

<b>STUDY MODULE DESCRIPTION FORM</b>		
Name of the module/subject <b>Aerial Robots</b>		Code <b>1010532121010559184</b>
Field of study <b>Automatic Control and Robotics</b>	Profile of study (general academic, practical) <b>general academic</b>	Year /Semester <b>1 / 2</b>
Elective path/specialty <b>Smart Aerospace and Autonomous Systems</b>	Subject offered in: <b>Polish</b>	Course (compulsory, elective) <b>obligatory</b>
Cycle of study: <b>Second-cycle studies</b>	Form of study (full-time,part-time) <b>full-time</b>	
No. of hours Lecture: <b>15</b> Classes: <b>-</b> Laboratory: <b>-</b> Project/seminars: <b>-</b>		No. of credits <b>3</b>
Status of the course in the study program (Basic, major, other) <b>major</b>		(university-wide, from another field) <b>from field</b>
Education areas and fields of science and art		ECTS distribution (number and %)
<b>Responsible for subject / lecturer:</b>  prof. dr hab. inż. Krzysztof Kozłowski email: krzysztof.kozlowski@put.poznan.pl tel. 61 665 2199 Faculty of Computing ul.Piotrowo 3, 60-965 Poznań		
<b>Prerequisites in terms of knowledge, skills and social competencies:</b>		
1	<b>Knowledge</b>	Student starting this module should have basic knowledge regarding robotics.
2	<b>Skills</b>	He/she should have skills allowing solving basic problems related to aerial robotics. Student should understand the need to extend his/her competences.
3	<b>Social competencies</b>	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.
<b>Assumptions and objectives of the course:</b> 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.		
<b>Study outcomes and reference to the educational results for a field of study</b>		
<b>Knowledge:</b> 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]		
<b>Skills:</b> 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]		
<b>Social competencies:</b>		

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]

### Assessment methods of study outcomes

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.

### Course description

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 or ... 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

#### Basic bibliography:

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 bibliography:

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

### Result of average student's workload

<b>Activity</b>		<b>Time (working hours)</b>
1. participating in lectures		15
2. consulting issues related to the subject of the course		3
3. studying literature / learning aids, 250 pages		25
4. preparing to and participating in exams		32
<b>Student's workload</b>		
<b>Source of workload</b>	<b>hours</b>	<b>ECTS</b>
Total workload	75	3
Contact hours	20	1
Practical activities	0	0