COURSE DESCRIPTION CARD - SYLLABUS

Course name
Motion planning methods and algorithms [N2AiR1-RiSA>MiAPR]

Course

Field of study
Automatic Control and Robotics

Year/Semester
2/3

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
compulsory

Number of hours

Lecture
20

Laboratory classes
20

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

4,00

Coordinators

dr hab. inż. Dominik Belter prof. PP
dominik.belter@put.poznan.pl

Lecturers

Prerequisites

A student starting this course should have a basic knowledge of programming, Linux and Robot Operating System. He or she should also have the ability to obtain information from the sources and be ready to cooperate within the team.

Course objective

To provide a knowledge about mobile and manipulation robots motion planning, designing motion planning systems and matching solutions to real problems.

Course-related learning outcomes

Knowledge
Has an organized and in-depth knowledge of artificial intelligence methods and their application in automation and robotics systems (K2_W2 [P7S_WG])
Has an organized and in-depth knowledge within the selected areas of automatic control and robotics (K2_W10 [P7S_WG])

Skills

1. Knows how to simulate and analyze the operation of complex automation and robotics systems, plan and perform experimental verification (K2_U09 [P7S_UK])
2. Is able to integrate and program specialized robotic systems (K2_U12 [P7S_UW])
3. Is able to formulate and verify (in simulation or experimentally) hypotheses related to engineering tasks and simple research problems in the field of automation and robotics (K2_U15 [P7S_UW])
Social competences
1. The student understands the need and knows the possibilities of continuous education - improving professional, personal and social competences, can inspire and organize the process of learning of others (K2_K1 [P7S_KK])

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Learning outcomes presented above are verified as follows:
The knowledge acquired during the lecture is verified by one 45-minute exam conducted in an examination session. The examination consists of 20-30 (test) questions and up to 5 open questions, differently scored. The credit threshold: 50% of points. Issues for the examination, on the basis of which the questions are developed are made available during the lecture.
Skills acquired during the laboratory classes are verified on the basis of a credit colloquium consisting of 20 questions and checking the practical implementation of the motion planning problem. The credit threshold: 50% of points.

Programme content

Lecture:
1. introduction to motion planning
2 Ways of representing the environment and motion restrictions
3. control architectures in robotics and local planning (collision avoidance)
4. introduction to path planning
5. planning methods using graphs and raster maps
6. methods of sampling the search space
7 Multi-criteria motion planning
8. Data Collection Planning and Traveling Salesman Problem
9 Kinodynamic planning
10 Planning using neural networks (Deep RL)
11 Examples of applications

Laboratory:
1. introduction to Robot Operating System - data structures in motion planning and display in Rviz
2. access to data structures in the Robot Operating System
3. motion planning using graphical methods
4. motion planning using space sampling methods
5 Motion planning using the OMPL library
6. implementation of the motion planning task on the selected problem

Course topics

none

Teaching methods

1. lecture: multimedia presentation, illustrated with examples given on the board.
2. laboratory exercises: instructions carried out on computers and robots available in the laboratory

Bibliography

Basic
Steven M. LaValle, Planning Algorithms, Cambridge University, 2006

Sebastian Thrun, Wolfram Burgard, Dieter Fox, Probabilistic Robotics, MIT Press, 2005
Additional
H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki and S. Thrun, Principles of Robot Motion: Theory, Algorithms, and Implementations, MIT Press, Boston, 2005

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50