COURSE DESCRIPTION CARD - SYLLABUS

Course name Robotics I

Course

Field of study Artificial Intelligence
Area of study (specialization)
Level of study
Form of study

Year/Semester 1/1
Profile of study
Course offered in English
Requirements

Number of hours

Lecture 30
Tutorials 0
Laboratory classes 30
Projects/seminars 0
Other (e.g. online) 0

Number of credit points 3

Lecturers

Responsible for the course/lecturer:
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Responsible for the course/lecturer:

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Prerequisites

Basic knowledge of matrix operations and differential equations. Basic programming skills in Python, ability to interpret a code written in C++.

Course objective

The purpose of the course is to introduce students with the main tools related to robotics and control

theory. Students are introduced to basic methods, techniques and algorithms related to transformations for rigid bodies in 3D space, kinematics of robotic arms, control systems, modeling of dynamic systems and estimation of their state. Perception systems and principles of operation of various types of sensors used in mobile robotics are also presented.

Course-related learning outcomes

Knowledge

K1st_W4: knows and understands the basic techniques, methods, algorithms, and tools used for solving computer problems as well as problems in artificial intelligence, including clustering, classification, optimization, and decision support

K1st_W5: has a basic knowledge of key directions and the most important successes of artificial intelligence understood as an essential sub-domain of computer science, making use of the achievements of other scientific disciplines and providing solutions with a high practical impact; knows the history and recent trends in Artificial Intelligence

K1st_W6: has a basic, ordered, and well-grounded knowledge of computer architecture and robotics, which is useful for modeling, designing, and controlling the computer and robotic systems

K1st_W9: knows cybersecurity and ethical issues related to the creation and use of computers and, in particular, AI-based systems

Skills

K1st_U3: can formulate and solve complex data mining, optimization, and decision problems within the scope of computer science and, in particular, artificial intelligence, by applying appropriately selected methods such as clustering algorithms, classification techniques, optimization approaches, graph search methods, or decision analysis tools

K1st_U7: can carry out a critical analysis and an assessment of the functioning of both computer systems and AI methods

K1st_U9: can adapt the existing algorithms as well as formulate and implement the novel algorithms in Python, including the algorithms typical for different streams of AI such as data mining, machine learning, artificial neural networks, multiple criteria decision analysis, and optimization

K1st_U11: can adapt and make use of the models of intelligent behavior (e.g., genetic algorithms, artificial neural networks, or decision support methods) as well as computer tools simulating such a behavior

K1st_U12: can plan and carry out life-long learning, and is aware of the possibilities of MSc studies

Social competences

K1st_K1: understands that knowledge and skills quickly become outdated in AI, and perceives the need for constant additional training and raising one's qualifications

K1st_K2: is aware of the importance of scientific knowledge and research related to AI in solving practical problems which are essential for the functioning of individuals, firms, organizations as well as the entire society within such example application fields as transport, healthcare, education, home/service robots, public safety, and entertainment

K1st_K3: knows the examples of poorly functioning AI systems, which led to the economic, social, or environmental losses

K1st_K5: can think and act in an enterprising way, finding the commercial application for the created AI-based systems, having in mind the economic benefits as well as legal and social issues

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Lectures: Assessment test conducted at the last lecture. Students must solve a test consisting of 31 questions. Each task has 4 answers, one of which is correct. The points for the tasks are summed and the following scale is used to determine the grade: <50% - 2.0, [50% , 60%) - 3.0, [60% , 70%) - 3.5, [70% , 80%) - 4.0, [80% , 90%) - 4.5, and [90% , 100%] - 5.0.

Laboratories: Assesment test conducted at the last meeting. Students must solve a test consisting of 30 practical questions regarding the conducted instructions during previous laboratories. Each task has 4 answers, one of which is correct. The points for the tasks are summed and the following scale is used to determine the grade: <50% - 2.0, [50% , 60%) - 3.0, [60% , 70%) - 3.5, [70% , 80%) - 4.0, [80% , 90%) - 4.5, and [90% , 100%] - 5.0.

Programme content

1. introduction to robotics, the main fields of application, example applications, and the main development trends.

2. introduction to Robot Operating System

3. programming in Robot Operating System

4. transformations and basic concepts in robotics

5. kinematics of kinematic chains

6. basic concepts in control theory

7 Representation of objects in state space

8. state observers and Kalman filter.

9. perception systems in robotics

10. classical vision systems in robotics.

11. mobile robots

Teaching methods

Lecture: slide show presentations on different sub-fields of AI and computational methods, illustrated with examples and practical assignments that serve as a summary of the lectures and preparation for the assessment test.

Laboratory classes: solving illustrative programming examples and coding problem solutions in Python, conducting computational experiments, discussion on the chosen methods, teamwork.

Bibliography

Basic

Mark Mitchell, Jeffrey Oldham, Alex Samuel, Advanced Linux Programming, Robot Operating System (ROS), Springer 2016

Peter Corke, Robotics, Vision, and Control: Fundamental Algorithms in MATLAB.

Bruno Siciliano, Oussama Khatib (Eds), Springer Handbook of Robotics.

Additional

Tutorial ROS: http://wiki.ros.org/ROS/Tutorials

D Belter, P Skrzypczyński, Rough terrain mapping and classification for foothold selection in a walking robot, Journal of Field Robotics 28 (4), 497-528

Breakdown of average student's workload

	Hours	ECTS
Total workload	103	4,0
Classes requiring direct contact with the teacher	53	2,0
Student's own work (literature studies, preparation for laboratory classes, preparation for the assessment test, project preparation - solving programming assignments, solving practical exercises) [1]	50	2,0

[1] delete or add other activities as appropriate