2011-12

CSE6324 From control to actuators

Introduction

A "robot building course", this course will follow the issues involved in building a robot or robotic system from control to actuators. This includes microcomputer control, actuator design, high-level software models, and sensor inputs.

This course involves building, from (almost) scratch an autonomous aquatic robot. Given the time constraints of the course various components have been pre-selected but you should feel free to suggest and make modifications to the basic components. By the end of the course students will have built their own autonomous system. Systems will exhibit basic mobility and sensing including state sensing (compass) as well as external sensing via video cameras. Off-board communication to remote compute/sensing will also be built. Students will construct a standard software library so that they can control and program their robot from shore using ROS or a similar toolkit. A sequence of field trials will be scheduled in the Ross Pool and Stong Pond (weather permitting) to validate the systems. Time permitting, the course will also explore multiple-robot coordination using heterogeneous teams of autonomous agents.

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Prerequisites

A previous course in robotics would be helpful, but is not required.

Course Meetings

The course meets Monday and Wednesdays from 1-2:30 in Ross South 501. The first course meeting is on September 7th. As the course progresses, the Monday meeting will likely move to the Field Robotics Laboratory in Sherman.

Evaluation

The course will proceed in two phases: Part I, development of the autonomous platform, and Part II, experiments with the platform. Depending on enrollment, Part I will be a group project with the class broken down into a small number of groups. This project will involve actual construction of the device. Part II will involve experiments with the devices. Part II can be performed in smaller groups if desired. Each part will be weighted equally (50% each).

Part I. The goal of Part I is to actually build an autonomous device. This term we will build autonomous surface vessels (motorboats). These vessels will be built from modified RC motorboats (electrical). Students will develop basic control systems to provide access to the motors and onboard sensors. Libraries will be constructed so as to provide basic vehicle mobility. (e.g., follow a specific heading at a commanded speed). Systems will be validated in field trials in the Ross pool and Stong Pond (weather permitting). Deliverables will include system design documentation, experimental validation, and a manuscript describing the system.

Part II will involve the development of software to provide higher level control of the system(s) built in Part I. Students will propose a specific problem (e.g., point to point locomotion through a set of gates), develop an algorithm to solve the problem, and evaluate their algorithm through field trials. Possible problems to consider solving include

- Point to point navigation using visual targets
- Autonomous docking with a visual target
- Leader/follower group robot tasks
- Providing sensor coverage of a larger autonomous surface robot

Building the robots

Given the time constraints of the course various hardware components have been pre-chosen for the course. This includes the specific R/C platform and onboard compute modules. Students will have to spend some time in the lab working on the various components although it will be possible for groups to take the system off-site for development.