ROBOTICS AND INTELLIGENT SYSTEMS MASTER PROGRAM

Course Details				
Code	**Academic Year**			**Semester**
RIS 520				
Title	**T**	**A**	**L**	**ECTS**
Advanced Robotics	2	2	0	7

Language	English					
Level	**Undergraduate**		**Graduate**	x	**Postgraduate**	
Department / Program	Robotics and Intelligent Systems					
Forms of Teaching and Learning	Lectures, Practical Exercieses					
Course Type	**Compulsory**		**Elective**	x		
Objectives	Learn basic concepts and ideas of current topics in robotics and their applications in the industry.					
Content	- Introduction to ROS - Robot Programming - Visual Servoing - Robot-based Grasping (Bin-Picking) - Mobile Robots - Human-Robot Collaboration - Robotics and AI					
Prerequisites	None					
Coordinator	Prof. Dr.-Ing. Jörg Krüger					
Lecturer(s)	Prof. Dr.-Ing. Jörg Krüger					
Assistant(s)						
Work Placement						

Recommended or Required Reading	
Books / Lecture Notes	- Bruno Sicilian, Oussama Khatib. Springer Handbook of Robotics. Springer, 2008. - J. Norberto Pires. Industrial Robots Programming. Springer, 2007. - Sebastian Thrun, Wolfram Burgard, and Dieter Fox. Probabilistic Robotics (Intelligent - Robotics and Autonomous Agents). The MIT Press, 2005. - Frank Dellaert and Michael Kaess. “Factor Graphs for Robot Perception”. In: Founda- - tions and Trends in Robotics 6 (Jan. 2017), pp. 1–139. - Lihui WangXi Vincent WangJózsef VánczaZsolt Kemény. Advanced Human-Robot Collaboration in Manufacturing. Springer, 2021.
Other Sources	- ROS Wiki. URL: http://wiki.ros.org/ - Finn, Chelsea & Yu, Tianhe & Zhang, Tianhao & Abbeel, Pieter & Levine, Sergey. (2017). One-Shot Visual Imitation Learning via Meta-Learning. - Lee, Michelle & Zhu, Yuke & Srinivasan, Krishnan & Shah, Parth & Savarese, Silvio & Fei-Fei, Li & Garg, Animesh & Bohg, Jeannette. (2018). Making Sense of Vision and Touch: Self-Supervised Learning of Multimodal Representations for Contact-Rich Tasks. - Wulfmeier, Markus & Abdolmaleki, Abbas & Hafner, Roland & Springenberg, Jost & Neunert, Michael & Siegel, Noah & Hertweck, Tim & Lampe, Thomas & Heess, Nicolas &

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	Riedmiller, Martin. (2020). Compositional Transfer in Hierarchical Reinforcement Learning. 10.15607/RSS.2020.XVI.054.
Additional Course Material	
Documents	
Assignments	
Exams	Midterm, Final exam

Course Composition		
Mathematics und Basic Sciences	20	%
Engineering	20	%
Engineering Design	0	%
Social Sciences	0	%
Educational Sciences	0	%
Natural Sciences	0	%
Health Sciences	0	%
Expert Knowledge	60	%

Assessment		
Activity	**Count**	**Percentage (%)**
Midterm Exam	1	40
Quiz	0	0
Assignments	0	0
Attendance	0	0
Recitations	14	0
Projects	0	0
Final Exam	1	60
	Total	**100**

ECTS Points and Work Load			
Activity	**Count**	**Duration**	**Work Load (Hours)**
Lectures	14	2	28
Self-Study	14	9	126
Assignments	0	0	0
Presentation / Seminar Preparation	0	0	0
Midterm Exam	1	2	2
Recitations	14	3	42
Laboratory	0	0	0
Projects	0	0	0
Final Exam	1	2	2
		Total Work Load	**200**

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ECTS Points (Total Work Load / Hour)	**7**

Learning Outcomes	
1	Learning the fundamentals of Robot Operating Systems (ROS)
2	Learning the fundamentals of robot programming
3	Learning the fundamentals of visual servoing
4	Learning the fundamentals of robot-based grasping (Bin-picking)
5	Learning the current deep learning-based methods in object detection and 6D pose estimation
6	Learning the fundamental topics behind mobile robots (Lokalisation, SLAM and navigation)
7	Learning the fundamentals of human-robot-collaboration
8	Overview of the application areas of AI in robotics
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Weekly Content	
1	Introduction to ROS
2	Robot Programming (1): Overview, Online Programming
3	Robot Programming (2): Offline Programing, Hybrid Methods
4	Visual Servoing (1): Fundamentals, Camera Calibtation, Hand-Eye Calibration
5	Visual Servoing (2): Feature Detection, Tracking, Depth Perception
6	Robot-based Grasping (1): Fundamentals
7	Robot-based Grasping (2): Object Detection and 6D Pose Estimation
8	Mobile Robots (1): Kinematics of wheeled Robots, Lokalisation
9	Mobile Robots (2): Mapping and SLAM
10	Mobile Robots (3): Navigation
11	Human-Robot Collaboration (1)
12	Human-Robot Collaboration (2)
13	Robotics and AI (1)
14	Robotics and AI (2)
15	

Contribution of Learning Outcomes to Program Objectives (1-5)

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**
1							
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Contribution Level	1: Low 2: Low-intermediate 3: Intermediate 4: High 5: Very High
Compiled by:	
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