Lab 4 - Simulink and Non-Linear Modeling

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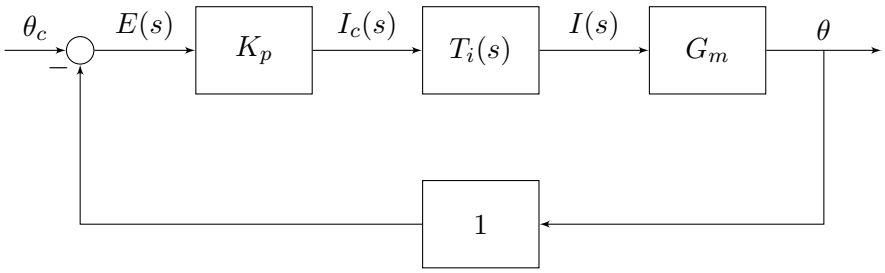
1 Introduction

- The Motorlab won't be used in today's lab. Instead we will be making a simulation of the hardware in Simulink and compare results found from the friction lab
- Simulink is different because it allows us to do non-linear simulations. Example, students might have noticed gravity has never been included in dynamic equations, it is modeled as a disturbance. Gravity can be added in with Simulink.
- The simulations are setup like those from a block diagram. It is possible to model a system as a block diagram and then simulate it with Simulink

2 The Model

$$\frac{\theta(s)}{\theta_c(s)} = \frac{K_p k_t k_{dr}}{Js^2 + bs + K_p k_t k_{dr}}$$



3 Introduction to Simulink

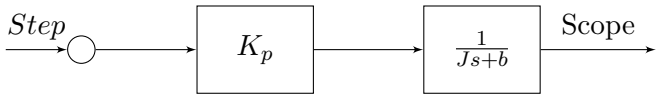
- Simulink and MATLAB are dynamically linked together
- This means Simulink can see changes to the workspace in MATLAB
- This also means Simulink can output variables the MATLAB workspace that can be read

3.1 Develop Simple Models in Simulink

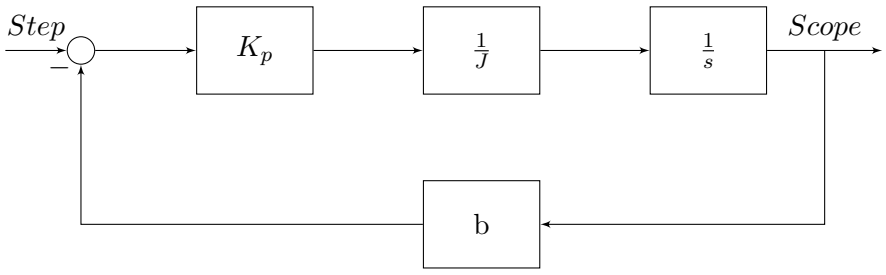
To illustrate how simulink works, demonstrate a few examples

1. Run setup.m file
2. To open simulink, type 'simulink' in the command window
3. Open the library browser. This is where all the different blocks are located
4. Continuous time blocks are were you can find things like the transfer function, etc.
5. Sinks are exactly what the name implies. Scopes, to workspace variables etc.
6. Sources are things like step inputs, sin waves etc.

3.1.1 Open Loop Model



3.1.2 Closed Loop Model



4 Other useful information

4.1 The First Simulation

- The first simulation what you are doing is looking at the initial condition response that was done in the friction lab. However this time we are simulating the motorlab rather than actually running in on the hardware.
- Top block diagram is the actual motorlab simulation
- Bottom block diagram is the linear estimate for friction that we came up with
- There is an error somewhere in linear block diagram you have to find.

4.2 The Second Simulation

- The only two things that need to be done for the second simulation are: Putting in the transfer function block for the linear position control diagram.
- The second thing you are doing is putting the controller gains into the Nonlinear position control simulation

4.3 Other things

- Order of blocks matters. Remember different blocks emit different signals
- Ex. The controller block (i.e. Kp) emits a current.
- For the nonlinear position control simulation, notice we are asking you to saturate the current
- On the real motorlab system, the motor amplifier saturates the current at +- 3 amps. You need to incorporate that in your simulation using the saturation block.
- Explain why friction is a feeback term.
- Explain why there is a saturation block in the feedback