MICRO-513

Signal processing for functional brain imaging

Van De Ville Dimitri

Cursus	Sem.	Type
Bioengineering	MA2, MA4	Opt.
Computational Neurosciences minor	E	Opt.
Electrical and Electronical Engineering	MA2, MA4	Opt.
Neuroprosthetics minor	E	Opt.
Neuroscience		Opt.
Sciences du vivant	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

MICRO-513 is an interdisciplinary course at the interface of neuroscience, psychology, engineering, and statistics. Students will learn mathematical and statistical processing tools in the context of analyzing human brain imaging data.

Content

Human brain imaging (MRI, fMRI EEG) allows non-invasive investigation of the human brain in health and disease. Data sets are large and noisy and their analysis depends on an array of mathematical and signal processing tools. Students will learn to implement 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. Lab exercises and Matlab exercises allow analysis of real 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

Learning Prerequisites

Important concepts to start the course

Mathematics at the engineering level (i.e., matrix algebra, probability theory)
Basic signal processing concepts

Learning Outcomes

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

- Explore clinical and cognitive neuroscience
- Propose a brain imaging experiment
- Design data analysis method
- Choose among signal processing tools
- Implement signal processing tools
- Assess / Evaluate statistical significance
- Critique original research papers
- Structure a scientific presentation

Transversal skills

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

Teaching methods

lectures, lab exercises for analysis of real brain imaging data sets, homework exercises for understanding and implementation of specific tools, journal club for exploring applications of brain imaging in fundamental and clinical neuroscience, journal club presentations for synthesis and critique of original research as well as practice of presentation skills.

Expected student activities

attendance at lectures and exercises. one journal club.

Assessment methods

written exam.

Supervision

Office hours	No
Assistants	Yes
Forum	Yes

Resources

Moodle Link

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