

## ASSIGNMENT #5

DR. SANKALP K. BHAN

**Due Date: 02/27 @ 6:00 pm.**

### 1. RULES

Submit your work before the deadline and a hard-copy in my box or in class. As a reminder, late-work is graded but receives no credit.

### 2. ACADEMIC INTEGRITY

This is an individual assignment. I expect everyone to turn in their own Matlab code, their own Simulink models, and their own writing. The assignment will also require you to collect your own data from your UAV.

Post any and all questions on canvas, and I will answer them as soon as possible.

### 3. ASSIGNMENT

This assignment adds signal processing for our 1-g hover feedback control system.

**Basic Signal Processing:** We have linear dynamics to develop the control system; however, we may not have the available feedbacks to control our system.

- (1) Collect the signals

$$X_{ned}, Y_{ned}, h, p, q, r, \dot{u}, \dot{v}, \dot{w}, \phi, \theta, \psi, u, v, w$$

from your UAV with all motors set to 200 Hz

- (2) If any of these signals are missing on your UAV, attempt to reconstruct them with naive integration. Don't make an observer yet.

$$\dot{\phi} = p.$$

Therefore, if your UAV does not have  $\phi$  available, integrate  $p$  to estimate  $\phi$ .

- (3) Take the fast finite Fourier transform of the signals from your UAV's data for the signals

$$p, q, r, \dot{u}, \dot{v}, \dot{w}, u, v, h.$$

- (4) Add a low-pass filter to your UAV's code that destroys any noise apparent in the signals. Note that you may not need to apply a filter to every signal, and if the signal seems clean to you, don't add a filter, but explain why it seems clean. Code that performs a Fourier transform will be made available on canvas (example\_fft.m)
- (5) Collect the filtered signals from your UAV and incorporate them into your data-logging plot scripts
- (6) Over-plot the original time history with filtered time histories

$$X_{ned}, Y_{ned}, h, p, q, r, \dot{u}, \dot{v}, \dot{w}, \phi, \theta, \psi, u, v, w$$

- (7) Take the FFT of the filtered version of the signals  $p, q, r, u, v, w$
- (8) For each of the following,  $p, q, r, \dot{u}, \dot{v}, \dot{w}$ , provide a single Bode-plot of the transfer matrices (magnitude-phase plot of the frequency response) that overlays raw and filtered frequency responses.
- (9) For each of the following,  $p, q, r, \dot{u}, \dot{v}, \dot{w}$ , provide a single Nyquist plot of the transfer matrices (real vs imaginary plot of the frequency response) that overlays the raw and filtered frequency responses.

#### 4. WHAT TO TURN IN

Please submit files individually into Canvas (no-more Zips please).

- (1) All matlab files pertaining to this work
- (2) All Simulink models pertaining to this work
- (3) A report that includes all numbered items from the assignment section.

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