Mech 221: Computer Lab 7

Hand in the solutions to the three questions in the lab at the *end* of the lab.

Question 1: Turning on the motor

In this question, we are going to simulate the response the motor has to a step input signal.

- Use the MATLAB `ode45` command to simulate the response of the Parker BE341F DC motor described in the pre-lab to a unit step in voltage. Assume the system starts from rest. If you describe the motor as a first order system in the variables ω (angular velocity) and i_a (armature current) the plots required below will be easy to generate.
- Plot the angular velocity ω and the armature current i_a vs time over a duration of about five times the system time constant.
- What is the steady-state angular velocity (in rpm) predicted by your computation?
- What is the steady-state armature current predicted by your computation?
- *Hand in your plots above and your predictions of the steady state angular velocity and armature current.*

You can check that your predictions of the steady state are correct by considering the underlying equations at steady state and solving a linear system of equations for the steady state quantities.

Question 2: Response to a periodic input

- Using an input $V(t) = \sin(\omega_n t)$ (in volts) and initial conditions for the system at rest, simulate the response of the system. Here, ω_n is the natural frequency of the system found in pre-lab Question #2.
- Make plots of the angular velocity and the armature current in time for this case over eight times the system time constant.
- What is the amplitude of the angular velocity oscillations at the end of the simulation?

- *Hand in your plots above and your estimate of the amplitude of the oscillations.*

Question 3: Estimation of the quality factor

For an underdamped system such as this one, a rule-of-thumb is that the quality factor is roughly the ratio of the amplitude of the response at the natural frequency to the amplitude of the DC response. Using the amplitudes from the simulations in Questions #1 and #2 above, estimate the quality factor using the rule-of-thumb. Compare to the exact value from your pre-lab Question #2. *Hand in your prediction of the quality factor from the rule-of-thumb and comparison to the exact value, showing your work.*