EE-514

Brain-computer interaction

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

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	**48**

Summary

How to provide a direct interaction between the human neural system and machines aiming to augment human capabilities, especially of disabled people. Description of the brain signals and the algorithms (signal processing & machine learning) for recognizing subjects' intents and cognitive states.

Content

1.Introduction
2. Basic Neurology + ML
3. Multiunit Recording
4. Electroencephalogram (EEG) & Inverse Methods
5. EEG-based BCI and Paradigms
6. Electrocorticogram (ECoG)
7. Beyond Motor-related Signals for BCI
8. Cognitive Signals for Brain Interaction
9. BCI Applications

Keywords

brain-computer interfaces, brain-machine interfaces, neuroprosthetics, pattern recognition, brain signal processing, human physiological signals, neuroscience, human-computer interaction

Learning Prerequisites

Required courses

Pattern recognition (for instance, Data Analysis and Model Classification)
Signal Processing

Recommended courses

Neuroscience and Cognitive Neuroscience

Important concepts to start the course

Pattern recognition: feature selection, linear models for classification and regression (quick introduction at the beginning of the course)
Signal processing: Frequency domain analysis, filtering (basic introduction at the beginning of the course)
Matlab programming (tutorial provided at the beginning of the course)

Teaching methods

Lectures and project based on students' own experiments.

Expected student activities

Students will have to run their own experiments on a protocol of their choice. Then, they will analyze the recorded brain signals (EEG) and provide a written report.

Assessment methods

Written exam. Final grade: 60% Exam, 40% Exercises.

Resources

Bibliography

Dornhege, G. Millán, J.d.R., Hinterberger, T., McFarland, D.J., and Müller, K.-R. (eds.) (2007). Towards Brain-Computing Interfacing. Cambridge, MA: MIT Press.
Wolpaw, J. and Wolpaw E.W. (eds.) (2012). Brain-Computer Interfaces: Principles and Practice. Oxford University Press.

Ressources en bibliothèque

- Brain-computer interfaces : principles and practice / Wolpaw
- Towards BRain-Computing Interfacing / Millan

Moodle Link

- http://moodle.epfl.ch/course/view.php?id=8831