

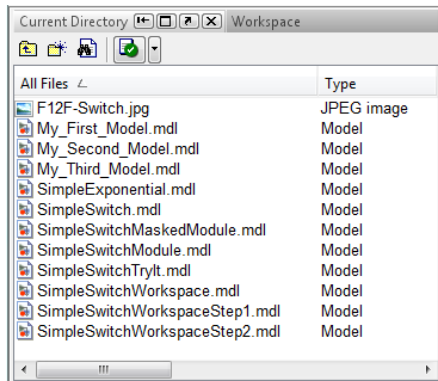
# EE202 Lab#10 Interactive Simulink Tutorial – Part 2

## Modeling Transfer Functions

Follow along with this interactive tutorial on Simulink. After watching each interactive tutorial section, please do the example in Simulink. Along the way take snap-shots of your work as shown below. I use the snipping tool which comes with Windows 7 – Accessories / Snipping Tool) of your work. Please **do not** take snap-shots of the tutorial itself or these instructions. To save time, some of tutorials are included in a folder you can download as part of the tutorial.

[http://www.mathworks.com/academia/student\\_center/tutorials/slregister.html](http://www.mathworks.com/academia/student_center/tutorials/slregister.html)

Before you begin, set your Matlab Current Directory to “Simulink Tutorial.” Next, create a subfolder and name it “Modeling Transfer Functions.” By the end of the lab your folder should contain the following models.

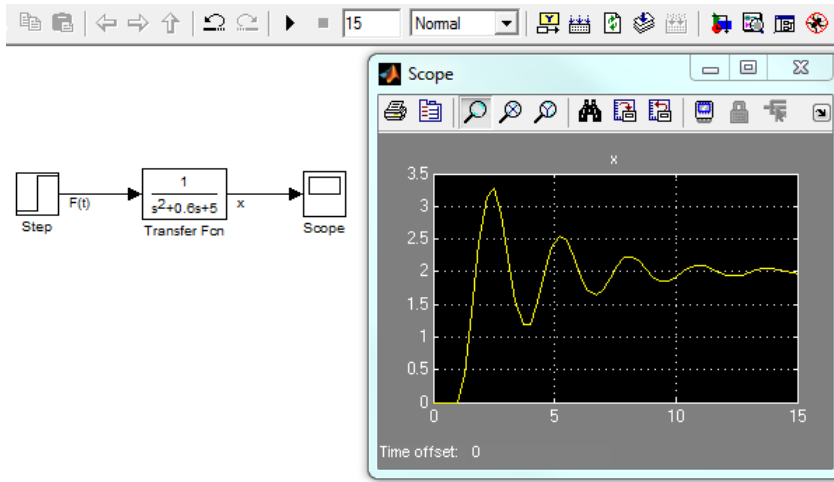


## Using Simulink to Model Continuous Dynamical Systems

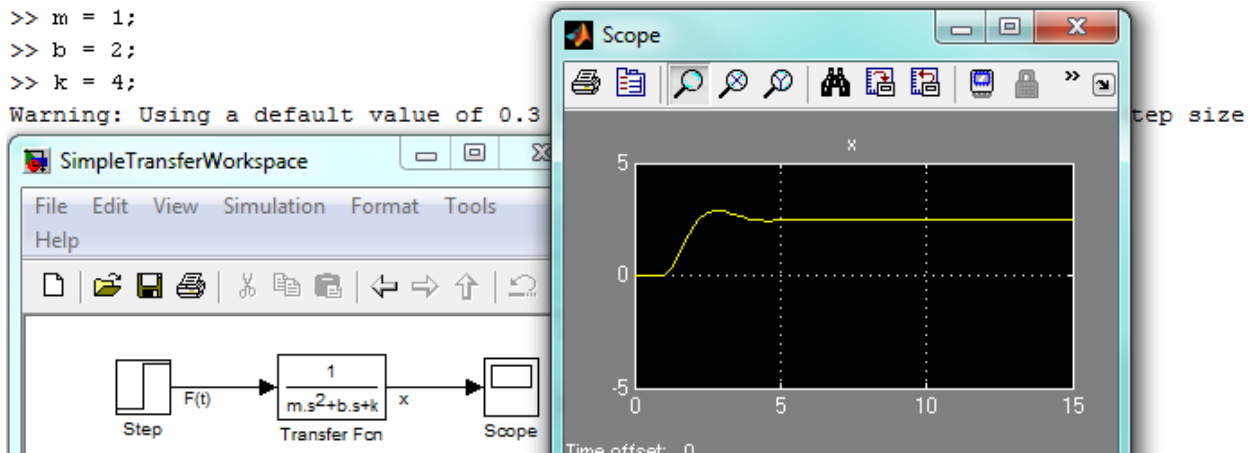
- Mass Spring Damper Example
- Modeling Transfer Functions
- Modeling a System of Differential Equations
- Applying System Modeling to Controls

