

EE155/255 F17 Homework 3

Motor Simulation and Feedback Control

Assigned 10/9/17

Due 10/16/17

For Lab 4 we will be controlling an electric motor. In this homework you will simulate the motor in Matlab and develop a feedback controller for the motor. Refer to Chapters 29 and 30 of the course notes for relevant background. The motor in the lab has the following parameters.

$$K_M = 220 \text{ rpm/V}$$

$$R_M = 3.401 \text{ Ohms}$$

$$L_M = 13.58 \text{ mH}$$

Assume a load inertia of

$$J_L = 0.1754e-6 \text{ Amperes*s}^3\text{V}/(\text{rad}^2) \text{ or } \text{kg*m}^2$$

Problem 1

In Matlab, write a function that simulates the behavior of the motor for a small time step. Its inputs should be the time step Δt , PWM duty cycle, and supply voltage. It will also need to know the load inertia and motor parameters. Make a plot that simulates the response of your motor to a step in the PWM from a duty factor of 0 to 0.5 and then back to zero. Allow enough time between the transitions for the motor to reach steady state. The motor operates from a 24V supply.

Problem 2

Design a controller that will keep the motor running at a given constant speed (setpoint). Implement it in your simulation and show that it tries to hold the motor speed steady when the load or speed setpoint changes.

The controller has the following inputs available:

1. Motor speed
2. Motor current

3. Setpoint speed

The controller's output is a PWM duty factor between 0 and 1.

Plot the motor speed and current for acceleration from stopped to one speed, from there to a higher speed, and to a lower speed. The controller needs to limit current to a safe value in all cases. Show that the controller is safe when given a very high setpoint (even an unreachable speed) and when stopping from a high speed.