COURSE DESCRIPTION CARD - SYLLABUS

Course name
Human-Machine Interfaces and Biological Signals in Robotics [N2AiR1-RiSA>PO3-ICM]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/4

Area of study (specialization)
Autonomous Robots and Systems

Profile of study
general academic

Level of study
second-cycle

Course offered in
Polish

Form of study
part-time

Requirements
elective

Number of hours

Lecture
10

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

3,00

Coordinators

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Lecturers

Prerequisites

A student starting this course should have basic knowledge of Python programming, signal processing and machine learning methods and statistics.

Course objective

Learning Module Objective: 1. knowledge of the types and acquisition methods of biological signals including design of analog and digital parts for signal acquisition 2. ability to design and apply methods of signal filtration 3. ability to acquire and process basic biological signals EMG, EEG, including determination of signal characteristics 4. ability to classify features in the application of biological signals to human-computer interface construction. 5. ability to process data including: outlier detection, unsupervised cluster analysis methods, dimensionality reduction

Course-related learning outcomes

Knowledge
1. has knowledge of the current state of the art of human computer interfaces using biological signals
2. has knowledge of methods of analysis, processing and properties of stationary and non-stationary signals

Skills
1. Recording of EMG and EEG signals using dedicated sensors with the principles of safety and health at work
2. is able to analyse a signal and select appropriate methods of preprocessing and filtering
3. is able to design a digital filter which allows to preprocess signal, and to select the methods of determining the time/time-frequency characteristics of the signal
4. is able to use designated features for discrete state recognition and apply them to human-computer interface design
Social competences
The graduate is aware of the need for a professional approach to technical issues, meticulous familiarization with the documentation and environmental conditions in which the equipment and its components can operate. The graduate is ready to observe the rules of professional ethics and to demand it from others, to respect the diversity of opinions and cultures.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
Lecture: written examination in the lecture
Laboratory: realization of two project tasks involving the practical application of the learned methods and evaluation of work during the classes

Programme content

The lecture and lab schedule includes the following topics:
- Methods of analysis and filtration of stationary and non-stationary signals including (among others) Fourier transform, wavelet transform, design of linear and nonlinear digital filters
- Recording of biological signals EMG and EEG
- Methods of EMG signal processing and classification
- Methods for selecting and evaluating the significance of features in a multidimensional data set
- Methods of EEG signal analysis
- Building a human-computer interface using biological signals

Course topics

none

Teaching methods

Lecture: multimedia presentation, illustrated with examples given on the blackboard, and programs created during the classes.
Laboratory exercises: self-directed practicing of the material supported by didactic materials placed on the e-learning platform

Bibliography

Basic
1. elearning materials available on the course website
2. Tomasz Zieliński „Cyfrowe przetwarzanie sygnałów od teorii do zastosowań” WKL
Additional
3. Roberto Merletti, Philip Parker „Electromyography, Physiology, Engineering and Noninvasive Applications”, John Wiley & Sons

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	45	2,00