EE-514  
**Brain computer interaction**  
Millán José del R.

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<tr>
<th>Cursus</th>
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<td>Bioingénierie</td>
<td>MA2, MA4</td>
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<tr>
<td>Génie électrique et électronique</td>
<td>MA2, MA4</td>
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<td>Ingénierie des sciences du vivant</td>
<td>MA2</td>
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<td>Mineur en Neuroprosthtiques</td>
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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. 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
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