Introduction

In this lab we will be modeling and simulating 2nd order systems. The reason we focus on 2nd order systems and their responses will become apparent within a few weeks. To kick off the semester, your first assignment will be a refresher of what you learned in ECE 431.

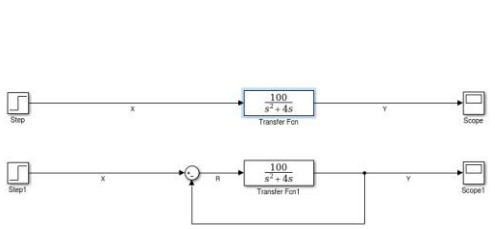
MATLAB and SIMULINK

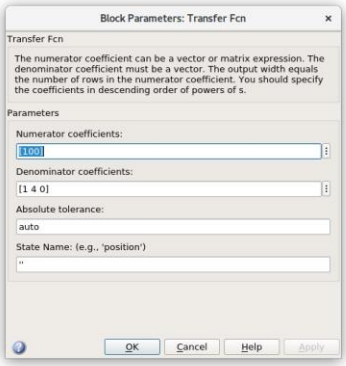
Before we can proceed, please install MATLAB which is available at https://ist.njit.edu/matlab.

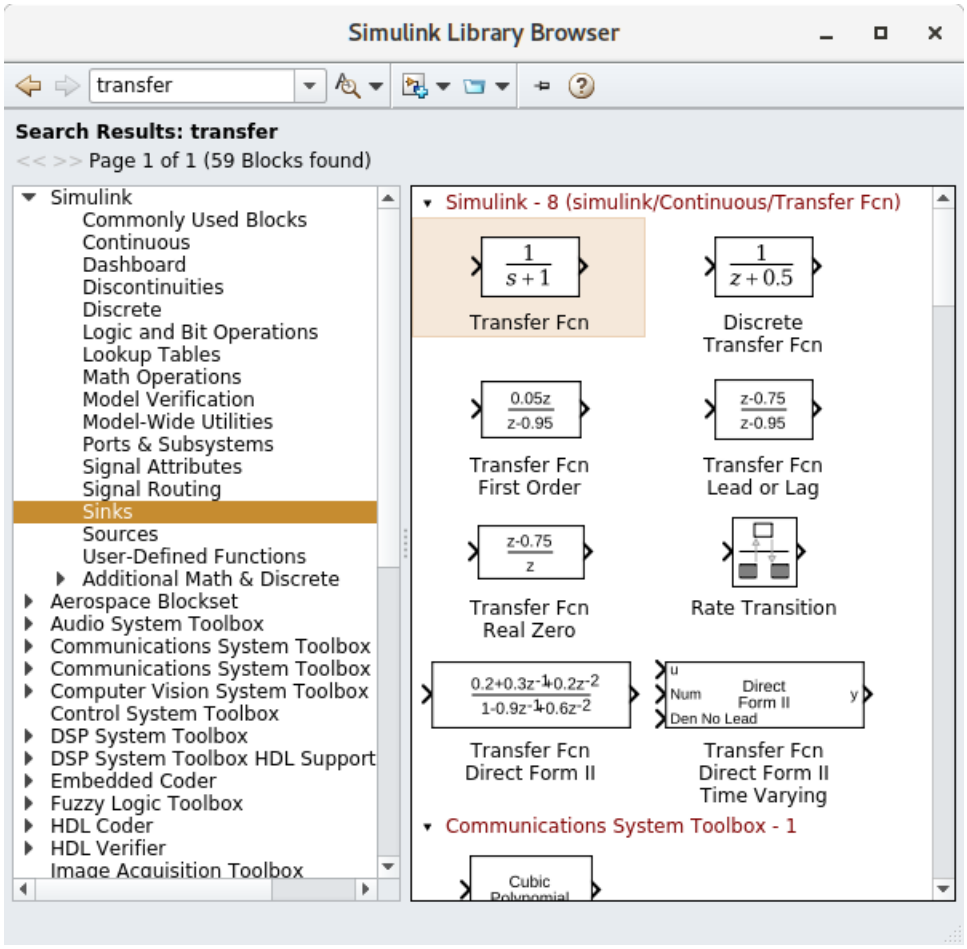
Assignment

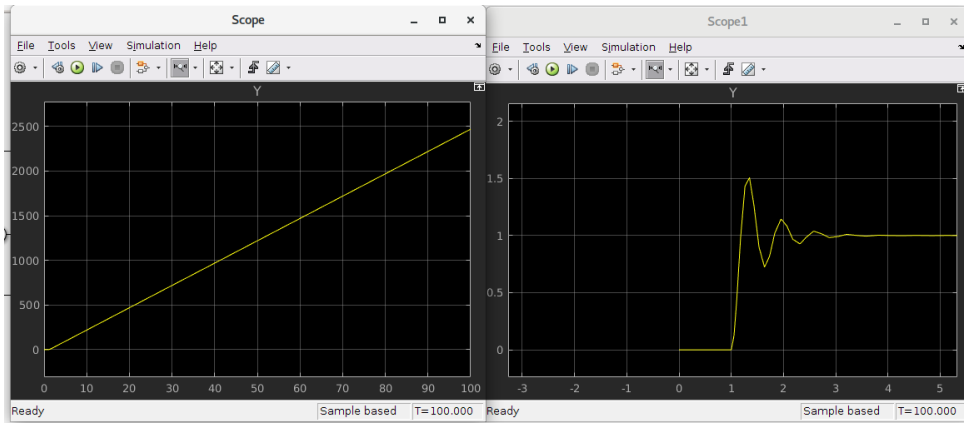
1. Install MATLAB
    a. Check out this video for an intro to MATLAB
    https://www.youtube.com/watch?v=qGiKv3-02vw
    b. Check out this video for an intro to SIMULINK
    https://www.youtube.com/watch?v=vxzR3W2BcRk
2. Get familiar with MATLAB
    a. For Matrices **B** = [1 2 3; 4 5 6; 7 8 9]; **A** =[3 2 1; 1 3 4; 1 2 3]; **C** = [1 2; 1 4; 1 5];
        1. **A**+**B**
        2. **A***B**
        3. **A**.***B** (What is the difference between this and A*B?)
        4. **A**' (What is this?)
        5. **C***A** (What's wrong?)
        6. **A**+**B**; (What did the ';' do?)
    b. Create the following vector **V** = [1 2 3 4 5 6 7 8];
        1. Create a new complex vector **J**=**V**+1i***V.** (What just happened?)
        2. **J**'
        3. **J**.' (What's the difference? Hint: type doc transpose and doc ctranspose for help in the command window.)
        4. Create a complex variable a = 2 + i2. (Use 1i = i)
    c. SIMULINK
        1. Create a new blank model and call it "secondOrder.slx"
        2. Add a source "Step"
        3. Add a sink "Scope"
        4. Add a transfer function and give it the following equation "100/(s^2+4s)"
        5. Label the input wire "X"
        6. Label the output wire "Y"
        7. Run the simulation and add the scope image to your report
