ME 4811

Lab #5: Disturbance Estimation/Integral Control

Consider the "Phoenix" equations of motion from Lab #4.

Do the following:

1. In order to simulate the system using the control law that you developed in Lab #4, you need to know the value of the current v_0. In practice this will not be measurable. Therefore, assume that you have measurements for ψ, r, and y, and build a reduced order observer to estimate v and v_0. Use appropriate poles for the observer.

2. Simulate the system using the two values for the current from Lab #4. Use the estimated values for v and v_0 in the control law. Is your observer estimating the true value for the current? Is there a steady-state error in the response?

3. Evaluate the performance of your compensator by simulating the system in a current which is sinusoidal in time with a period of ten "seconds." Compare the estimated and true value of v_0 as the current period is varied. Summarize your observations. How would you alter your observer design if you needed to estimate a sinusoidal current? Do not redo the design here but describe the procedure and set up the matrices.

4. Evaluate the response of your system by assuming v_0=0 and adding a general disturbance force F and disturbance moment M in the right hand side of the sway and yaw equations, respectively. Use F=0.001 and M=0.0002 for the simulations. How is your system performing? What is your observer estimating? Can you interpret what is physically happening to the design? What would you do if you wanted to design an observer for general disturbances F and M? No calculations are needed here, but give the values for the matrices involved.

5. Design an integral control to take out the steady state error of the system. Since no disturbance feedforward is required, use the reduced order observer that you have from a previous lab. Use a "sufficiently large" time constant for your integrator; i.e., the fifth pole in the pole placement command should be less negative than the others. Simulate the system for both values of v_0 and then for v_0=0 and the two values of F and M. Also do a simulation where no disturbances are acting. **Summarize** your results and conclusions with regards to feedforward control/disturbance estimation vs. integral control.