

Autonome Intelligente Systeme

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Albert-Ludwigs-Universität Freiburg

Introduction to Mobile Robotics - SS 2018

Introduction to Mobile Robotics (engl.) - Autonomous Mobile Systems

This course will introduce basic concepts and techniques used within the field of mobile robotics. We analyze the fundamental challenges for autonomous intelligent systems and present the state of the art solutions. Among other topics, we will discuss:

- Kinematics
- Sensors
- Vehicle localization
- Map building
- SLAM
- Path planning
- Exploration of unknown terrain

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- Lecturer: Prof. Dr. Wolfram Burgard,
 - Co-organizers: Chau Do Marina Kollmitz, Lukas Luft
 - Lecture: Wed 16.00-18.00 / Fri 14.00-15.00, Building: 101, Room: SR 00-010/014
 - Exercises: Fri 15.00-16.00, Building: 101, Room: SR 00-010/014
 - Exam: The exam is ORAL for bachelor students of Computer Science and WRITTEN for everyone else.
 1. WRITTEN: Wed 19-09-2018, 10:00, Building: o82 Room: 00-006 (Kinohörsaal)
 2. ORAL: Please check the date in your HISinOne
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Lectures

Lecture	Dates	Topic	Slides	Recordings
00	18-04-2018	Introduction	PDF	MP4
01	20-04-2018 25-04-2018	Linear Algebra	PDF	MP4 MP4
02	25-04-2018	Robot Control Paradigms	PDF	MP4
03	25-04-2018 27-04-2018	Wheeled Locomotion	PDF	MP4 MP4
04	27-04-2018	Proximity Sensors	PDF	MP4
05	02-05-2018 02-05-2018 04-05-2018	Probabilistic Robotics	PDF	MP4 MP4 MP4
06	09-05-2018 09-05-2018	Probabilistic Motion Models	PDF	MP4 MP4
07	11-05-2018	Probabilistic Sensor Models	PDF	MP4 MP4
08	18-05-2018	Bayes Filter - Discrete Filters	PDF	MP4
09	30-05-2018	Bayes Filter - Particle Filter and MCL	PDF	MP4

	01-06-2018			MP4
10	06-06-2018	Bayes Filter - Kalman Filter	PDF	MP4
11	08-06-2018	Bayes Filter - Extended Kalman Filter	PDF	MP4
12	13-06-2018 15-06-2018	Grid Maps and Mapping With Known Poses	PDF	MP4 MP4
13	22-06-2018	SLAM - Simultaneous Localization and Mapping	PDF	MP4
14	27-06-2018	SLAM - Landmark-based FastSLAM	PDF	MP4
15	29-06-2018 04-07-2018	SLAM - Grid-based FastSLAM	PDF	MP4 MP4
16	04-07-2018 06-07-2018	SLAM - Graph-based SLAM	PDF	MP4 MP4
17	11-07-2018	Techniques for 3D Mapping	PDF	MP4
18	11-07-2018	Iterative Closest Point Algorithm	PDF	MP4_ss16
19	13-07-2018 18-07-2018 18-07-2018	Path and Motion Planning	PDF	MP4_ss16 MP4 MP4
20	20-07-2018	Multi-Robot Exploration	PDF	MP4 MP4_ss16
21	20-07-2018	Information Driven Exploration	PDF	MP4_ss16

Exercises

Solving the exercise sheets is recommended but not mandatory to be admitted to the final exam. There are no bonus points.

Exercise sheets will be published on Fridays and will be discussed in class one week later. We strongly encourage you to solve the exercise sheets beforehand to benefit from the discussions in class.

Join this Google group forum for discussing questions on lectures and exercises or send a mail to mobilrobotics@informatik.uni-freiburg.de for an appointment with one of the teaching assistants.

Sheet	Due date	Topic	Exercise Sheet	Exercise Material	Solutions
01	20-04-2018	Setup Python	PDF		func.py
02	27-04-2018	Linear Algebra	PDF	laserscan.dat	PDF
03	04-05-2018	Locomotion, Differential Drive	PDF		PDF
04	11-05-2018	Bayes Rule	PDF		PDF
05	18-05-2018	Sampling, Motion Models	PDF		PDF
06	01-06-2018	Sensor Models	PDF		PDF
07	08-06-2018	Discrete Filter, Particle Filter	PDF	pf_framework.tar.gz	PDF
08	15-06-2018	Extended Kalman Filter	PDF	kf_framework.tar.gz	PDF

09	22-06-2018	Mapping with Known Poses	PDF		PDF
10	29-06-2018	Simultaneous Localization and Mapping	PDF		PDF
11	06-07-2018	FastSLAM	PDF	fastSLAM_framework.tar.gz fastSLAM_algorithm.pdf	PDF
12	13-07-2018	Iterative Closest Point Algorithm	PDF	icp_framework.tar.gz	PDF
13	20-07-2018	Path Planning	PDF	planning_framework.tar.gz	PDF

Additional Material

- Notes on one dimensional Gaussians (PDF)
- Notes on multi dimensional Gaussians (PDF)
- Python cheat sheet (PDF)
- Matrix cookbook (PDF)