ECE 257 - LESSON 24
INTRODUCTION TO SIMULINK - PART I

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Matlab is a program for doing matrix based calculations. Simulink is a graphical interface to Matlab that is particularly useful in design of systems like control and communication systems.
Reference: *Mastering Simulink* by Dabney and Harman

IN CLASS

OPENING SIMULINK

Open Simulink by first opening Matlab and then click on the Simulink icon to the left of question mark with all the different colors. Then open a new file.

SINEWAVES

1. Displaying a Sinewave on a Scope
    a. Click on sources and drag over a sinewave generator
    b. Click on sinks and drag over a scope
    c. Connect the sinewave generator to the scope
    d. Double click on the scope icon to display the scope window
    e. Run Simulink by selecting Start in the Simulation menu or clicking on the start icon. Click on the binoculars to autoscale the output

2. Varying the Parameters of a Sinusoid
    a. Double click on the sinewave icon and change the parameters to generate $5\sin(2\pi 1000t + 1.2)$
    b. Click on the 2nd icon from the left on the scope window to modify its parameters to obtain 3 cycles of the sinusoid
    c. Change the stop time at the top of the window from its nominal value of 10 to a more appropriate value. Use the configuration parameters in the Simulation menu to make the step time small enough to get a nice smooth graph
    d. Run the simulation

3. The Gain Block
    a. Open the "commonly used" library
    b. Select and drag over a gain block (in the shape of a triangle). Set the gain to 2
    c. Insert the gain block between the sinewave generator and the scope in Example 2
    d. Run the simulation

4. Dual Trace Scope
    a. Set the scope to have two inputs
    b. Run a connection from the sinewave generator in Example 3 directly to the scope
    c. Run the simulation to simultaneously see both the input and output of the gain block

5. Adding a Second Sinusoid
    a. Go to sources and drag over a 2nd sinewave generator and set it to $5\cos(2\pi 2000t + 1.2)$
    b. Go to the "commonly used" menu and drag over a summer
    c. Connect the two sinewaves to the summer for

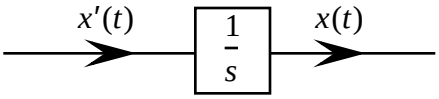
$5\cos(2\pi 1000t + 1.2) + 3\cos(2\pi 2000t + 1.2)$

d. Display the sum on the scope

INTEGRAL AND DIFFERENTIAL EQUATIONS

6. Step Inputs
   a. Drag over a unit step - set the start time to 0
   b. Display the unit step on a scope

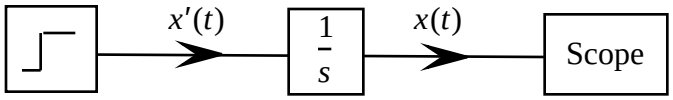
7. Integration of the Unit Step
   a. Drag over an integrator symbolized by $\frac{1}{s}$. We then have



   b. Now connect a unit step to the integrator so that

$$x'(t) = u(t)$$

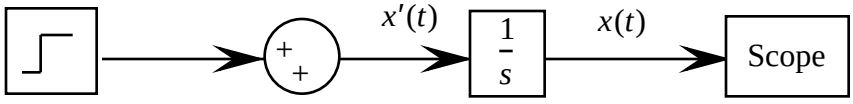
   and then display the input and output of the integrator on a scope as follows. Again set the start time of the unit step to $t = 0$



8. Differential Equations
   a. In the Integration example we found $x(t)$ for the case $x'(t) = u(t)$. In this example we find $x(t)$ for the more general case of the following first order differential equation

$$x'(t) + x(t) = u(t) \qquad x'(t) = -x(t) + u(t) \qquad x(0) = 0$$

   The first step is to insert a summer into the Simulink diagram of the Integration example as follows



   b. And then bring feedback around from the output of the integrator as follows. Note that a line can be connected to an existing line by pressing the control key as you use the mouse to draw the line