Brain computer interaction

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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. Multunit Recording
4. Electroencephalogram (EEG) & Inverse Methods
5. EEG-based BCI and Paradigms
6. Electrocoritcogram (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
Matlab programming
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: 50% Exam, 50% Exercises.

Resources

Bibliography

Ressources en bibliothèque
• Brain-computer interfaces : principles and practice / Wolpaw
• Towards BRain-Computing Interfacing / Millan

Moodle Link
• https://moodle.epfl.ch/course/view.php?id=8831