## Modeling Transfer Functions

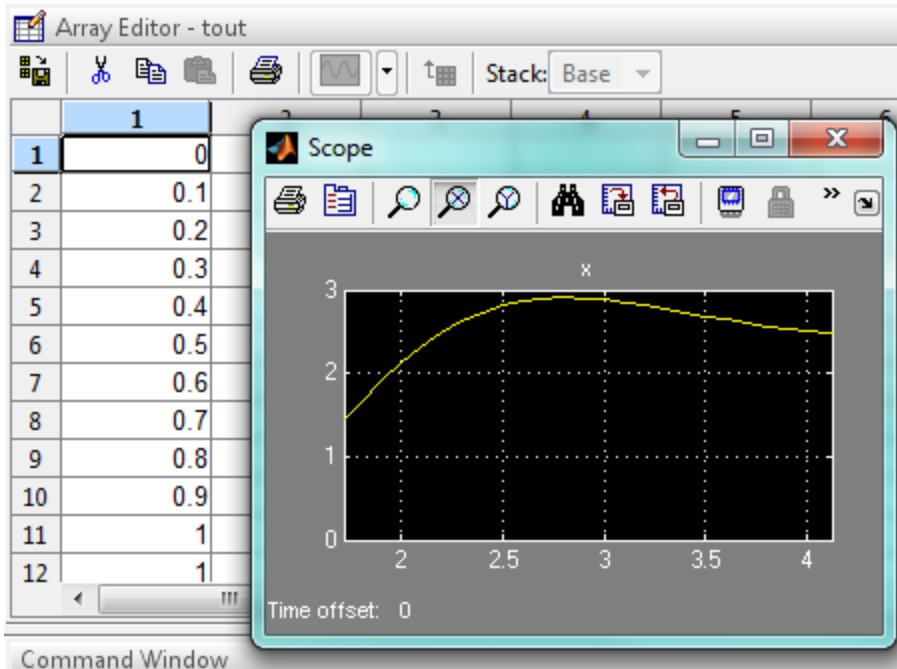
- Transfer Functions: Mass Spring Damper
- Transfer Function Block
- Try It – Locating the Transfer Function Block
- Completing the Model
- Running the Model
  - Save your model with the name **SimpleTransferFunction**.
  - Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 1**.



- Tuning the Model
  - Save your model with the name **SimpleTransferWorkspace**.
  - Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 2**.



- Q&A – Entering Coefficients
- Under the Hood – ODE Solvers
  - Controlling integration Errors. *Continue to work with your SimpleTransferWorkspace model.*
  - Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 3**.

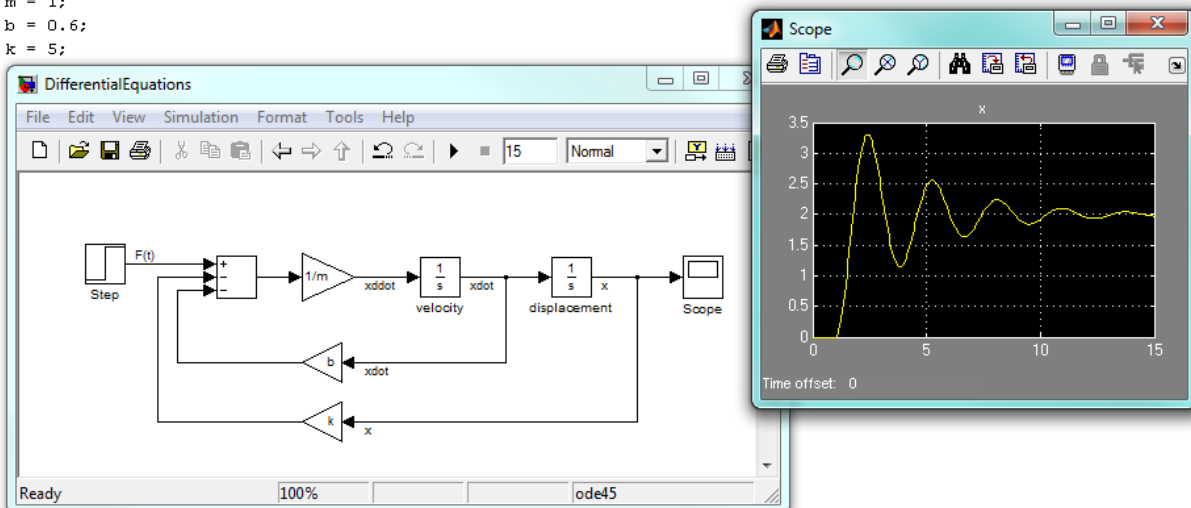


- Discrete Transfer Function Block
  - You will be implementing the discrete model built in this section of the tutorial at the end of the lab (see Lab Question 6)
- Summary

