CS 483/503: Introduction to Robotics
Spring 2015

Project 2

1 Introduction

This project will focus on the planning component in robotics. You will fly a quadcopter in the ROS/Gazebo simulator to a subset of checkpoints of varying importance. The goal is to visit as many important checkpoints as possible and return to the starting location within a set amount of time.

This project consists of three parts. The first part requires that you submit a "Project Plan" that documents your designs and approach for solving this problem. The second part requires that you implement your plan on the simulator and demonstrate that it works. For CS 483 students, the third part requires that you submit a "Project Report" that documents the lessons learned from the project (e.g., interesting observations when you applied ideas that work well on paper to practice). For CS 503 students, the third part requires that you submit a "Paper Critique" on a research paper that will be given at a later date.

The first two parts are team assignments (i.e., each team needs to submit only one project plan and jointly demonstrate the team's implementation). The third part is an individual assignment (i.e., each team member needs to submit a *separate* project report or paper critique).

2 Project Description

Similar to Project 1, you are to fly your quadcopter to a sequence of checkpoints in the ROS/Gazebo simulator. However, in this project, you need to identify which checkpoints to visit and plan the order to visit them. The quadcopter will also need to return and land at the starting location after visiting the last checkpoint. A checkpoint is considered successfully visited only if the quadcopter reaches the coordinate of the checkpoint within a 0.5 tolerance in each axis.

You will be given the coordinates of 10 checkpoints and the weight (i.e., importance) of each checkpoint. You will also be given a time duration to complete the task. For example, 10 example checkpoints and corresponding weights are shown below. You may use 15 minutes as an example time duration.

Coordinates	Importance
(4.0, 5.0, 10.0)	1
(2.0, 5.0, 3.0)	5
(6.0, 3.0, 3.0)	7
(−16.0, −8.0, 0.5)	10
(−16.0, −10.0, 2.0)	10
(4.0, −7.5, 2.0)	5
(4.0, −8.5, 0.5)	10
(−8.0, 1.5, 0.5)	7
(−8.0, 1.0, 10.0)	1
(−8.0, 0.5, 2.0)	2

Additionally, similar to Project 1, you need to output the current location of the quadcopter and the current time in an "`output.txt`" file immediately prior to take off, upon arrival at each checkpoint, and upon landing.

Finally, your program can take at most 5 minutes before the quadcopter takes off.

The coordinates of the 10 checkpoints and their corresponding weights will be announced on the day of the demonstration. Each team will be given

3 tries to complete the task and the best try will be used. Full credit will be given if your quadcopter visits *at least* 3 checkpoints and return to the starting location within the time duration. Partial credit will be given based on the number of checkpoints the quadcopter successfully reaches within the time duration.

You will also be scored based on the importance of the checkpoints your quadcopter visits. Specifically, your score will be the sum of the importance of all checkpoints visited. Extra credit (on the project execution component) will be given to the teams with the top two highest scores. 10% will be given to the team with the highest score and 5% will be given to the team with the second highest score.

3 Document Outlines

You may use the following outlines as suggestions for how to structure your documents.

3.1 Project Plan

- **Design**: How do you plan to design your robot in terms of its underlying architecture and its algorithm? (e.g., how are you planning to choose which checkpoints to visit? how do you plan for the sequence of checkpoints? how do you ensure that your program takes no more than 5 minutes to compute a path? how do you ensure that the quadcopter has enough time to return to the starting location? how do you make sure the quadcopter does not overshoot the checkpoint? how do you ensure that the quadcopter avoids the obstacles in the map?)
- **Motivations**: What are the motivations for above decisions? Why is your algorithm a good idea? What are the assumptions that you are making with your algorithm? What goals are you planning to achieve with your design? (e.g., are you design an algorithm that is slow but robust? are you designing an algorithm that is fast but erroneous?) Why are you pursuing that goal?

- **Limitations**: What are the limitations of your design? In what situation will it not work well?

3.2 Project Report

- **Lessons Learned**: What are the lessons learned in terms of the architecture and algorithm of the robot? Did your algorithm work as expected? How can improve it?

3.3 Paper Critique

- **Summary**: If you had to summarize the paper in two or three sentences, what would they be? Do NOT copy from the abstract verbatim! ;)
- **Motivations**: Why do you or the authors think the work is important?
- **Contributions**: What are the contributions of the paper? How does it differ from the previous state of the art? How did the authors justify/verify/validate their contributions?
- **Limitations**: What are the limitations of the proposed work? Are the assumptions that the authors made reasonable? Are the experimental results interpreted in a reasonable manner?
- **Future work**: What are the potential future directions that you can take to extend the research in the paper? Is there any idea from the paper that applies to your project or your research?

4 Deadlines

- **Project Plan**: 11:59 pm, February 20, 2015
- **Project Demonstration**: Class time, March 2, 2015
- **Project Report**: 11:59 pm, March 6, 2015

- **Paper Critique**: 11:59 pm, March 6, 2015

5 Submission Instructions

Your project plan, project report, and paper critiques must be submitted in PDF format only.

Please include your full name (if it is an individual assignment) or your team members' full name (if it is a team assignment) on the front page of this document. Name the document as `Student Name/Team Name - Document Name.pdf`.

For example, `Team 1 - Project Plan.pdf`, or `William Yeoh - Project Report.pdf`, or `William Yeoh - Paper Critique.pdf`

Submit these documents online via Canvas.

Important Note: Failure to follow to above guidelines will result in point deductions. We will be enforcing strict submission guidelines for this project. We will not accept zipped files, email submissions, and files in sub-folders, etc. A submission can be updated simply by resubmitting as long as it is on or before the due date. Late submissions are not accepted.