ASEN 3128 Assignment 4

Due: Thursday, February 20 at 11:59 PM on Canvas

1) Design a feedback control system for the linearized lateral and longitudinal dynamics of the quad copter to stabilize elevation and bank attitude. Use feedback gains on measured pitch rate and roll rate, along with feedback gains on measured elevation and bank angles. **Design these feedback gains to produce modal behavior for the "top two" states in the lateral and longitudinal sets such that the modes have real eigenvalues, and one eigenvalue dominates the time constants in each set with a value of 0.5 sec.** Keep the angular rate feedback control from Assignment 3 for the azimuth portion of the system.
2) Simulate the response of the **closed loop linearized** system to initial condition deviations from the steady hover trim state as follows:
    a. Deviation by +5 deg in bank
    b. Deviation by +5 deg in elevation
    c. Deviation by +0.1 rad/sec in roll rate
    d. Deviation by +0.1 rad/sec in pitch rate

   Discuss the resulting behavior. Does it correspond to the expected behavior from the linearized modal response theory? Is steady hover now a stable flight condition?
3) Repeat 2) using the **non-linearized** dynamics model together with the feedback control design for the linearized system, and compare the closed loop linearized and non-linearized behaviors.
4) Implement your control design on the Rolling Spider quad copter, using the feedback gains derived above. It is difficult to emulate specific initial conditions for the quad copter (as in the above simulations), although response to a non-zero angular initial condition can be emulated by **giving the quad copter a corresponding step in angle command away from trim, for a short time (e.g. 2 sec), then back to zero trim again.** Compare the resulting behavior with the simulations (for initial condition deviations in bank and elevation).