FICHE DE COURS

Neural signals and signal processing

NX-421

Fiche de cours

Enseignant(s):
Micera Silvestro
Van De Ville Dimitri Nestor Alice

Langue:
English

Summary
Understanding, processing, and analysis of signals and images obtained from the central and peripheral nervous system

Content
Understanding neural signals obtained by electrophysiology and imaging techniques requires knowledge both about their origin and the measurement process. This course will introduce the properties of a wide range of neural signals that are used to study the brain in health and disease. The relevance of these signals for applications in fundamental and clinical neuroscience will be made clear. In addition, a broad range of signal processing tools and their implementations will be presented with the specific focus to implement and tailor analysis of these signals, which typically comes as large, noisy, but richly structured datasets. Exercises and lab exercises will provide insights into the analysis of imaging data and electrophysiological neural signals.

Keywords
Electrophysiology, nervous system, neuroimaging, brain mapping, systems-level neuroscience, MRI

Learning Prerequisites

Required courses
Mathematics at the engineering level (i.e., matrix algebra, probability theory)
Basic signal processing, statistics, and machine-learning concepts
Basic knowledge of programming

Learning Outcomes
By the end of the course, the student must be able to:
• Analyze processing steps of neural signals and imaging data
• Assemble a neural data processing pipeline

https://isa.epfl.ch/imoniteur_ISAP/itffichecours.htm?ww_i_matiere=3150386813&ww_x_anneeAcad=2022-2023&ww_i_section=945244
Critique suitability of analysis methods
Interpret results of neural signals analysis
Explain choice of methodology

Transversal skills
- Use a work methodology appropriate to the task.
- Make an oral presentation.
- Give feedback (critique) in an appropriate fashion.

Teaching methods
Weekly lectures (4h) and weekly exercise session (2h)
Mini-projects during the semester with presentations

Expected student activities
Attendance at lectures and exercises

Assessment methods
Attendance and completion of mini-projects with presentations
Written exam

Supervision
- Office hours: Yes
- Assistants: Yes
- Forum: Yes

Resources
Virtual desktop infrastructure (VDI)
No

Bibliography

Ressources en bibliothèque
- Handbook of Neuroengineering / N. V. Thakor
- Introduction to human neuroimaging / Hans Op de Beeck, Chie Nakatani

Dans les plans d'études
Neuro-X, 2022-2023,
Master semestre 1

Semestre
Automne

Forme de l'examen
Ecrit

Crédits
6

Matière examinée
Neural signals and signal processing

Cours
4 Heure(s) hebdo x 14
semaines

Exercices
2 Heure(s) hebdo x 14
semaines

Ingénierie des sciences du vivant, 2022-2023,
Master semestre 1

Ingénierie des sciences du vivant, 2022-2023,
Master semestre 3

Microtechnique, 2022-2023, Master semestre 1

Microtechnique, 2022-2023, Master semestre 3

Robotique, 2022-2023,
Master semestre 1

Robotique, 2022-2023,
Master semestre 3

Mineur en Neuro-X,
2022-2023, Semestre automne

Mineur en Technologies biomédicales, 2022-2023,
Semestre automne
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En construction

### LÉGENDE

- Semestre d'automne
- Session d'hiver
- Semestre de printemps
Session d'été
Cours en français
Cours en anglais
Cours en allemand