



Applied Mathematics and Computational Biology

CNRS UMR 8542

ÉCOLE NORMALE SUPÉRIEURE

And SignalMed+



## Research engineer internship position: Software engineering of brain-machine interface to prevent over-sedation

**Background:** Anesthesia overdose is a serious brain state that can lead to animal death. In the past, we have developed signal processing algorithms coupled to classification approaches to prevent in real time a deep sedation based on electro-encephalogram (EEG). We isolated predictive patterns that can be used to prevent over-sedation [1,2].

**Goal:** The goal of this internship is to implement a method that computes and displays predictive features during general anesthesia. The candidate will implement the algorithm into a software prototype and will be in charge of its validation with our experimental collaborators during mice surgery. The main tasks are to design an interface with commercial EEG acquisition devices, to implement signal processing algorithms developed by our team, and visually present relevant information with ergonomic design on a computer screen. Thus the internship will be divided into 1 - Building a prototype. Writing a protocol to extract EEG data in real-time during surgery. Adapting computations of predictive EEG features for a real-time setting. Implementing visual display. 2 - Incremental improvements. Testing and debugging the algorithm in experimental settings. Improving the product following feedback from experimentalists. 3 - Converging to finalized product operating with a web interface.

### References:

- [1] Cartailier et al, *Alpha rhythm collapse predicts iso-electric suppressions during anesthesia*, *Communications Biology* (2019)
- [2] Sun & Holcman, *Combining transient statistical markers from the EEG signal to predict brain sensitivity to general anesthesia*, *Biomedical Signal Processing and Control* (2022)

**Candidate:** The candidate should be highly motivated, autonomous and interested in software engineering and medical science. A strong problem solving and analytical mindset, as well as attention for code quality and maintainability, are necessary. A strong background in Python, computer engineering (communication protocols, operating systems), and web apps is expected. Ideally, the candidate would be familiar with version control systems (e.g Git) and have an understanding of signal processing (e.g Fourier transform).

**Where:** The internship position will take place at SignalMed+, a recent start-up company, in collaboration with the Group of Applied Mathematics and Computational Biology at École Normale Supérieure in Paris, 46 rue d'Ulm, France directed by D. Holcman.

**Internship type:** Master internship, master project.

**Duration:** 6 months

**Supervisors:** Virginie Loison (Tutor) and David Holcman (Supervisor)

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