CS 483/503: Introduction to Robotics
Spring 2015

Project 1

1 Introduction

This project will focus on the initial setup of the Gazebo open-source simulator and the Robot Operating System (ROS), where you will fly a quadrotor from its starting location to two checkpoints.

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).

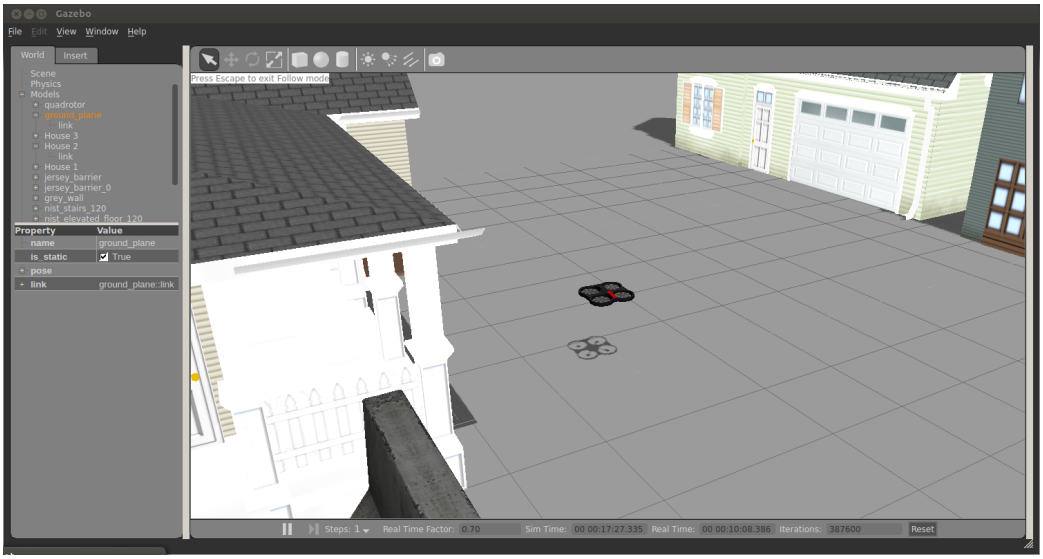

Figure 1: Screenshot of Gazebo

2 Project Description

You are to set up ROS and Gazebo and load the `ardrone.world` file using the script provided by the TA during his tutorial. Figure 1 shows a screenshot of the quadrotor in the ardrone.world environment. Then, you are to get the quadrotor to take off from its initial default location. Immediately prior to take off, you need to output the current location of the quadrotor and the current time in a file called "`output.txt`". The output should use the following format

```
(x-coordinate, y-coordinate, z-coordinate) (hh:mm:ss)
```

Then, you are to fly the quadrotor from its initial location to two checkpoints sequentially while *avoiding the obstacles in the environment*. For example, the first checkpoint can be coordinate $(4.02, -8.71, 0.04)$ and the second checkpoint can be coordinate $(-8.03, 1.80, 0.10)$. When it reaches a checkpoint, it should output its current location and the current time in the same output file using the same format as above. Each coordinate-time pair should be printed in a new line.

Finally, the quadrotor should land at the second checkpoint. Once it has landed, it needs to again output its current location and the current time in the same output file using the same format as above.

The sequence of checkpoints 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. Partial points will be given based on the number of checkpoints the quadrotor successfully reaches.

Additionally, extra credit (on the project execution component) will be given to the teams with the top three fastest quadrotors that successfully navigates through both checkpoints. 10% will be given to the fastest team, 5% will be given to the second fastest team, and 3% will be given to the third fastest team.

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 make sure the quadrotor does not overshoot the checkpoint? how do you ensure that the quadrotor 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, January 30, 2015
- **Project Demonstration**: Class time, February 9, 2015
- **Project Report**: 11:59 pm, February 13, 2015
- **Paper Critique**: 11:59 pm, February 13, 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.