



## Thesis Project Form

**Title (tentative):** Data analysis tools for high-density neural recordings

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### Description

#### Motivation and application domain

Brain lesions from stroke or traumatic brain injury (TBI) cause significant global health issues, leading to severe motor dysfunctions and impaired daily living skills despite standard rehabilitation treatments. Advanced neuroprosthetic devices and neurotechnologies such as neurostimulation and brain-computer interfaces offer potential solutions but require further development for sustained benefits. Understanding the changes in the thalamo-cortical-thalamic circuits post-stroke is crucial for enhancing these therapeutic strategies, as this loop is vital for sensory perception and sensorimotor integration.

#### General objectives and main activities

The primary goal of this project is to investigate the changes in neuronal activity and connectivity in cortical and subcortical thalamic regions before, immediately after, and during recovery phases following a stroke lesion. This will involve recording spontaneous neuronal firing in the forelimb somatosensory cortex, hippocampus and motor thalamic nuclei in anesthetized rats. Comparisons will be made between control conditions and early post-stroke phases. The analysis will focus on (but not necessarily limited to) firing rates, latencies, spike patterns, and synchronicity among these areas.

#### Training Objectives (technical/analytical tools, experimental methodologies)

The student will:

- Learn to set up data analysis environments using containerized solutions
- Learn to analyze neural signals and extend known algorithms to high-density data
- Deepen their coding skills in Matlab and Python

**Place(s) where the thesis work will be carried out:** DIBRIS and LiSTechLab (joint Lab UNIGE-San Martino)

### Additional information

**Pre-requisite abilities/skills:** Programming skills, signal processing, statistics, attitude to computational work

**Curriculum:** Neuroengineering

**Maximum number of students:** 1