MICRO-513

Signal processing for functional brain imaging

Van De Ville Dimitri

Cursus	Sem.	Type
Computational Neurosciences minor	E	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Life Sciences Engineering	MA2, MA4	Opt.
Microtechnics	MA2, MA4	Opt.
Neuroprosthetics minor	E	Opt.
Neuroscience		Opt.
Robotics	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

Computational methods for the analysis of human brain imaging data

Content

Human brain imaging such as magnetic resonance imaging (MRI) and electroencephalography (EEG) allows non-invasive investigation of the human brain in health and disease. Datasets are large, noisy, and richely structured, thus their analysis needs to rely on a broad range of mathematical and signal processing tools. Students will learn to understand, implement, and tailor general tools including linear regression (mass univariate models), multivariate models (principal components analysis, partial least squares, independent component analysis), pattern recognition (machine learning), and graphical models. Exercises and lab exercises (in Python) provide insights into the analysis of brain imaging data. A journal club emphasizes application of brain imaging tools in fundamental and clinical neuroscience. Students will read, present and critique original research papers.

Keywords

neuroimaging, functional MRI, EEG, brain mapping, systems-level neuroscience

Learning Prerequisites

Important concepts to start the course

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

Learning Outcomes

By the end of the course, the student must be able to:

- Analyze processing steps of neuroimaging data
- Assemble a neuroimaging pipeline
- Critique suitability of analysis methods
- Interpret results of neuroimaging 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 (2h) following by an exercise session (1h)
Three lab exercises during the semester
Journal club at the end of the semester

Expected student activities

attendance at lectures and exercises. one journal club.

Assessment methods

Attendance and completion of three lab exercises during the semester
Written exam

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=14944