VIRGINIE LOISON

Paris
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Updated in June 2024

RESEARCH INTERESTS

I am passionate about neuroscience and medical research and aim to help advance research in these areas at both the cellular and macroscopic levels. To that end, I wish to bring my math and computer science training to collaborations with biologists and medical doctors.

EDUCATION

Mathematics, Vision, Learning (MVA) 2020-2021
Paris-Saclay University

- Mathematics and Machine Learning for clinical applications.
- Deep Learning, Computer Vision, Optimization, Statistics.

M.S. in Mathematics and Computer Science 2016 - 2020
Ecole des Ponts ParisTech, French Engineering "Grande École"

- Probabilities, Stochastic Processes, Statistics, Optimization.
- Machine Learning, Deep Learning, Computer Vision.

Advanced scientific training ("Prépa", equivalent to B.S) 2013 - 2015
Lycée Charlemagne, Paris, France

- Analysis, Probability, Algebra, Computer Science, Physics.

PUBLISHED PAPER

Mapping General Anesthesia Brain States based on Electro-Encephalogram Transition Phases NeuroImage
with Yulia Voskobiynyk, Britta Lindquist, Deanna Necula, Jeanne Paz (Gladstone Institutes, UCSF), Dan Longrois (APHP) and David Holcman (ENS).

In human patients, overdosing during general anesthesia can lead to cognitive impairment. Cortical electro-encephalograms are used to measure the depth of anesthesia. They allow for correction, but not prevention, of overdose. However, data-driven approaches open new possibilities to predict the depth of anesthesia. We established an electro-encephalogram signal-processing pipeline, and constructed a predictive map representing an ensemble of gradual sedation states during general anesthesia in mice. In particular, we identified crucial electro-encephalogram patterns which anticipate signs of overdose several minutes before they occur. Our results bring a novel paradigm to the medical community, allowing for the development of individually tailored and predictive anesthetic regimens.

WORKING PAPER

Unmixing Noise from Hawkes Process to Model learned Physiological Events Under Review

with Guillaume Staerman and Thomas Moreau (INRIA Saclay).

Physiological signal analysis often involves identifying events crucial to understand the underlying biological dynamics. Traditional methods rely on handcrafted procedures or supervised learning, presenting challenges such as expert dependence, lack of robustness, and the need for extensive labeled data. Data-driven methods like Convolutional Dictionary Learning (CDL) offer an alternative but tend to produce spurious detections. This work introduces UNHaP (Unmix Noise from Hawkes Processes), a novel approach addressing the joint learning of temporal structures in events and the removal of spurious detections. Leveraging marked Hawkes processes, UNHaP distinguishes between events of interest and spurious ones. By treating the event detection output as a mixture of structured and unstructured events, UNHaP efficiently unmixes these processes and estimates Hawkes process parameters. This approach significantly enhances the understanding of event distributions while minimizing false detection rates.

WORK EXPERIENCE

PhD student 2023 - now

INRIA, Paris-Saclay

- Advisors: Thomas Moreau (INRIA) and Jérôme Cartailler (INSERM).
- Point Processes models for Physiological Events
- Construction of mathematical methods to quantify events distribution in physiological data.
- Exploration of clinical physiological data during surgery.
- Analysis of computational results from a clinical perspective.

Research Assistant 2021 - 2023

IBENS, ENS PSL, Paris

- Construction of signal processing, statistics and machine learning pipelines to identify predictive patterns in electro-encephalograms and electro-myograms of mammals under general anesthesia.
- Analysis of computational results from a clinical perspective.

Research Assistant 2020

Lab Imagine - LIGM, Paris *github repository link*

- Tutor: Mathieu Aubry.
- Implementation of a PyTorch pipeline for handwritten text recognition.
- Benchmark of the state of the art methods.

Research Project 2020

Warner Bros & École des Ponts ParisTech *github repository link*

Tutors: Lisa Regnier and Mathieu Aubry.
Benchmark and training of deep learning models (CNN + BLSTM) for a multi-level classification problem, applied to movie posters.

TALKS AND CONFERENCES

MIND team seminar (**Talk** and weekly attendance)

WIRED Workshop, Paris, France (March 2024)

MIND internal seminar(**Talk** and weekly attendance)

ENS Internal Neuroscience Seminar (**Talk** and regular attendance)

Cure-ND Clinical Workshop, Paris, France (February 2023)

Gordon Conference: Thalamocortical interactions, Lucca, Italy (October 2022, **Poster**)

Paris Biological Physics Community Day 2021 (October 2021)

TEACHING

Data analysis in Python 2023
aivancity Paris-Cachan

24-hour tutorial for master students. Course preparation and teaching.

TECHNICAL AND LINGUISTIC SKILLS

Linguistic	French (native), English (bilingual), Spanish (fluent)
Programming Languages	Python, C++, Caml, MATLAB, Julia, R
Python Packages	Pandas, Matplotlib, Numpy, PyTorch, Tensorflow, Scipy, Jupyter