EEE 342 Feedback Control Systems
Spring 2024-2025
Lab-1 Preliminary Work Manual

Download the Matlab workspace file `prelab1_response.mat` from Moodle. This file contains the time and angular velocity data, which has a sampling frequency of 10KHz, and obtained from simulation of a DC motor. 6V step change is applied to the terminals of a DC motor and its angular velocity data is recorded.

1. Suggest a method to determine a first order approximate transfer function between the angular velocity and input voltage (type each step of your calculations in the report). By using this method, find a first order approximate transfer function for the DC motor and compare its response with the original data. Plot the output of your transfer function where $r(t) = 6u(t)$, on top of given data.

   Hint: Use the low pass filter
   $$H_{LPF}(s) = \frac{1}{0.001s + 1}$$
   to reduce measurement noise on data. You need to use Simulink to filter the signal. The blocks in your Simulink diagram should include:
   Simulink Library Browser → Sources → From Workspace: The variable name should match with the one in your workspace.
   Simulink Library Browser → Continuous → Transfer Fcn: Enter the correct polynomials in numerator and denominator. Note that entering [0.001 1] results with $0.001s + 1$.
   Simulink Library Browser → Sinks → To Workspace: The variable name should be a different string to avoid overwriting input data.

   Then, by assuming that the pole of first order approximation is dominant, neglect the effect of LPF on filtered data. Since you will have two unknowns to find first order approximation, while choosing the data points, use `round(mean(y(t)))` where $2 < t < 10$ seconds, to determine the gain, and choose a point in the interval $0 < t < 0.1$ to find the time constant. Following this procedure will ease your calculations.

   After you find the first order approximation, check if the pole of the transfer function (p_{TF}) is dominant compared to the pole of LPF (p_{LPF}), i.e.,
   $$|\Re\{p_{TF}\}| < \frac{|\Re\{p_{LPF}\}|}{10}$$

2. Please study the Proportional (P) and Proportional-Integral (PI) controller and explain the effect of P and I controllers to the system response (in terms of overshoot, settling time, peak time, etc.). Please also comment on why we need to add integral controller to compensate for the steady-state error in the case of velocity control example.

This is a technical report, therefore you need to type equations by using mathematical tools of the text editor you are using, and use the appropriate template with introduction and conclusion sections. Also, your report should include all the Matlab codes you used for this work. Note that you need to do your preliminary works individually.