COURSE DESCRIPTION CARD - SYLLABUS

Course name

Aerial Robots

Course

Field of study	Year/Semester
Automatic Control and Robotics	1 / 2
Area of study (specialization)	Profile of study
Smart Aerospace and Autonomous Systems	general academic
Level of study	Course offered in
Second-cycle studies	English
Form of study	Requirements
full-time	compulsory

Number of hours

Lecture	Laboratory classes	Other (e.g. online)
15	0	0
Tutorials	Projects/seminars	
0	0	

Number of credit points

3

Lecturers

Responsible for the course/lecturer:

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Faculty of Control, Robotics and Electrical Engineering

ul.Piotrowo 3, 60-965 Poznań

Responsible for the course/lecturer:

Prerequisites

Knowledge: Student starting this module should have basic knowledge regarding robotics.

Skills: He/she should have skills allowing solving basic problems related to aerial robotics. Student should understand the need to extend his/her competences.

Social competencies: In addition, in respect to the social skills the student should show attitudes as honesty, responsibility, perseverance, curiosity, creativity, manners, and respect for other people.

Course objective

1. Provide students knowledge regarding current and emerging aerial robotics systems.

2. Develop students? skills in solving problems related to modeling, control and planning of aerial robots in 2D and 3D.

3. Acquire such skills by solving practical tests during laboratory classes.

4. Develop students? skills to carry out experiments and to work with aerial robots.

Course-related learning outcomes

Knowledge

1. acquire knowledge on aerial robots - [K_W4]

2. have wide and in-depth knowledge on modeling, control and planning of aerial robots - [K_W5]

3. be informed about trends and advances in aerial robotics - [K_W6]

4. know methodology of carrying out experiments with aerial robots - [K_W8]

Skills

1. is able to acquire, integrate, interpret and evaluate information from literature, databases and WWW sources on modeling, control and planning of aerial robots. - [K_U1]

2. is able to plan and arrange self-education process in particular covering issues of aerial robot planning. - [K_U5]

3. is able to apply control and planning methods to solve engineering as well as scientific problems. - [K_U9]

4. is able to integrate knowledge coming both from different sub-domains of computer sciences and robotics to formulate and solve engineering tasks. - [K_U10]

5. can conduct experimental studies and analyse their results with statistical tools - [K_U12]

6. is able to evaluate strong and weak points of algorithms and their implementation and asses their usefulness to IT tasks - [K_U13]

Social competences

1. understands that knowledge and skills related to aerial robotics quickly becomes non relevant - [K_K1]

2. knows examples / case studies of aerial robotics and analysis and understands their limitations - [K_K4]

3. is able to correctly assign priorities to own tasks - [K_K6]

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Formative assessment:

a) lectures:

based on answers to question in the written exam,

b) laboratory classes:

evaluation of doing correctly assigned tasks (following provided lab. instructions).

Total assessment:

a) verification of assumed learning objectives related to lectures:

i.evaluation of acquired knowledge on the basis of the written exam,

ii.discussion of correct answers in the exam,

b) verification of assumed learning objectives related to laboratory classes:

i.evaluation of student?s knowledge necessary to prepare, and carry out the lab tasks,

ii.monitoring students? activities during classes,

iii.evaluation of lab reports (partly started during classes, finished after them),

iv.two written tests during the classes.

Additional elements cover:

i.discussing more general and related aspects of the class topic,

ii.showing how to improve the instructions and teaching materials.

Programme content

This course presents current and emerging aerial robotics systems. A basic problem which has to be solved by aerial robots is the problem of planning. By planning we mean the generation and execution of a plan to move from one location to another location in space to accomplish a desired task. There are three principal tasks : Path planning(Determining an optimal path for vehicle to go while meeting certain objectives and constraints, such as obstacles), Trajectory Generation(Determining an optimal control maneuver to take to follow a given path or to go from one location to another) and Collision. Moreover, it is desirable that the plan makes optimal use of the available resources to achieve the goal optimizing some 'cost' measure : the time required for the execution of the trajectory, its length, the deviation from a reference trajectory, control effort. The last part of the course covers nonlinear control design and analysis methods. The first part covers robust stability analysis, optimal control and projective control theory used to project state feedback into output feedback and Lyapunov stability theory. Key design points are discussed and illustrated through simulation examples. This course ends with an overview of open problems and future research directions.

The lecture should cover the following topics : Introduction to aerial robotics, Path planning, Trajectory generation,

Task Allocation and Scheduling, Robust stability analysis, optimal control and projective control, Lyapunov stability theory, Backstepping

The lab-classes will be focused on practical exercises with software implementations and their application to test or real situations. It should cover modeling, control and planning of aerial robots

Learning methods:

1. Lectures: multimedia presentation, presentation illustrated with examples presented on black board, solving tasks, multimedia showcase

2. Labs: solving tasks, practical exercises, discussion, teamwork, multimedia showcase, competitions or case studies

Teaching methods

Bibliography

Basic

1. F. Fahimi, Autonomous robots, modeling, path planning and control, Springer, 2009

2. C. Laugier, Autonomous navigation in dynamic environments, Springer, 2004

3. R. Colgren, Applications of robust control to nonlinear systems, AIAA press, 2003

Additional

1. Y. Bestaoui, Lighter than air robot, Springer, 2012.

Breakdown of average student's workload

	Hours	ECTS
Total workload	75	3,0
Classes requiring direct contact with the teacher	20	1,0
Student's own work (literature studies, preparation for tests, project preparation)[1]	55	2

[1] delete or add other activities as appropriate