QuadCopter Dynamics and Controls: Ramp-Up Reading…

I started to sketch a quadrotor model myself and derive the equations of motion, but I lost confidence and figured it would be best to sample the literature first. Below is a list of papers I found online. Click the links to see the papers.

All the papers are useful, but I found the, “PID vs LQ Control Techniques Applied to an Indoor Micro Quadrotor” by Bouabdallah et al. to be a most useful reference. It is becoming my primary basis for understanding and modelling the system I need to design a controller for.

PID vs LQ Control Techniques

modelling_of_quadrotor_minicraft

design_of_four_rotor_aerial_robot

Thesis KTH – Francesco Sabatino

State Space System Modeling of a Quad Copter UAV

Modelling of the ETH Helicopter

linearization

A goal here is to develop a dynamic model and controller scheme as a platform for learning and applying, “Optimal Control and Estimation” techniques.

The multi-input model can be broken into a set of independent PID servos for level flight (hover). It will be interesting to retain the coupled system in which roll, pitch, and yaw terms interact over a larger, “flight envelope” (larger roll and pitch angles) and not just small control action from level flight. It might not be necessary for much practical flying, but we’re going to follow some advanced topics for the fun of it.

The Bouabdallah paper above doesn’t jump to model simplifications and linearizations. It maintains consideration for gyroscopic effects because the focus is on a lightweight, presumably highly dynamic platform. I’m also intrigued by the, “successive linearization” concept presented.

We’re going to get a better grasp on model linearization through this exercise. We’re going to better understand how to modify the, “state transition matrix” (typically termed matrix ‘A’ for continuous control models and ‘F’ for discrete-time models). Hence the, “Linearization” paper above.