ELEC 5660: Introduction to Aerial Robotics
Project 1: Phase 3

Assigned: Mar. 5, 2024 Due: 11:59 PM Mar. 22, 2024

1 Project Work

In phase 1 and 2, a controller and trajectory generator are implemented respectively. Phase 3 will focus on path finding and obstacle avoidance.

1.1 A* Path Search

In this task, you must implement a 3D **A* path search** method to find an optimal path with a safety guarantee.

We provide two simple 3D voxel maps containing the obstacles, start, and target locations. Their coordinates on the z-axis are all 1.0. The provided voxel maps are shown in Fig.1. The black dot and red star are the start and target points. Crossed boxes represent obstacles. The environments are divided into 1x1x1 M voxels, each of which is represented by the coordinate of the left-bottom corner.

We also provide one random 3D voxel map for testing. In the random map, the start point($[1.0, 1.0, 1.0]$) and the target point($[5.0, 9.0, 1.0]$) are fixed. Eight obstacles will be generated in the range of $[1.0, 5.0]$, $[2.0, 8.0]$, $[1.0, 2.0]$ (no obstacle in both the start and target points). If your algorithm passed the first two simple tests, the third test case could provide various maps for your testing.

We provide the code to pre-process these maps into a 3D map array in `path_from_A_star.m`. Here are some tips that may help you.

1. You need to design a 3D voxel map representation. For example, "0" represents the target point, "1" illustrates the start point, and "-1" means obstacles.
2. You can assume that a node is only connected to its six neighboring nodes.
3. You can connect all the path points using your previous trajectory generator.
4. You need to control your drone to follow the trajectory as the same in phase 2.

2 Structure of Simulator

The simulation code is almost the same but `path_from_A_star.m`. See `README.txt` for details.

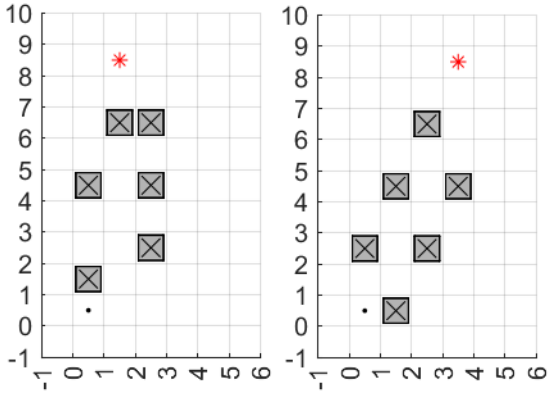

Figure 1: Grid maps

3 Submission

When you finish the assignment you may submit your code and documents on **canvas** before **Mar. 22, 2024 23:59:00**. You should submit a zip file named titled "`proj1phase3_your_name.zip`"

Please cite the paper, GitHub repo, or code url if you use or reference the code online. Please keep academic integrity. **Plagiarism** is not tolerated in this course.

Your submission should contain:

1. A **maximum 2-page** document including:
   (a) Figures which include the path and trajectory.
   (b) Analysis of your result. Include at least one of following topics: how does the heuristic function influence path finding **efficiency** and **optimality**. i.e. path finding algorithm should expand as few as possible nodes and find one of the shortest paths.
   (c) Any other things we should be aware of.
2. Folder `code` containing files `controller.m`, `trajectory_generator.m`, `path_from_A_star.m` as well as any other Matlab files you need to run your code.

You will be graded on successful completion of the tasks and how optimal your path and trajectory are. This time we will also test 10 random 3D voxel maps and count the success rate of your algorithm.