephalography (MEG) using artificial intelligence approaches: comparison of spike detection strategies

Topic abstract

Localizing the epileptogenic zone - the brain region responsible for epileptic seizures - is a key step in the pre-surgical evaluation of drug-resistant patients. Magnetoencephalography (MEG) is a promising non-invasive method for identifying these epileptic foci, notably through the detection and localization of intercritical "spikes".

The aim of this internship is to compare the effectiveness of three approaches for detecting and localizing epileptic foci from intercritical MEG data, derived from a database of over 50 patients explored as part of their clinical management:

Automated AI approach: spike detection using artificial intelligence models developed by the team (deep convolutional networks, transformers), followed by source localization using an inverse model.

Semi-automated approach: manual validation of homogeneous clusters of spikes detected by AI, followed by source localization.

Manual approach: expert visual detection of spikes, followed by localization.

The ground truth for localizing foci will be defined on the basis of available clinical data (results of invasive explorations, MRI, surgery, etc.).

Educational objectives

The trainee will be able to:

- Familiarize themselves with the analysis of MEG signals from epileptic patients.

- Deepen their knowledge of MEG source localization techniques.

- Become familiar with the use of artificial intelligence methods applied to the detection of pathological events in electrophysiological signals.

- Participate in a translational project at the interface between clinical research and computational modeling.

Profile required

Neurology / neurosurgery resident pursuing a Master's degree (M2) Neurosciences

Neuroradiologist resident pursuing a Master's degree (M2) in Medical Imaging, Signal and System

M2 neurosciences student with an interest in clinical neurosciences, signal analysis and/or AI

Python and/or Matlab skills appreciated

Sense of autonomy, critical thinking and scientific rigor.

Supervisors

Julien JUNG, neurologist, Department of Epileptology and Functional Neurology, Lyon Neurological Hospital, Hospices Civils de Lyon, Lyon F-69500, France

Pauline MOUCHÈS, Romain QUENTIN, Romain BOUET, researchers, Centre de Recherche en Neurosciences de Lyon (CRNL)- Lyon Neuroscience Research Center, INSERM U1028 - CNRS UMR5292, Lyon F-69000, France.

Location

The internship will take place at the CRNL (Centre de Recherche en Neurosciences de Lyon), in close collaboration with the clinical teams at the Hospices Civils de Lyon (HCL).