## Modeling a System of Differential Equations

- Differential Equations: Mass Spring Damper
- Q&A – How many integrator Block
- Building the Model
  - Save your model with the name **Differential Equations**.
  - Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 4**.
- Compare the model output from Question 1 and 4.

```
>> m = 1;
>> b = 0.6;
>> k = 5;
>>
```



- Q&A – Steps to Modeling Differential
- Summary

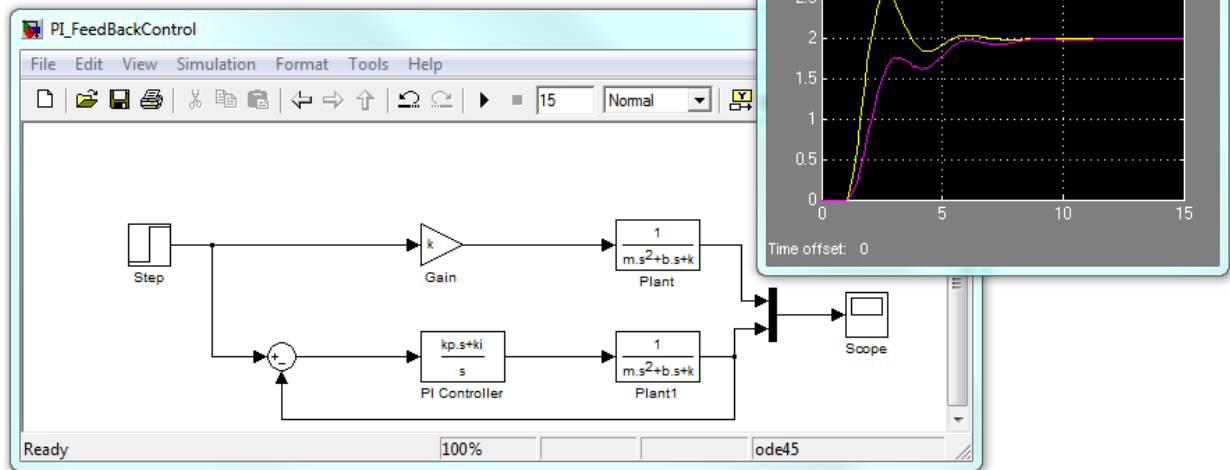
## Applying System Modeling to Controls

- Feedback Controls - Continuous
  - Build the first continuous feedback PI control Model shown in this section of the tutorial and reproduced here.
  - In addition to the variable definitions shown in the picture, to recreate the simulation I assigned the Final Value property of the Step block to  $u$ , and the Max step size in the Simulation > Configurations Parameters window to 0.1.
  - Save your model with the name **PI\_FeedBackControl**.
  - Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 5**.

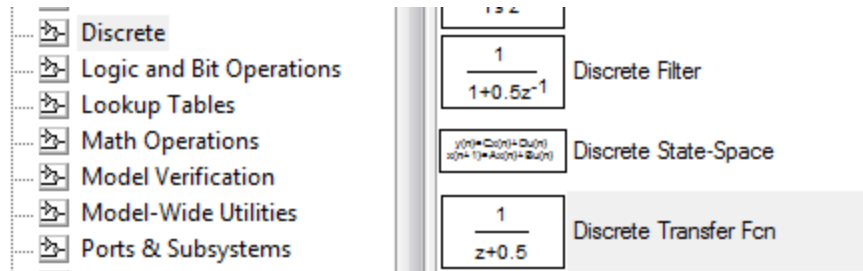
```

b = 1.5;
k = 4;
ki = 2.6;
kp = 1;
m = 1;
u = 2;
>>

```



- Feedback Controls - Discrete
  - In place of the remaining two examples provided in the tutorial, the last being a discrete transfer function, you will be implementing the discrete transfer function described in the “Modeling Transfer Function [10:13] – Discrete Transfer Function” section. Before you continue listen again to this section.
  - Feedback control systems can also be implemented using microcontrollers. These systems work in discrete units of time (the sample time). Convert your continuous PI feedback control model to discrete time by replacing the continuous transfer block with a Discrete Transfer Function block.



- Within the Function Block Parameter window be sure to set the Sample time to  $T_s$  seconds and set this variable to .01 in the Workspace window.
- After entering the transfer function, you will need to expand the block in the simulation window in order to see the equation displayed in the block.
- Save your discrete model with the name **DiscretePI\_TransferFunction**.
- Include the title of this section and a snap-shot of your Simulink model and scope display as **Lab Question 6**.

```

% Continuous Time Example
b = 1.5;
k = 4;
k1 = 2.6;
kp = 1;
m = 1;
u = 2;
% Discrete Time Example
% Sample Time 0.01 seconds
Ts = 0.01;

```

- Additional Examples
- Tutorial Summary