



COURSE DESCRIPTION CARD - SYLLABUS

Course name

Motion planning methods and algorithms

Course

Field of study

Control and robotics

Area of study (specialization)

Robotics and autonomous systems

Level of study

Second-cycle studies

Form of study

full-time

Year/Semester

1/1

Profile of study

general academic

Course offered in

polish

Requirements

compulsory

Number of hours

Lecture

30

Laboratory classes

30

Other (e.g. online)

0

Tutorials

0

Projects/seminars

0

Number of credit points

4

Lecturers

Responsible for the course/lecturer:

Dominik Belter, PhD, Dsc

Responsible for the course/lecturer:

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

1. has a detailed knowledge of robot motion planning methods.



2. has knowledge of how to represent the environment (maps) and limitations in motion planning systems

3. has knowledge of designing motion planning systems for mobile and manipulation robots.

Skills

1. has the ability to design and build motion planning systems for mobile and manipulation robots

2. can use motion planning tools in Robot Operating System, Linux and OMPL

Social competences

1. understands the need to continuously update their knowledge and skills in motion planning

Methods for verifying learning outcomes and assessment criteria

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

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	103	4
Classes requiring direct contact with the teacher	53	2
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) ¹	50	2

1 delete or add other activities as appropriate

