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Prerequisites: Consent of instructor. Solid programming experience as well as a basic knowledge of AI concepts and Embedded Systems is required

Lecture Times: Tue, Thu: 17:00 - 19:30, Machray Hall 500A, Linux Lab
Fri: 17:00 - 19:30, Linux Lab

Introduction

This course covers a variety of topics and issues in applied AI: computer vision, mobile robotics, and multi-robot systems. These abstract components are grounded in the problem of robotic soccer.

In four assignments, the students will implement the components for a team of intelligent mobile robots capable of performing interesting and challenging tasks such as robotic soccer and urban search and rescue.

The course is based on programming uses physical robots, all topics are covered with specific emphasis on real-time performance.

A selection of topics covered during lectures are:

- **Computer vision**: image processing, color models (RGB, HSI, SCT), filter cascades, visual servoing, optical flow analysis, ego-motion estimation, model matching.
- **Control**: Kinematic models of (car-like) robots, PID control, CMACs, Neural Nets.
- **Local Path planning and navigation**: Exploration algorithms, obstacle avoidance, landmark-based navigation.
- **Localization**: Monte-Carlo methods, particle fields, distance filters.
- **Mapping**: occupancy grids, topological maps, simultaneous localization and mapping (SLAM).
- **Task planning, agent architectures, and reasoning**: subsumption architecture, BDI agent model, distributed AI.
- **Machine learning**: Q-learning, instance-based learning, self-organizing maps, and genetic algorithms.

Grading

The course mark is determined by practical work (60% Assignments) and a final exam for the underlying theory (40%).
Assignments (60%)

Course assessment includes a large practical component. There are four assignments covering specific topics in the problem domain. Each assignment is worth 15%. The following list contains some sample assignment topics:

1. Path following control of a mobile robot. Implement a visual servoing based line tracker,
2. Explore an environment and identify different objects within this environment,
3. Localization in a structured environment. Follow a unmarked path in a mapped environment,
4. SLAM. Create a map of an unstructured environment and find an object hidden in the environment.

Final Exam (40%)

There will be a final exam worth 40%. The exam will be three hours long. The exam will be held during the examination period at the end of the term. Exact time and location will be advertised by Student Records.

Textbook

I will use research papers describing both some of the background material as well as the current state of the art. Students are expected to understand the material as well as being able to implement a simple version of the algorithm.

A reading list is attached to the end of this document. I will be using selections from the these publications, all of which will be made available online or in the library.

Reading List


