Autonome Intelligente Systeme

Autonome Intelligente Systeme
Albert-Ludwigs-Universität Freiburg

Introduction to Mobile Robotics - SS 2011

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:

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

- Lecturers: Prof. Dr. Wolfram Burgard, PD Dr. Cyrill Stachniss, Juniorprof. Dr. Maren Bennewitz, Juniorprof. Dr. Kai Arras
- Co-organizers: Jürgen Hess, Jörg Müller
- Lectures: Tuesday 14-16, Friday 14-15, Room: Geb. 101 - SR 01-009/13
- Exercises: Friday 15-16, Geb. 101 - SR 01-009/13

Exercises

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

The exercises should be solved in groups of two students. In general, assignments will be published on Wednesday and have to be submitted the following Tuesday before class. Submit programming exercises via email to mobilerobotics@informatik.uni-freiburg.de.

- Exercise sheet 1 — Setup (PDF)
- Exercise sheet 2 — Linear Algebra, Locomotion, and Sensing (PDF, laserscan)
- Exercise sheet 3 — Locomotion, Bayes Rule (PDF)
- Exercise sheet 4 — Sampling, Motion Models, Sensor Models (PDF)
- Exercise sheet 5 — Sensor Models, Error Propagation, and Feature Extraction (PDF, split and merge framework)
- Exercise sheet 6 — Particle Filter (PDF, pf_framework)
- Exercise sheet 7 — Mapping with Known Poses (PDF)
- Exercise sheet 8 — Extended Kalman Filter (PDF, ekf_framework)
- Exercise sheet 9 — SLAM: Basics (PDF)
- Exercise sheet 10 — ICP (PDF, icp_framework)
- Exercise sheet 11 — Exploration, SLAM (PDF)
- Exercise sheet 12 — Motion Planning (PDF, planning_framework)

Slides

- Introduction PDF

- Robot Control Paradigms PDF
- Linear Algebra PDF
- Wheeled Locomotion PDF
- Proximity Sensors PDF
- Probabilistic Robotics PDF
- Motion Models PDF
- Sensor Models PDF
- Error Propagation PDF
- LSQ Estimation, Geometric Feature Extraction PDF
- Kalman Filter PDF
- Discrete Filter PDF
- Particle Filter PDF
- Mapping with Known Poses PDF
- EKF Localization PDF
- SLAM PDF
- Landmark-based FastSLAM PDF
- Grid-based FastSLAM PDF
- ICP: Iterative Closest Point Algorithm PDF
- Multi-Robot Exploration PDF
- Information Gain-Based Exploration PDF
- 3D Mapping PDF
- Robot Motion Planning PDF (updated 26.07.2011)

Additional Material

1. Octave cheat sheet
2. Basic Probabilities Rules PDF
3. Explanation and derivation of the particle filters equations for mobile robot localization and for mapping with grid maps (PDF)

Recordings

There will be no recordings this year, but you may consult the 2009 recordings in case you miss a lecture.