Robot Control - course description

General information

Course name	Robot Control
Course ID	06.9-WE-AutP-RC-Er
Faculty	Faculty of Computer Science, Electrical Engineering and Automatics
Field of study	Automatic Control and Robotics
Education profile	academic
Level of studies	First-cycle Erasmus programme
Beginning semester	winter term 2022/2023

Course information

Semester	5
ECTS credits to win	5
Course type	obligatory
Teaching language	english
Author of syllabus	• dr hab. inż. Maciej Patan, prof. UZ

Classes forms

The class form	Hours per semester (full-time)	Hours per week (full-time)	Hours per semester (part-time)	Hours per week (part-time)	Form of assignment
Lecture	15	1	-	-	Credit with grade
Laboratory	30	2	-	-	Credit with grade
Project	15	1	-	-	Credit with grade

Aim of the course

- To provide fundamental skills within the framework of design and implementation of control algorithms with the use of various programming languages.
- To provide knowledge on methods of control for mobile robots and robotic manipulators.

Prerequisites

Fundamentals of robotics, Control engineering

Scope

Robot manipulator as a control plant. Point to point control. PD and PID controllers. Observers. Trajectory interpolation. Robot control with Lead feedback and computed moment methods. Multidimensional control.

Robot force control. Natural and artificial constraints. Stiffness and susceptibility. Inverse dynamics in the problem space. Impedance control. Hybrid position/force control.

Advanced control. Feedback linearization. Sliding mode control. Adaptive control.

Programming of robot operation. Programming languages for robotics. Programming structures, robot programming through learning; Task-level programming languages; Requirements for programming languages.

Navigation of autonomic vehicle. Foundations of environment recognition methods. Adaptive identification of mobile robot models. Follower type motion control algorithm. State observers for mobile wheel robots. Prototyping of analyzed systems.

Teaching methods

Lecture, Laboratory exercises.

Learning outcomes and methods of theirs verification

Outcome description	Outcome symbols	Methods of verification	The class form
Can apply typical languages and methods for programming robots		• a quiz • an ongoing monitoring during classes	• Laboratory
Can apply trajectory planning algorithms for robotic manipulators and mobile robots		• a quiz • an ongoing monitoring during classes • carrying out laboratory reports	• Laboratory
Can apply basic methods of environment recognition navigation of a mobile robot		• a quiz • an ongoing monitoring during classes • carrying out laboratory reports	• Laboratory
Understands robots manipulative limitations and identifies workspace for typical robotic manipulators		• a quiz • a test	• Lecture

Outcome description	Outcome symbols	Methods of verification	The class form
Knows and can apply simple and inverse kinematics		• a preparation of a project • an ongoing monitoring during classes	• Project
Can characterize multidimensional, force and feedback linearization control systems		• a quiz • a test	• Lecture
Can design a PID regulation system for independent control of manipulator axes		• a preparation of a project • an ongoing monitoring during classes	• Project

Assignment conditions

Lecture – the main condition to get a pass are sufficient marks in written or oral tests conducted at least once per semester.

Laboratory – the main condition to get a pass is scoring sufficient marks for all laboratory exercises.

Project - the main condition to get a pass is positive grade for prepared project.

Calculation of the final grade: lecture 40% + laboratory 30% + project 30%

Recommended reading

1. Siegwart R., Nourbakhsh I.R.: Introduction to Autonomous Mobile Robots. MIT Press, 2010
2. Asada, H., and J. J. Slotine. *Robot Analysis and Control*. Wiley, New York, 1986.
3. Spong M. W., Vidyasagar M.: *Dynamics and robot control*, Wiley, NJ, 2006
4. Sciavicco L. , Siciliano B.*: Modelling and Control of Robot Manipulators,* McGraw Hill, New York, 1999
5. Corke P.: Robotics, Vision and Control, Springer, 2011

Further reading

Notes

Modified by dr hab. inż. Wojciech Paszke, prof. UZ (last modification: 11-04-2022 09:05)