COURSE DESCRIPTION CARD - SYLLABUS

Course name

Research Project

Course

Field of study

Automation and Robotics

Year/Semester

1 / 2

Area of study (specialization)

Smart Aerospace and Autonomous Systems

Profile of study

general academic

Level of study

Second-cycle studies

Course offered in

English

Form of study

full-time

Requirements

compulsory

Number of hours

Lecture

0

Laboratory classes

0

Other (e.g. online)

0

Tutorials

0

Projects/seminars

30

Number of credit points

2

Lecturers

Responsible for the course/lecturer:

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Faculty of Control, Robotics and Electrical Engineering

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Responsible for the course/lecturer:

Prerequisites

The student should understand fundamentals of algorithm design, programming, dynamical systems modeling. The student should also be familiar with control of mobile robots and fundamentals of nonlinear control system design. The basic knowledge of optimization algorithms and problem classification is also required.

Course objective

The objective is to provide the students with an ability to autonomously read scientific papers and implement planning/control algorithms. The students also learn to investigate the results of simulations and propose their own modifications of control algorithms.

Course-related learning outcomes

Knowledge

1. The student understands methodology of finding conceptual and implementation errors in control system software.

2.The student knows basic optimization-based analysis methods for nonlinear control systems

3. The student knows application of various planning algorithms

Skills

1. The student can implement and test simple motion planning algorithms

2. The student can analyze behaviour of control systems with polynomial nonlinearities utilizing sum of squares methods

3. The student can use selected optimization software packages

Social competences

1. The student can work in small group and learns the importance of clear communication

2. The student understands that proper skills in modeling the problems are more important than tools

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

The learning outcome is verified by a project report, which is prepared by pairs of students and handed in at the end of the course. The students are also orally examined by answering 6 questions each about details of project implementation and research results. Both of those criteria are treated equally - the amount to 50% of the final grade. To pass the course, students must get more than 50% points for both the report and answers to questions.

Programme content

Brief recall of optimization problem classification and gradient-based optimization algorithms. Introduction to sum of squares optimization with basic simulation examples. Analysis and implementation of motion planning on state lattice and Rapidly Random Exploring Tree - based algorithms. Funnel computation with utilization of sum of squares programming and Lyapunov functions.

Teaching methods

Multimedia presentations illustrated with examples explalined on the whiteboard. Joint software code analysis with students.

Bibliography

Basic

1. Steven M. LaValle. 2006. Planning Algorithms. Cambridge University Press, USA.

Additional

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,0
Classes requiring direct contact with the teacher	32	1,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	18	0,5

[1] delete or add other activities as appropriate