**Internship Subject:**

**Localization of the STN by analyzing Electrophysiological Signals using Convolutional Neural Networks**

***Localization :*** Laboratoire Traitement du signal et de l'Image (LTSI), Faculté de Médecine de Rennes 1 (Rennes, 35000)
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**Keywords:** Deep Learning, Parkinson Disease, Signal Analysis, Python

**Context**

This study takes place in the context of **Deep Brain Stimulation** (DBS) of the Subthalamic Nucleus (STN) as a treatment for **Parkinson Disease** (PD).
The efficiency of a DBS highly relies on the accuracy of the electrode implantation. Targeting is firstly done prior to the operation, by using Magnetic Resonance Imaging (MRI) sequences. Then, during the operation, a scan is realized with the stereotactic frame, in order to determinate the coordinates of the target and the trajectory.
In top of that, some electrophysiological signals are acquired by a temporal electrode, before implanting the definitive electrodes. The medical staff present during the operation listen to the signals, and try to determine if they **recognize some patterns in the sound** specific to the neurons inside the STN. By proceeding this way at several depths along the trajectory, it allows to determine very accurately the borders of the STN. This new source of information is important, because targeting on the sole utilization of imaging techniques cannot be reliable, because of problems such as brain shift.
This procedure is effective, but subjective and time consuming. The general objective of this study as to **build a tool able to automatically determine if the electrode is inside the STN** or not, based on the electrophysiological signals.
An intern in medicine already worked on this study, allowing to obtain a proof of concept using Recurrent Neural Networks (RNN). This internship consists in enhancing the performances of the system, by using **Convolutional Neural Networks** (CNN) instead of RNN.

**Objectives of the internship**

This internship will mainly be composed of three steps:

1. Get acquainted with the existing code, get more familiar with the *Keras* deep learning library and clean/reorganize the code. Possibly change the backend from *Keras* to *PyTorch*.
2. Getting familiar with Deep Learning (DL), CNN, finding the state of the art of CNNs in the scientific literature and implement/find of the implementation of the selected CNN structure in the project, using *Keras* backend. Then, performing tests to get results to validate the methodology.
3. Writing the internship report and a draft of the scientific paper if the results are satisfying.

**Profile researched**

The intern must be comfortable with programming (Python), and with Linux environment. Having some machine learning/deep learning background is a plus. He/she has to be curious, proactive, persevering, motivated and interested into artificial intelligence in a medical context.

This internship can be for a duration of 2 to 6 months, depending on the candidate. The remuneration will depend on the duration.