RO10005 - Advanced Robotics
Project 1 Phase 2

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1 Project Work

In phase 1, a controller is implemented and the quadrotor can track a pre-defined trajectory. Phase 2 will focus on the problem of trajectory generation. A carefully designed trajectory generator can enable the quadrotor to operate aggressively and precisely. Your task includes the following.

1.1 Trajectory Generator

A natural way to command the quadrotor is to set waypoints that it passes by. What the trajectory generator needs to do is to generate a trajectory that

1. connects all waypoints (including start and end points).
2. meets smoothness criterion.

Two sets of waypoints are provided in `test_trajectory.m`. You need to design two more sets of waypoints (with at least 6 waypoints). You can choose either 5^{th} order polynomial trajectory or minimum snap trajectory [1]. The later one is our recommendation and will win you bonus points.

2 Structure of Simulator

The simulation code is almost the same as phase 1 except for the additional `trajectory_generator.m`. Refer to comments for more details.

3 Tutorial

You can use the naive trajectory generation method in your lecture (only smoothness and connection of waypoints is required), or you can try the optimization-based method (We

encourage you generate the trajectory using this method). If you prefer the latter one, you have two ways to implement it.

1. You can use the method in the slides of Lecture 4 to map the original constrained quadratic program (QP) to an unconstrained QP, and then obtain the closed form solution of the unconstrained QP directly. TAs will give a tutorial on this solution.

2. You can use "quadprog" function in Matlab to solve the constrained QP. This function is originated in Matlab, and you can type in "help quadprog" in the command window for more detail.

4 Submission

Please submit your code and documents to hnu_ro10005@yeah.net. The project name for this assignment is titled "`proj1phase2-YOUR NAME-STUDENT ID`".

Your submission should contain:

1. A **maximum 2-page** document including:

   (a) A brief introduction of the trajectory generation method you used.

   (b) Figures plotted by the simulator.

   (c) Statistics about your controller. (For example, RMS error between current state and desired state for position, velocity).

   (d) Analysis of your result. (For example, parameter studies).

   (e) Any other things we should be aware of.

2. Folder `code` containing files `controller.m`, `trajectory_generator.m`, as well as any other Matlab files you need to run your code.

You will be graded on successful completion of the code and how quickly and accurately your quadrotor follows the generated trajectory.

References

[1] D. Mellinger and V. Kumar. Minimum snap trajectory generation and control for quadrotors. Shanghai, China, May 2011.