Precision Motion Control – Midterm Exam (Due 2pm 4/9/2024)

In an optical coherence tomography (OCT) imaging system, a galvanometer is used to direct the laser beam to create the desired scanning pattern. In this exam, you will be asked to design digital controllers for the galvanometer based on the model you identified in Lab Assignment #1.

Please complete the following assignments:

1. Collect step response data (i.e., u(k) is a step function and you need to record y(t)).
2. Design, analyze, and verify a full order state estimator using the discrete plant model you identified in Lab Assignment #1. Next, using the data collected in (1), compare the measured output y(k) and the estimated output \hat{y}(k).
3. DAVI (Design, analyze, verify, **implement**) state observer feedback control (direct digital control design) using the full order state estimator obtained in (2).
4. Perform the step response of the state observer feedback closed-loop system. Is there any steady-state error?
5. Track a 400 Hz sine wave using the state observer feedback controller. Discuss your experimental result with the sensitivity function.

Please submit the following items to NTU COOL:

A written report that includes the discussion made on your results. Place and sign the following statement in your submitted work: *We did this exam by ourselves without working with or getting help from any other group.*

Hints:

1. Do not use Pa(s) to design your controller. Pa(s) is only applicable to the verification.
2. Make sure \hat{y}(k) aligns with y(k), except for noises. This is the key to success.
3. You may build a Simulink model for the design, analysis, and verification of the state estimator and state observer feedback control.