Udacity Nanodegree Controls

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1 Introduction

In this document I briefly explain the methods used for building the Udacity drone controller. The general workflow for the controller is as follows;

1. The Attitude controller gives the required upward thrust u1 for the drone. It is important to note that thrust is negative in the upward Z direction in the global NED coordinates.
2. The body rate controller, which accepts input angle rotation rates from the roll-pitch and yaw controllers, generates the required moments in the roll, pitch and yaw directions.
3. Finally the required individual thrusts on the four rotors of the drone are generated by the Generate-Motor-Thrust function which accepts the collective thrust (Altitude controller) and moments (Body rate controller) as inputs.

2 Altitude controller

The PID altitude controller has been implemented. The integrator has been implemented to account for drones of different masses, as has bee discussed in the project Readme. Note that the thrust carries a negative sign due to the fact that Z is negative in the upward direction. Also, the thrust is limited by the maximum ascent rate and maximum descent rate. The maximum ascent rate again carries a negative sign as the negative Z is increasing as the drone ascends.

3 Lateral position controller

A PD controller with a feed forward acceleration term is used for control of lateral positions X and Y. The commanded velocity and acceleration are limited by their respective maximum values.

Note that the above figure and plots are achieved after successful implementation of yaw controller.

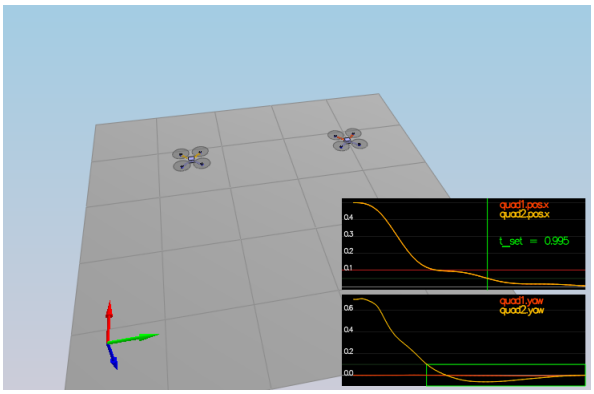

Figure 1: Altitude and lateral position control

4 Attitude control

To successfully control the attitude of the drone, the body rate controller and the roll pitch controller have been implemented. Note that this also needs the successful implementation of the Generate motor commands method as the roll pitch controller accepts the commanded thrust as input. A simple proportional controller has been implemented for the body rate controller. The roll pitch controller also uses a proportional controller. The attitude controller makes use of the rotation matrix terms. The terms are directly mapped onto the commanded angular velocities.

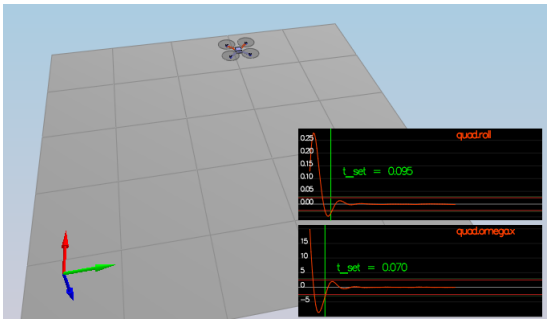

Figure 2: Attitude control