CS 4610/5335: Semester Project

Due: 4/22/2016

1 Project Description

The final project should be an application of an algorithm (either taught in this class or otherwise) to some robotics problem of interest to you. I expect that some projects will be implemented in ROS/Gazebo, OpenRAVE, or some other robotics simulator used in practice. However, you may also implement something using Corke's RTB, as used in the homeworks in this class. Some projects will not require a robot simulator at all. People may work alone, in pairs, or in groups of three. However, project teams with two or three people must tackle more challenging projects.

Here are some examples of projects that would be suitable for a pair of students:

- **Grasping a box**: simulate a point cloud obtained when a robot looks at box using a depth sensor. Localize the pose of the box using the depth sensor data. Move the robot arms/hands into a grasp configuration.
- **Search and rescue**: Use a SLAM algorithm to localize a mobile robot relative to a 2D map created using a simulated laser range sensor. Plan robot motion so as to minimize the time required to locate a stationary target.
- **Computer vision**: Use an object instance/category detection algorithm to locate an object of interest in an RGB or RGBD image. You may use whatever kinds of training data you want (and can obtain).
- **Planning**: Identify a set of path planning problems that are challenging for vanilla PRM or RRT to solve. Introduce some idea for sample refinement and show that the resulting algorithm has improved performance.
- **Planning**: Combine RRT or PRM with an optimization-based planning method such as trajectory optimization or LQR. Show that you obtain improved performance on some class of problems.

2 Timeline and Deliverables

2/23/16 Project proposal due. Please submit a one-page document describing a proposed problem and solution via email.

2/26/2016 In-class presentation of project proposals. Each team must give a 10-minute in-class presentation of their proposed project.

4/22/2016 In-class presentation of project results. Each team must give a 10-minute in-class presentation summarizing their findings.

4/22/2016 Final project due. You must submit a six page project report (preferably in PDF format). Also submit the code used to produce your results. Your report should include the following:

1. **Problem description:** What problem are you solving? Describe the problem from a computational perspective. What are the inputs and outputs (exactly)?
2. **Algorithms:** What algorithms do you use? Why are these algorithms appropriate? How are these algorithms typically used, and how are you using them?
3. **Results:** Quantitatively characterize how your algorithm worked. Under what circumstances does the algorithm solve your problem successfully? When does it fail? You should quantify performance somehow. For example, if you are using a search algorithm, you might report the number of nodes expanded for different problem scenarios. If you are using a learning algorithm, you might report accuracy. If you are using reinforcement learning, you might report average utility as a function of trial number.