CSCI–4190 Introduction to Robotic Algorithms, Spring 2006

Final project information

For the final project, you may pick your own topic, subject to my approval — I want to ensure an appropriate and approximately equal project scope over the whole class. I will suggest a number of projects, but you can feel free to design your own project.

Here are the basic requirements for final project topics:

- Projects are to be done in teams of 2–3 students.
- You must combine at least two topics that we have covered in the class.
- You must do an implementation and demonstration of your project on a real robot, i.e., you cannot do a project solely in simulation. A good demonstration is a fairly important component of the project.
- The emphasis of the project should be on techniques/algorithms in robotics and on robust implementation/demonstration. You will probably need to do some amount of user interface or display, but this will not count for much in evaluating the results of your project.
- Your project should take a "principled approach" to a problem, i.e., take a reasonably general approach to solving the problem instead of just using a "hack." For example, a project that deals with smoothing piecewise linear paths by simply putting circular arcs at each corner would be sort of a hack; instead, consider different representations of smooth paths (e.g., different kinds of splines) and how you can deform/change a piecewise linear path into a smooth path that is collision-free.
- You can use your code from the assignments or labs in your final project. (In fact, I would encourage this if appropriate for your project.) However, I would expect the scope of your project to be larger than for a project that isn't based on assignment or lab code.
- Your project need not be unique; it is fine if several groups work (independently) on essentially the same project.

A few suggestions:

- Don't delay getting started!!! Robot time will be in short supply towards the end of the semester.
- I don't think implementing SLAM is feasible in the time frame we have for the final projects.
- I would suggest that your project not depend too heavily on having small odometry error, i.e., a project that tries to do metric mapping without doing some sort of (independent) localization will probably not be that successful.
- If you have some prior experience with computer vision, we may be able to provide support for using the camera. We do have some libraries that do basic image processing. However, this is a robotics class, not a computer vision class, so the focus of your project should be robotics. Please contact me very soon if you are thinking about using the camera in your project.
- You can do these projects in the lab using the cardboard walls, but where appropriate you should think about running the robot in the hallways of the building.

Timeline & requirements

- Monday April 10 — form a final project group and submit a project proposal. (Preferrably, submit a proposal earlier and have it approved by Monday.)
- Monday April 24 or Thursday April 27 (TBD) — brief (5–10 minute) in-class presentation from each final project group about their topic and results to-date.
- May 1–8 — final project demonstration
- Monday May 8 — written report due (on hardcopy) by the end of the day

Suggested projects

Please note that you will still need to develop the following suggestions (adding details, figuring out exactly what techniques you will use) for a project proposal.

Some of these projects are larger than others. The larger projects would be more appropriate for a 3-student team, the smaller ones for a 2-student team. Most of these projects can be adjusted to increase or decrease the scope.

- Topological mapping — have the robot create a topological map of an area. The robot can use hall- or wall-following behaviors to get from "place" to "place." One key question: how will the robot identify the "distinctive places" that correspond to the vertices in the map.
- Hall-following & obstacle avoidance — the robot can travel down a hallway and dynamically avoid unexpected obstacles. The robot should be able to deal with small rectilinear variations in the hallway due to doors or columns as well as doors that may be open or closed.
- Motion planning, localization, & path following — place the robot (approximately) at a start location, plan a path to a goal location, possibly smoothing the path, and then execute that path while doing EKF localization to keep the robot on track.
- Localization, motion planning, & path following — give the robot a map of an area, be able to place the robot anywhere in that area, have the robot localize itself in the map (using Markov localization or particle filter localization), then plan a path to a goal location, possibly smoothing the path, and then execute the path while continuing to localize the robot.

  The problem of localizing the robot placed in a random location in the map is known as the "kidnaped robot problem."

Project proposal

Once you form your group, you should write a brief (perhaps 3–4 paragraph) project proposal. It should describe:

- The problem you will solve in your final project
- How you will approach this problem, e.g., techniques/methods that you will use, etc.
- What, if any, existing code (e.g., assignment or lab code) you will be using in your project.
- Describe the demonstration that you should be able to give at the end of your project.