COURSE DESCRIPTION CARD - SYLLABUS

Course name
Human-Robot Interfaces

Course

Field of study
Automatic Control and Robotics

Year/Semester
1/1

Area of study (specialization)
Vision systems

Profile of study
general academic

Level of study
Second-cycle studies

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
-

Tutorials
-

Projects/seminars
30

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:
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Faculty of Automatic Control, Robotics and Electrical Engineering

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Prerequisites

Knowledge: The student starting this course should have knowledge of the basics of signal theory and signal and information processing.

Skills: Students should have the ability to solve basic problems in the field of signal processing, computer science, information theory and should have the ability to obtain information from indicated sources, including the Internet and the IEEE Xplore database of scientific publications. Should also understand the need to expand his/her competences and be ready to cooperate in a team.

Social competences: In addition, should exhibit such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity, personal culture, respect for other people.

Course objective

1. Providing students with knowledge about the methods used in human-robot interfaces and in the field of digital signal processing in vision systems.

2. Developing students' skills to solve problems related to data processing in human-robot interfaces.

3. Shaping students' teamwork skills and the use of software and laboratory equipment available during classes for the implementation of human-robot interfaces.

Course-related learning outcomes

Knowledge

A student:

1. have extended and in-depth knowledge of selected mathematics sections necessary to formulate and solve complex tasks in the field of control theory, optimization, modeling, identification and signal processing - [K2_W1]

2. have extended knowledge within selected areas of automation and robotics - [K2_W10]

Skills

A student:

1. can use advanced methods of signal processing and analysis, including video signal and extract information from the analyzed signals - [K2_U11]

2. can integrate and program specialized robotic systems - [K2_U12]

3. can assess the usefulness and the possibility of using new achievements (including techniques and technologies) in the field of automation and robotics - [K2_U16]

Social competences

1. Students are aware of responsibility for their own work and is ready to submit to the rules of teamwork and responsibility for jointly performed tasks; can lead a team, set goals and define priorities leading to the implementation of the task - [K2_K3]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) in the scope of lectures:

based on answers to questions about the material discussed in previous lectures,

b) in the scope of laboratory classes:

on the basis of the assessment of the current progress in the execution of tasks,

c) in the scope of project classes:

on the basis of the assessment of the current progress in the execution of tasks and on the basis of two presentations made independently by each team of 2/3 students.

Summative assessment:

a) in the field of lectures, verification of the assumed learning outcomes is carried out by:

i.assessment of the knowledge and skills demonstrated in a problem-based exam carried out over time by a selected group of interested students or by verifying the learning outcomes on set dates

ii. discussion of the exam results

b) in the scope of laboratory classes, verification of the assumed learning outcomes is carried out by:

i. continuous assessment, during each class (oral answers) - rewarding the increase in the ability to use the learned rules and methods

ii. evaluation of the report prepared during the classes; the report allows you to get 10 points, getting 50% of the number of points gives a positive grade; this assessment also takes into account the ability to work in a 2/3-person team

c) in the field of project classes, verification of the assumed learning outcomes is carried out by:

i. assessment of knowledge and skills related to the execution of project tasks; this assessment also includes the ability to work in a team,

ii. evaluation and "defense" by the student of the report on the execution of the project.

Obtaining additional points for activity during classes, in particular for:

i. discussions of additional aspects of the issue,

ii. effectiveness of applying the acquired knowledge while solving a given problem,

iii. ability to cooperate as part of a team practically carrying out a project task,

iv. comments related to the improvement of teaching materials,

v. indicating students' perceptual difficulties, enabling the ongoing improvement of the teaching process.

Programme content

The lecture program covers the following topics:

1. Introduction to the issue of human-computer, human-machine and human-robot interfaces - classification of issues; computer vision, machine vision, computer hearing, gesture control, vision control, mouth movement control etc., control by evoked potentials, i.e. signals sent by the brain; biometrics, automatic and active prostheses.

2. CAPTCHA technique and biometrics - types, structure and applications of CAPTCHA codes; two meanings of biometrics (in biological sciences and engineering sciences), an overview of issues from microbiometry to macrobiometry; recognition (identification and classification) of people based on the examination of fingerprints, handwriting and signature, face, iris and retina of the eye, hands, course of blood vessels, voice, gait, rhythm of typing, DNA, etc.

3. Face recognition - two- and three-dimensional face modeling methods, face segmentation, PCA, ICA, NMF methods, biometric standards and face databases; recognition of gender, emotions and age based on face examination.

4. Speech and speaker recognition - construction and modeling of the voice path, voice analysis, articulation and semantic analysis of language in order to recognize people; the impact of codecs used in the Internet and in telecommunications systems on voice recognition.

5. Iris and fundus recognition - structure of the human eye, biometric norms and bases of the iris, methods of iris segmentation, fundus images, structure of the retina, OCT technique, two- and three-dimensional models of the retina.

6. Robot control - control of automated production processes, control of stationary and mobile robots, robotics in medicine - laparoscopes and medical robots, microsurgery - integration of microscopy and OCT.

7. Monitoring networks - industrial monitoring, city monitoring, automatic traffic control, recognition of threats in urban areas, vehicle and people traffic density testing, vehicle and people counting.

Laboratory classes are conducted in the form of 2-hour exercises in the laboratory, preceded by a 1-hour instructional session at the beginning of the semester. Exercises are carried out by teams of 2/3 people.

The program of laboratory classes includes the following issues:

1. Stereovision interfaces for image acquisition and visualization

2. Stereovision interfaces based on the calculation of the robot's distance to objects

3. Application of one-dimensional barcodes in human-robot interfaces

4. Application of two-dimensional barcodes in human-robot interfaces

5. Objects classification on the production line

6. Chosen technologies of human-robot interfaces

The project classes program covers the following topics:

analysis of chosen signal processing algorithms used in human-robot interfaces; development of implementation of chosen signal processing algorithms in human-robot interfaces.

Teaching methods

1. Lecture: multimedia presentation, presentation illustrated with examples given on the board, solving problems, multimedia show, demonstration

2. Laboratory classes: simulation research in Matlab environment, practical exercises, problem solving, conducting experiments, discussion, analysis of results, team work

3. Project classes: multimedia presentations, discussion, team work

Bibliography

Basic

1. Computer vision - algorithms and applications, Szeliski R., Springer, 2011

2. 3D computer vision - efficient methods and applications, Wohler Ch., Springer, 2009

3. Information theory in computer vision and pattern recognition, Escolano F., Suau P., Bonev B., Springer, 2009

4. Wybrane zagadnienia biometrii, Ślot K., WKŁ, Warszawa, 2008

5. Biometria, Bolle R., Connell J., Pankanti S., Ratha N. Senior, WNT, Warszawa, 2008

Additional

1. Rozpoznawanie obrazów i sygnałów mowy, Kasprzak W., Oficyna Wydawnicza Politechniki Opolskiej, Opole, 2009

2. Visual perception for manipulation and imitation in humanoid robots, Azad P., Springer, 2009

3. Autonomous land vehicles - steps towards service robots, Berns K., von Puttkamer E., Springer, 2009

4. Rozpoznawanie biometryczne - nowe metody ilościowej reprezentacji obiektów, Ślot K., WKŁ, Warszawa, 2010

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	60	2,5
Student's own work (literature studies, preparation for laboratory/project classes, preparation for exam, making a presentation, project preparation)[1]	40	1,5

[1] delete or add other activities as appropriate