EE 1130
Freshman Eng. Design for Electrical and Computer Eng.

Class 2

Signal Processing Module (DSP).

- Matlab and Simulink.

Signal Processing Engineer

- We are detectives of hidden information in signals.
  - Communication signals: obtain the information.
  - Signals from CO_2 sensors, heat sensors, etc.
  - Data from Hard Drives.
  - Data from Computers to computers.

- In orde to do that we study MATHEMATICS!!

Matlab

- Matlab is a powerful tool for mathematical/engineering research and development. It is also useful to students to easily computate or solve almost all mathematical and engineering problems.

- This Signal Processing Module will use Matlab as a development and teaching tool.

- Matlab is learned in the course EE 3220 Software Applications in Electric Engineering.

Matlab

- We will use the **Simulink** part of Matlab for two main purposes

  - We will emulate/modelate a low frequency signal corrupted with an additive noise (high frequency signal).
  - Implement a FILTER that will eliminate a high frequency component (ripple or noise) meanwhile leaving untouched a low frecuency sinewave.

- This phenomenon is common in any electrical system, where the 60Hz signal from the power lines corrupt a signal of interest as an Electro EncephaloGram (EEG), Electro CardioGram (EKG), or just a sinewave.

Matlab

- To run Matlab, just double click on the matlab icon.

MATLAB 6.5.lnk

Matlab

- The Matlab window application will appear. We can see different sub-windows:
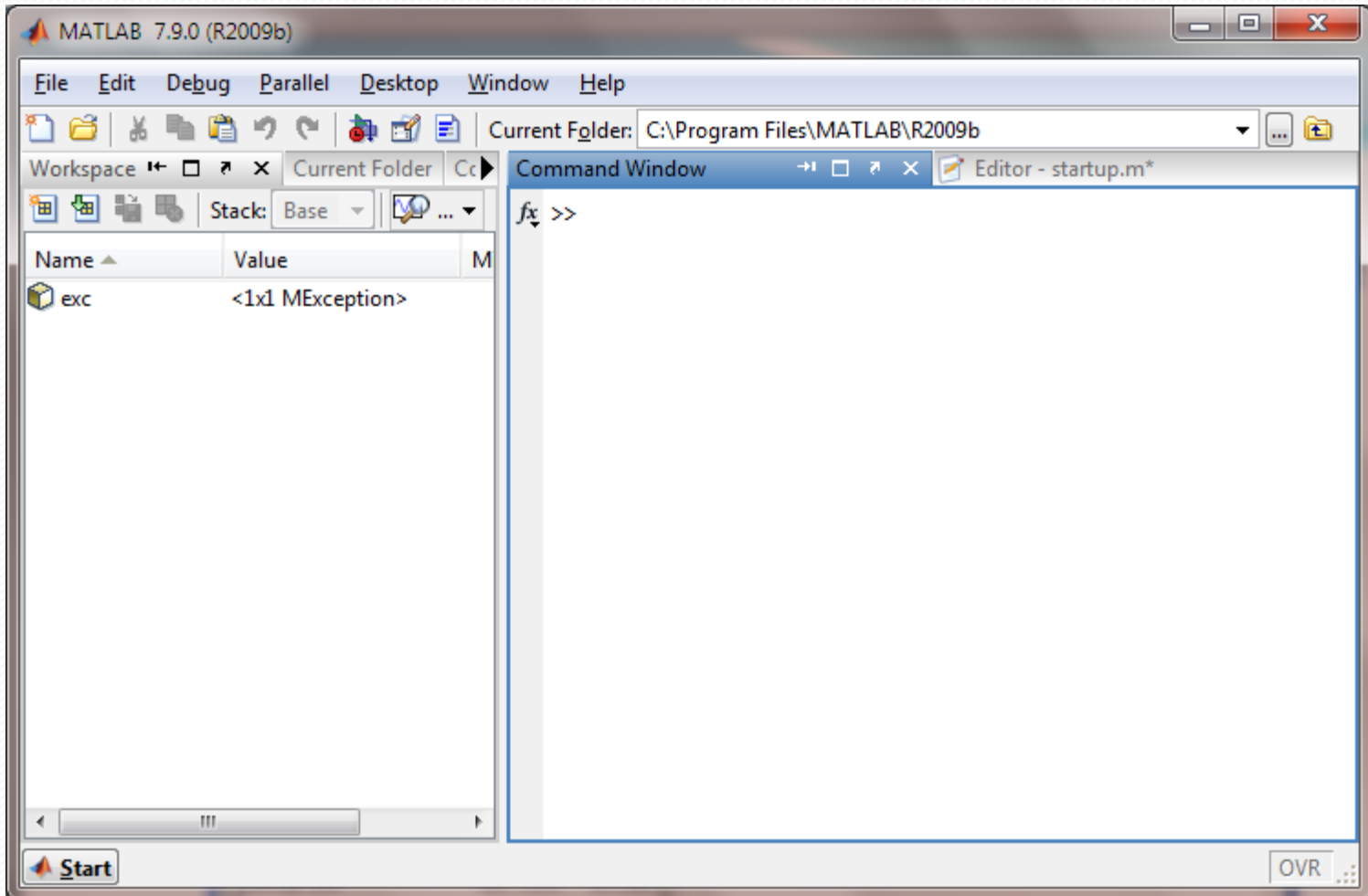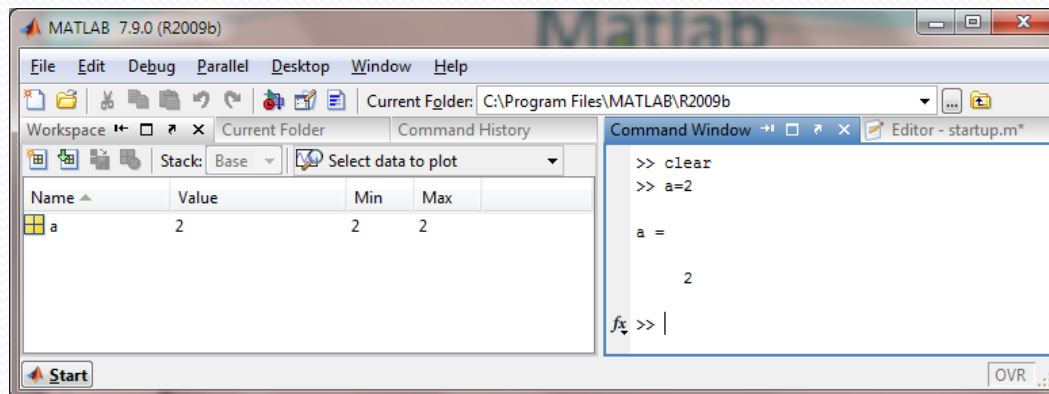
Matlab