        8. Close the loop by adding negative feedback
        9. Run the simulation for the closed loop and add the image to your report

Hints


Step
x
100
s² + 4s
Transfer Fcn
Y
Scope
Step1
x
R
100
s² + 4s
Transfer Fcn1
Y
Scope1


Block Parameters: Transfer Fcn
Transfer Fcn
The numerator coefficient can be a vector or matrix expression. The denominator coefficient must be a vector. The output width equals the number of rows in the numerator coefficient. You should specify the coefficients in descending order of powers of s.
Parameters
Numerator coefficients:
[100]
Denominator coefficients:
[1 4 0]
Absolute tolerance:
auto
State Name: (e.g., 'position')
''
OK
Cancel
Help
Apply


Simulink Library Browser
transfer
Search Results: transfer
<< >> Page 1 of 1 (59 Blocks found)
Simulink
Commonly Used Blocks
Continuous
Dashboard
Discontinuities
Discrete
Logic and Bit Operations
Lookup Tables
Math Operations
Model Verification
Model-Wide Utilities
Ports & Subsystems
Signal Attributes
Signal Routing
Sinks
Sources
User-Defined Functions
Additional Math & Discrete
Aerospace Blockset
Audio System Toolbox
Communications System Toolbox
Communications System Toolbox
Computer Vision System Toolbox
Control System Toolbox
DSP System Toolbox
DSP System Toolbox HDL Support
Embedded Coder
Fuzzy Logic Toolbox
HDL Coder
HDL Verifier
Image Acquisition Toolbox
Simulink - 8 (simulink/Continuous/Transfer Fcn)
Transfer Fcn
Discrete Transfer Fcn
Transfer Fcn First Order
Transfer Fcn Lead or Lag
Transfer Fcn Real Zero
Rate Transition
Transfer Fcn Direct Form II
Transfer Fcn Direct Form II Time Varying
Communications System Toolbox - 1
Cubic Polynomial


Scope
File Tools View Simulation Help
Y
2500
2000
1500
1000
500
0
0 10 20 30 40 50 60 70 80 90 100
Ready
Sample based
T=100.000
Scope1
File Tools View Simulation Help
Y
2
1.5
1
0.5
0
-3 -2 -1 0 1 2 3 4 5
Ready
Sample based
T=100.000