ME293 Project 1a

Hu Huang

Department of Computer Science
Tufts University
hu.huang@tufts.edu

1. Introduction

1.1 Physical system

The physical system that I want to study is the altitude control of a fixed wing aircraft.

1.2 Motivation for study

This is related to my research as I delve into various flight control software. I think it will be good for me to have a deeper understanding of how they work.

1.3 Description of system states

I am considering using the full 12 states of the aircraft which include:

1. Positions in the inertia frame: x, y, z
2. Velocities in body frame: v_{bx}, v_{by}, v_{bz}
3. Roll, pitch, yaw rates: p, q, r
4. Euler angles: ϕ, θ, ψ

1.4 Description of sensor data used for estimation

If we assume all states can be sensed directly, one potentially interesting route would be to add instrumentation into ardupilot to record the values of the state variables. Pick a representative scenario and derive the data. In fact, in one of the bug injection experiments I had, one of the bugs had a large pitch demand at one point when the plane came in for a landing. Maybe in a later project when the states are not all directly sensed I can bring in the sensors.

As for the sensors, I'm not sure about this yet, but I think the following would make sense (basically the things available in Ardupilot)

1. IMU (accelerometer, gyros)
2. GPS
3. Barometer

1.5 Description of approach to develop a model

I plan on using the following references to get the dynamics equations:

1. Model-based fault diagnosis for aerospace systems: a survey [1]
2. Aircraft Dynamics and Automatic Control [2]

References

[1] J. Marzat, H. Piet-Lahanier, F. Damongeot, and E. Walter. Model-based fault diagnosis for aerospace systems: a survey. *Proceedings of the Institution of Mechanical Engineers, Part G: Journal of Aerospace Engineering*, 226(10):1329–1360, October 2012.

[2] D.T. McRuer, D. Graham, and I. Ashkenas. *Aircraft Dynamics and Automatic Control*. Princeton Legacy Library. Princeton University Press, 2014.