

ASEN 4114/5114 Experiment 1

Due: Friday, January 21, 2022 at the beginning of lab.

1. [10pts] Find the parameters R_M , L_M , K_τ , and K_B from the motor specification sheet, noting units.
2. [20pts] Simulate the system relating power amp voltage V_P to sensor voltage V_S using a single transfer function block from the Continuous library in Simulink. I suggest you compute polynomial coefficients in a separate m-file (as in the intro_sims.m example), so the simulink system can be built using simple variable names from the workspace. Use a sinusoidal power amp input voltage (1V peak, 1Hz), and plot the corresponding input and output signals, with appropriate units. Does the output follow the input closely?
3. [10pts] Derive the closed loop transfer function between reference angle θ_R and load shaft angle θ_L when the controller has a proportional-plus-derivative (PD) control law, i.e.
$$V_p = G_p(\theta_R - \theta_L) + G_D \frac{d}{dt}(\theta_R - \theta_L).$$
Determine the DC gain of the closed loop system.
4. [20pts] Construct a Simulink model of the control system including both proportional and derivative control. DO NOT create one block that represents the closed loop transfer function derived in Part 3. Instead, create a second block for the control law itself and then connect it in a unity-feedback control system with the Plant block from part 2.
5. [10pts] Plot the simulated step response (0.4 radian amplitude) of this closed loop control system using a proportional gain of 10 V/rad and a derivative gain of 0.1 V/rad/s. Compare the steady state tracking behavior to that predicted by the DC gain calculated in part 3.
6. [20pts] Repeat part 5, but use sinusoid reference signals at 0.4 rad amplitude, with frequencies of 0.2 Hz and 2 Hz. Comment on the relative tracking ability of the system at these two frequencies.