Course guide
240315 - 240NR022 - Human-Machine Interfaces

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 707 - ESAII - Department of Automatic Control.

Degree: MASTER'S DEGREE IN NEUROENGINEERING AND REHABILITATION (Syllabus 2020). (Compulsory subject).
Academic year: 2023  ECTS Credits: 4.5  Languages: English

LECTURER
Coordinating lecturer: Romero Lafuente, Sergio
Others: Bachiller Matarranz, Alejandro
        Jordanic, Mislav

REQUIREMENTS
Students must pass the subject Biomedical Signals. Students must also pass or take simultaneously the subject Data Analysis in
Rehabilitation.

TEACHING METHODOLOGY
· Receive, understand and synthesize knowledge.
· Consider and solve problems, and analyze results.
· Perform a teamwork about developing an application of a BCI system. At the end of the course, the students will defend their project
orally.

LEARNING OBJECTIVES OF THE SUBJECT
The main objective is to introduce the field of human-machine interface (HMI) and in particular to the systems that translate a
measure of a user’s brain activity into messages or commands for an interactive application (BCI, brain-computer interfaces). Other
objectives include:
· To introduce brain and muscular recording and stimulation technologies.
· To present the basic components of an HMI system.
· To review the major applications of BCIs considering some ethical aspects.
At the end of the course, the student must be able to design, program and develop a BCI communication system.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>20,5</td>
<td>18.22</td>
</tr>
<tr>
<td>Self study</td>
<td>72,0</td>
<td>64.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>20,0</td>
<td>17.78</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h
## CONTENTS

### Topic 1. Introduction to human-machine interfaces

**Description:**

**Full-or-part-time:** 6h 30m  
Theory classes: 2h  
Self study : 4h 30m

### Topic 2. Evoked related potentials (ERP)

**Description:**
Visual, auditory, somatosensory and motor ERP. Most important waveforms. Applications in neurologic disorders.

**Full-or-part-time:** 18h 30m  
Theory classes: 2h  
Practical classes: 7h 30m  
Self study : 9h

### Topic 3. Brain computer interfaces (BCI)

**Description:**

**Full-or-part-time:** 43h  
Theory classes: 4h  
Practical classes: 12h  
Self study : 27h

### Topic 4. Motor imagery

**Description:**
BCIs based on movement intention for rehabilitation. High-density EMG signals (HD-EMG): acquisition and processing.

**Full-or-part-time:** 146h 30m  
Theory classes: 4h  
Practical classes: 7h 30m  
Self study : 135h

### Topic 5. Applications and ethical issues

**Description:**
Medical and non-medical applications. Ethical issues. Future perspectives on BCIs.

**Full-or-part-time:** 6h  
Theory classes: 1h 30m  
Self study : 4h 30m
GRADING SYSTEM

The final mark is the weighted sum of the following marks:
Nfe: Final exam mark
Nlabs: Mark of the laboratory sessions (attendance, participation)
NpBCI: Mark obtained in the group project on a BCI application (work and oral dissemination).
Nfinal = 0.3 Nfe + 0.2 Nlabs + 0.5 NpBCI
Students who do not submit the final exam or do not perform the BCI project will be denoted as "Not taken".

EXAMINATION RULES.

Students who do not submit the final exam or do not perform the BCI project will be denoted as "Not taken".

BIBLIOGRAPHY

Basic:

Complementary: