AE 450 Final Project *Due on Dec. 23 12:00(A.M.), 2019*

Instructor : Hyochoong Bang

Your task is to design a lateral autopilot control for an aircraft. Also, a quad-rotor type multicopter system is to be handled. The dynamics model can be found from any textbook or web-site. There are plenty of them.

Problem #1 Lateral Autopilot Design Practice

Part 1. Please find out any linearized model of lateral motion of an aircraft from any textbook or web-site. The system dynamics shall be given in the following form. Please refer to lecture note for details.

$$\dot{\mathbf{x}} = A\mathbf{x} + B\mathbf{u}$$

where $\mathbf{x} = [v, p, r, \phi]^{\mathrm{T}}$, and the control input $\boldsymbol{u}$ may include rudder and/or aileron.

Part 2. Demonstrate a roll/yaw coupling effect(such as adverse yaw) using the given lateral dynamics in Part 1. Please refer to lecture note for more information.

Part 3. Design a yaw damper with a washout filter. Plot the time responses to verify your design.

Part 4. Please refer to the lecture note and design lateral coordinated turn maneuver controller with your best efforts. Plot the resultant time responses.

Problem #2 Simulation of Gust Response to a Discrete Gust

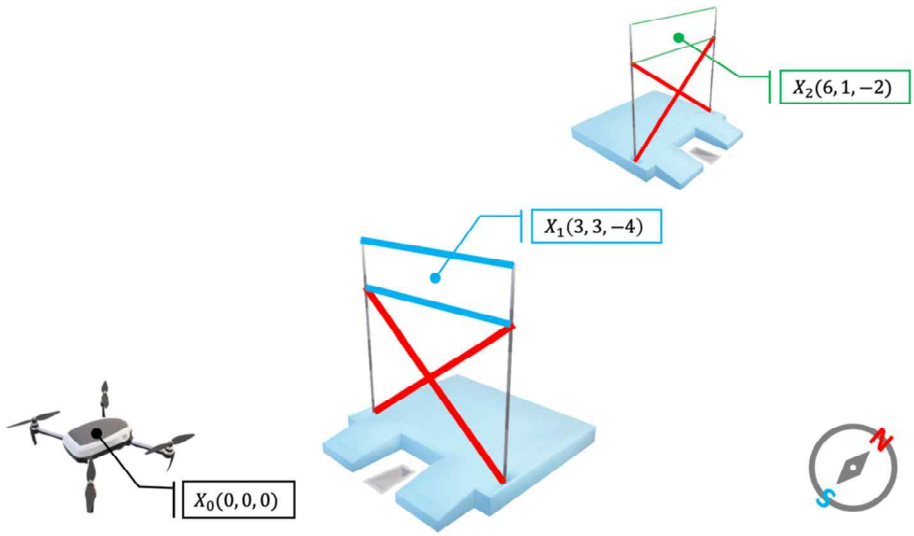
Follow the text book of “3ed Flight Dynamics Principles buy M.V. Cook” page 472-473. Reconstruct the plot Figs. 14.7 and 14.8 with different longitudinal linear dynamics model. *It is not DC-8 model but should be a different model* from any paper or references available. You should be able to construct Eq.(14.30) on page 455 for the simulation.

Problem #3 Auto-pilot Design for a Quad-rotor type Multicopter

Quad-rotor fly-off competition! Your goal is to fly your drone from the full stop initial position $X_0(0,\ 0,\ 0)$[m] to the goal post at $X_2(6,\ 1,\ -2)$[m] via the first post at $X_1(3,\ 3,\ -4)$[m] based on the local NED coordinate frame. Each post has a 2[m]×1[m] window that drone can pass through, which means your drone shouldn't have to pass the points exactly, yet within 0.3 radius sphere accuracy considering the body itself. The first post is facing South and North, and the second post is facing East and West. Other than that, **mandatory rules you must fulfill are as follows:**

- You must use a Quad-X type multi-copter airframe.
- You must use the specifications and coefficients, such as mass, inertias, arm-length, etc., in the lecture note[#10] to design your Quad-X for the fairness of the competition.
- Your motors cannot exceed 10,000 RPM.

Scoring: Total Score = S1×S2
S1 = The integrity of your simulator (Max. 10pts.) / 10
S2 = 31 − [Your Rank].
[Your Rank] = Based on your arrival time @X2. Who comes first will be get 1, second will get 2, third will get 3, ... etc. **Violations of the rules could be treated as the last(18th) place.**



Note : The number of maximum pages for report should be less than 20 excluding computer code. Original computer code should be submitted together with the report.

Thank you everyone with your great follow-through and all efforts! I wish you all the best and happy winter break!