RBE 3002 Unified Robotics IV: Navigation

Lab Assignment #5: Mobile Robot Exploration

Introduction

In this final project, you will implement mobile robot exploration, enabling your robot to explore and generate a map of an unknown environment.

Objectives

Your TurtleBot has been hired as a building surveyor. In this role, the robot must autonomously generate a map of whatever closed space it has been placed in. To ensure that this job is not given to a competitor, generating the map can take no longer than 20 minutes.

The final mapping demo will take place in the AK 120. To prepare for the demo you can practice generating maps for rooms that are easily accessible throughout the week, such as AK120 or AK108, and the basement level rooms of the building. The environment you will be mapping in the final demo will be free of moving obstacles (i.e., people).

Upon successful completion of this project, you will be able to:

1. Autonomously set navigation goals that allow the robot to efficiently discover new areas of the state space.
2. Plan a path and navigate to these goals while avoiding obstacles.
3. Generate a complete map of the space.
4. Halt exploration once the entire space is explored.

Deadlines

Lab 5: PDR's will be held on 4/28/16

Lab 6: Final project demos (AK120) 5/3/16 (reserve a time when the announcement is made via email)

Your presentation will be done alongside your demonstration.

PDR

The goal of the PDR is to evaluate your group's plan for the implementation and execution of the final project. Each group will meet with the TAs to present the plans for completing the project, including a detailed system diagram.

Final Project Report

Final submissions must be made through Blackboard. Please submit:

1. Compressed folder containing your code. The code should be well-organized and commented and must include a ReadMe file to provide an overview of your code organization and instructions for how to run it.
2. A formal report describing your implementation, including screenshots of the interface when appropriate. Include examples of mapping results in the form of images of the map. This could be for the final demo space in the gym, or for one or more spaces in AK.
3. A video (as a file or YouTube link) demonstrating the capabilities of your system. The video should include both a video of the robot, and screen capture of RVIZ during operation.
4. Any external code used for this lab should be referenced and cited within the formal report.

Project Presentations

During the lab period, each group will make a short presentation (5~10minutes) describing their final project solution. Videos and screenshots of the interface are encouraged. All members of the team are expected to participate, and each team should seek to demonstrate their mastery of the course content. The presentation will be worth 15 points towards the final project grade.

Grading Rubric

Name: _____

Name:_____

Name:_____

Implementation [150 points]

☐ Project presentation [15 points]
☐ The robot integrates its local sensor readings to generate a global map [15 points]
☐ The robot correctly identifies frontiers [25 points]
☐ The robot plans and navigates a path to the frontiers [25 points]
☐ The GUI provides information regarding sensing, path planning and nav goal selection [25 points]
☐ The resulting map accurately represents the topology of the space [25 points] ☐ The robot stops once the entire space has been explored [20 points]

Final Report [50 points]

☐ Introduction effectively presents the objectives and purpose of the lab. [5 points]
☐ Methodology gives enough details to allow for replication of procedure. [10 points]
☐ Results opens with effective statement of overall findings, presents visuals clearly and accurately, presents findings clearly and with sufficient support. [10 points]
☐ Discussion opens with an effective statement on the goals of the lab, backs up statement with reference to appropriate findings, provides sufficient and logical explanation for the statement, and addresses other issues pertinent to lab. [10 points]
☐ Conclusion convincingly describes what has been learned in the lab. [5 points]
☐ References are included and correctly referenced. [5 points]
☐ Grammar and spelling are correct. [5 points]