RO10005 - Advanced Robotics
Project 1 Phase 1

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1 Project Work

In this project, you are provided with a quadrotor simulator (implemented in Matlab) in the attachment. The simulator implements dynamic model of a quadrotor and relies on the numerical solver `ode45`. Your tasks include:

1.1 Controller

You will need to implement the controller in `controller.m`. The input of the controller includes time `t`, current state vector `s` and desired state vector `s_des`. The output of the controller is force `F` and moment `M`. Detailed derivation can be found in lecture notes and [1].

1.2 Trajectories

You are asked to drive the quadrotor flying through three sample trajectories: hovering, circle and diamond. All trajectory generators take time `t` and current state vector `s` as input and output desired state vector `s_des`. The duration of all trajectories should be 25 s. At least one circulation (for the last 2 trajectories) should be included. Besides, along the trajectory, the yaw angle of the quadrotor must be changing smoothly. Be careful about the discontinuous point of the Euler angle, such as -180° to 180° .

- `hover_trajectory.m`: Hover at $(0,0,0)$, the simplest motion. A sample code is given.
- `circle_trajectory.m`: A helix in the xy plane of radius 4 m centered about point $(0,0,0)$. The z coordinate should start at 0 and end at 3. The quadrotor should start at point $(0,0,0)$.
- `diamond_trajectory.m`: A "diamond helix" with corners at $(0,0,0)$, $(0,2\sin 45^\circ, 2\cos 45^\circ)$, $(0,0,4\cos 45^\circ)$, and $(0,-2\sin 45^\circ, 2\cos 45^\circ)$ when projected into the y-z

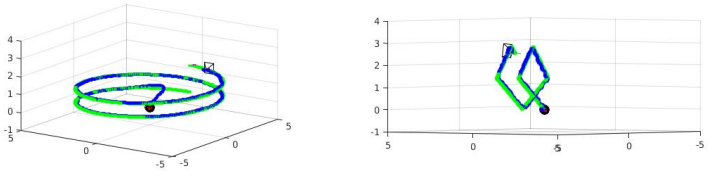

Figure 1: circle and diamond helix trajectories

plane, and x coordinate starting at 0 and ending at 4. The quadrotor should start at $(0,0,0)$.

Sample trajectories are shown in Fig. 1. Sample codes for generating such trajectories have been provided by TAs, you can directly use them. Or you can write your own trajectories, but the above requirements for the trajectories must be satisfied.

2 Structure of Simulator

A brief introduction to the code can be found in `README.txt`.

3 Submission

Please submit your code and documents to hnu_ro10005@yeah.net. The project name for this assignment is titled "`proj1phase1-YOUR NAME-STUDENT ID`".

Your submission should contain:

1. A **maximum 2-page** document including:
   (a) Figures plotted by simulator.
   (b) Statistics about your controller. (For example, RMS error between current state and desired state for position, velocity).
   (c) Analysis of your result. (For example, parameter studies).
   (d) Any other things we should be aware of.
2. Folder `code` containing files `controller.m`, `hover_trajectory.m`, `circle_trajectory.m`, `diamond_trajectory.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 three paths and another trajectory that is not released.

References

[1] Nathan Michael, Daniel Mellinger, Quentin Lindsey, and Vijay Kumar. The grasp multiple micro-uav testbed. *IEEE Robotics & Automation Magazine*, 17(3):56–65, 2010.