RTU Course "Modern robot systems"

33000 Faculty of Computer Science, Information Technology and Energy

General data

Code	DSP721
Course title	Modern robot systems
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Agris Ņikitenko
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV
Annotation	Modern robot systems architecture key aspect is the relationship between software solutions and mechanical solutions. Flexibly linking software and mechanical solutions it is possible to build robot system that can be easily modified and its parts can be reused. The course covers robots architectures and methods how to use different logics, mathematical formalisms and algorithms for planning. Significant attention will be paid to swarm intelligence solutions. The course practical part is organized as classroom courses where students will develop computer programs in the Microsoft Robotics Studio environment to solve problems covered in theoretical lectures.
Goals and objectives of the course in terms of competences and skills	The aim is to provide knowledge of robot architectures, planning methods, and theories necessary for their analysis. Tasks: 1) Be able to use different logics and mathematical formalisms for planning and realization of communication. 2) Be able to use evolutionary computation and the swarm intelligence to solve various problems. 3) Be able to analyze the robot architectures. 4) Be able to analyze and implement control in distributed robot systems.
Structure and tasks of independent studies	Practical work is organized in lectures, which are hald of total course lectures. In practical lectures students will write computer programs to solve mathematical problems explained in theoretical lectures. Part of practical work is task to write course paper.The course paper content is extension of content covered in course practical lectures.
Recommended literature	Obligātā literatūra / Mandatory resources: 1.Andries P. Engelbrecht. Fundamentals of Computational Swarm Intelligence. – Wiley. 2006, - 672 p. 2.Russell C. Eberhart, Yuhui Shi, James Kennedy. Swarm Intelligence. – Morgan Kaufmann. 2001, - 512 p. 3.Marco Dorigo, Thomas Stützle. Ant Colony Optimization. – The MIT Press. 2004, - 319 p. 4.David Poole, Alan Mackworth, Randy Goebel. Computational Intelligence: A Logical Approach. - Oxford University Press. 1998, - 576 p. 5.Davide Sangiorgi, David Walker. The Pi-Calculus: A Theory of Mobile Processes. - Cambridge University Press. 2003, - 596 p. 6.C. Hankin. An Introduction to Lambda Calculi for Computer Scientists. - College Publications. 2004, - 180 p. 7.Antoni Ligeza. Logical Foundations for Rule-Based Systems. - Springer Berlin Heidelberg. 2009, - 332 p. 8.Andrew S. Tanenbaum, Maarten Van Steen. Distributed Systems: Principles and Paradigms. - Prentice Hall. 2006, - 704 p.
Course prerequisites	Mathematics, Programming fundamentals

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
Introduction	1	0	0	0
Mathematical formalisms	6	0	0	0
Rule based systems in robotics	7	0	0	0
Function optimization in robotics	4	0	0	0
Evolutionary computation	6	0	0	0
Particle swarm optimization in robotics	6	0	0	0
Ant algorithms	4	0	0	0
Collective decision making in robot systems	4	0	0	0
Control in distributed robot systems	4	0	0	0
Robot architectures	6	0	0	0
Total:	48	0	0	0

Learning outcomes and assessment

Learning outcomes	Assessment methods
Be able to work with a variety of mathematical formalisms, for example., situation calculus, event calculus, lambda calculus, pi calculus, etc.	Practical works 1, 2 and 3. Exam questions
Know the principles of rule based systems and how to apply these knowledges in planning in robotics.	Practical works 4, 5 and 6. Exam questions
Be able to use optimization methods	Practical works 7, 8 and 9. Exam questions
Be able to use evolutionary computation methods	Practical works 10, 11 and 12. Course assignment. Exam questions
Be able to use different a swarm intelligence methods	Practical works 13, 14, 15 and 16. Course assignment. Exam questions
Be able to implement control in distributed robot systems	Practical works 17 and 18. Exam questions
Be able to analyse different robot architectures	Practical works 19 and 20. Exam questions

Evaluation criteria of study results

Criterion	%
Report of independent work	75
Final exam	25
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	4.5	1.5	1.5	0.0		*	