

ME 131: Final Project

(Spring Quarter, 2009)

1 Final Project

Like ME 132, the nature of this course makes it difficult to give a conventional final exam. Instead, students (or student teams of 2 or 3 students) should tackle a final project whose subject is related to the content of subject matter of ME 131 (as well as ME/CS 132). The level of effort should be approximately that of 2-3 lab exercises.

The final projects can take many forms: (1) theoretical projects (e.g., proposing a new motion planning algorithm and proving its completeness; (2) simulation studies of an algorithm (e.g., implementing a SLAM algorithm in player/stage and simulating its behavior in some different environments); or (3) an experimental project (e.g., implementing SLAM or joining together SLAM and a sensor-based motion planning scheme). Below are some abbreviated project descriptions to give you some ideas for your project. You need not be constrained by this list of projects—students can propose their own projects, subject to my approval.

2 Final Project Suggestions

- Implement a SLAM system using a Kalman filter or Bayesian filter, assuming that a laser-range finder provides the measurements. At the minimum, test it in player/stage. A more ambitious project will attempt to implement the system on the ER1 robot. A very ambitious experiment would map multiple rooms.
- Implement (in player/stage, or on an ER1) a *coverage algorithm*, that will systematically sweep a bounded area (such as a room). Think of the robot trying to vacuum the room, or systematically sweeping for land mines.
- Develop a *multi-robot* planning system and demonstrate it in player/stage. There are many forms of multi-robot cooperation. One project is the *formation control* problem, which seeks ensure that a group of robots travels in a specified formation. Another problem more related to content of this course is how to plan the motions of a group of robots so that they can each reach different goals without collision.
- The *Axel* robot being developed at JPL is a *tethered* robot designed to access steep slopes (such as craters or volcanic caldera). Two ambitious projects related to Axel are:
 - Develop a motion planner that not only allows Axel to avoid obstacles, but also minimizes the chance for Axel’s tether to get “snagged.” A simpler version would plan Axel’s motions on flat ground, where tether tension is not a large issue. A

vastly more complicated (and Ph.D. level research problem) would consider how to plan on a steep slope.

- Develop a visual odometry system for Axel (using stereo cameras)

3 Final Project Schedule

Preproposal: All students should prepare a 1 page “preproposal” by Wednesday, May 20 (5:00 pm). This preproposal will contain:

- A brief description of the proposed project.
- A summary of the likely approach that will be taken by the project investigator(s).
- A listing of the “project deliverables.” That is, a description of how you propose to demonstrate and document the outcome of your project.

Due date: The final project is due at 5:00 p.m. on the last day of the spring quarter finals period. Your final project submission will consist of a project report that will include *at least* the following items:

- a short introduction that reviews the subject area of the project, the goals of the project
- a description of the technical approaches taken to solve the project problems.
- A demonstration of the project’s function (e.g., snapshots of graphical simulations, or plots of data taken from the robot).
- A “debriefing,” which is a brief summary of what you would do differently if you had more time, or started all over again.

Note that you can borrow material from your preproposal to produce this final documentation. In creating your final report, you should aim for a document that could be read and understood by another student in the ME/CS 132 class.