COURSE DESCRIPTION CARD - SYLLABUS

Course name

Teleoperation systems

Course

Field of study

Automation and Robotics

Year/Semester

1/2

Area of study (specialization)

Automation and robotics systems

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

polish

Form of study

part-time

Requirements

elective

Number of hours

Lecture

12

Laboratory classes

12

Other (e.g. online)

-

Tutorials

-

Projects/seminars

-

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Piotrowo 3, 60-965 Poznan

Responsible for the course/lecturer:

Prerequisites

Knowledge:

The student starting this course should have basic knowledge of automation, robotics and computer science.

Skills:

He/she should have the ability to program in a high-level language and understand the source code created by another programmer. He/she should have the ability to obtain information from the indicated sources. He/she should know the methods of modeling mobile robots and issues related to controlling such a robot. He/she should have basic knowledge in the field of sensors. They should also understand the need to expand their competences / be ready to cooperate within the team.

Social competences:

In addition, in terms of social competences, the student must have such qualities as honesty, responsibility, perseverance, cognitive curiosity, creativity and personal culture.

Course objective

1. To provide students with basic knowledge in the field of teleoperation systems.

2. Review of communication protocols useful for the teleoperation task. User interface solutions, used effectors, control methods, delay compensation methods.

3. Developing students' skills in designing and implementing a teleoperation system.

4. Shaping in students the ability to work in a team at various stages of the project? from analysis of assumptions to implementation and testing.

Course-related learning outcomes

Knowledge

1. He/she has specialist knowledge in the field of remote and distributed systems, real-time systems and network techniques, - [K2_W3]

2. He/she understands the methodology of designing specialized analog and digital electronic systems, - [K2_W4]

3. He/she has extended knowledge of the modeling of linear and nonlinear systems, - [K2_W5]

4. He/she has detailed knowledge of the construction and use of advanced sensory systems, - [K2_W6]

5. He/she has an ordered, theoretically founded, detailed knowledge of methods of analysis and design of control systems - [K2_W7]

Skills

1. He/she can make critical use of literature information, databases and other sources in Polish and a foreign language, - [K2_U1]

2. He/she is able to prepare and perform an oral presentation in Polish and in a foreign language on specific issues in the field of automation and robotics, - [K2_U5]

3. He/she is able to simulate and analyze the operation of complex automation systems as well as plan and carry out experimental verification, - [K2_U9]

4. He/she can designate models of simple systems and processes, and use them for the purposes of analysis and design of automation and robotics systems, - [K2_U10]

5. He/she can integrate and program specialized robotic systems, - [K2_U12]

6. He/she can select and integrate the elements of a specialized measurement and control system, including: a control unit, an executive system, a measuring system and peripheral and communication modules - [K2_U13]

Social competences

1. He/she understands the need and knows the possibilities of continuous training improving professional, personal and social competences, is able to inspire and organize the learning process of other people, - [K2_K1]

2. He/she is aware of the need for a professional approach to technical issues, scrupulous reading of the documentation and the environmental conditions in which the devices and their components may function, - [K2_K4]

3. He/she is aware of the social role of a technical university graduate and understands the need to formulate and transmit to the society (in particular through the mass media) information and opinions on the achievements of automation and robotics in the field of research and application works and other aspects of engineering activities; makes efforts to provide such information and opinions in a commonly understandable manner with justification of different points of view - [K2_K6]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The learning outcomes presented above are verified as follows:

Formative assessment:

In the field of lectures:

- on the basis of answers to questions about the material discussed in previous lectures,

In the field of laboratories:

- on the basis of an assessment of the current progress of work,

Summative assessment:

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

1. assessment of the knowledge and skills shown in the written exam, during which the student answers 5 questions selected from 30 previously provided to students and one question requiring problem

analysis. The maximum number of points in the exam is 30, in order to obtain a satisfactory grade, the student must obtain at least 15 points

2.discussion of the exam results,

b) in the field of laboratories, verification of the assumed learning outcomes is carried out by:

3.assessment of the performance of works and skills related to their implementation,

4.assessment of teamwork skills,

5. evaluation and ‘defense’ of the implementation by the student (the report describes the work carried out in the field of analysis, design and implementation as well as tests),

Obtaining additional points for activity during classes, especially for:

1. discuss additional aspects of the issue,

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

3.the ability to cooperate within a team that practically carries out detailed tasks,

4. identifying students' perceptual difficulties enabling ongoing improvement of the teaching process.

Programme content

The lecture program covers the following topics:

Basic issues: teleoperation, system structure for teleoperation task, remote control, telepresence, virtual telepresence, telemanipulation, human-machine interface. Teleoperated robot versus autonomous robot. Applications in space, military, telemedicine, microsurgery; dangerous and inspection tasks. Structured and unstructured environment, hand-eye coordination, situational awareness, ‘filtering’ threats and disruptions, economic issues of using teleoperation systems.

The issue of delays in teleoperation systems, causes of delays, their impact on the operator's perception. Energy in mobile systems. Closed-loop teleoperation, coordinated teleoperation, operator supervision.

Wired and wireless communication, network protocols, their advantages and disadvantages in terms of teleoperation applications; connection-based and connectionless communication; properties of various communication methods in terms of mobility, energy efficiency, range, required bandwidth.

Simple and complex user interfaces, the use of the operator's senses, the amount and precision of information provided by the senses, object recognition by touch, hand movement mapping, hand touch mapping. Operator consoles, head tracking, eye tracking, touch, kinesthetic information. Sensors used. Mono and stereovision in teleoperation: solution architecture, network links, protocols, obtained resolutions, visual comfort, telepresence. The use of virtual reality (VR) and augmented reality (AR); strengthening the message, prediction.

Review of control methods. Bilateral control, stability, inertia and damping, tracking, stiffness, drift. Force reflection, position error, shared compiliance control, passive force reflection, predictive methods. Comparison of the properties of control methods. Teleoperation with local autonomous collision avoidance.

Laboratory classes are conducted in the form of nine 2-hour meetings, held in the laboratory. Projects are carried out in teams of 2 students. As part of the project, students learn such issues as: the use of communication protocols to exchange information between the operator console and the robot, design data frames. Communication implementation. Decomposition of the task into functionalities implemented by various system components. Implementation of the designed components of the teleoperation system.

Teaching methods

1. lecture: multimedia presentation, presentation illustrated with examples given on the blackboard.
2. project activities: team work, workshops, discussion, performing experiments.

Bibliography

Basic

1. Handbook of Robotics, B. Siciliano, O. Khatib,(Eds.) Springer, 2008.

Additional

1. Biblia TCP/IP tomy 1-3, R. Stevens, Wyd. RM, 1998.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	31	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	44	1,5

1 delete or add other activities as appropriate