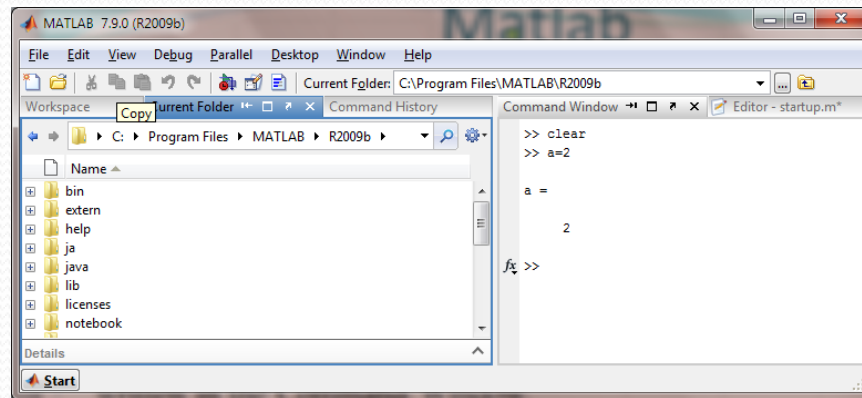- **Command window**: is the one where the user writes the variables and where the results are displayed
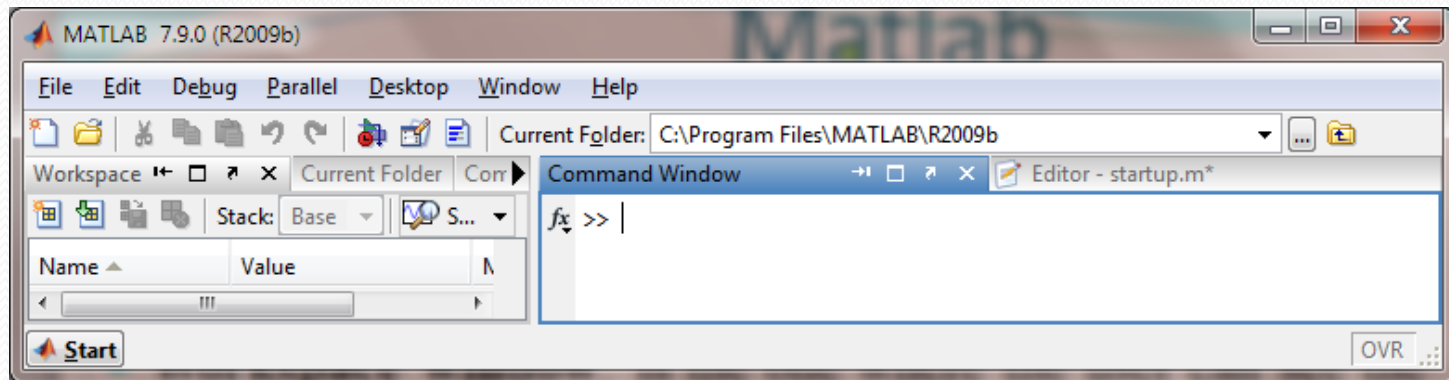
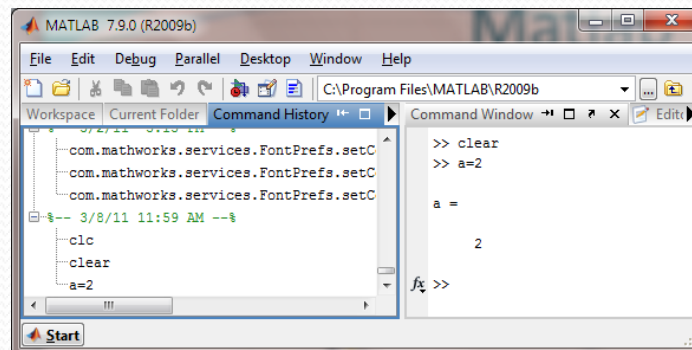- **Workspace window**: is the one where the user can see the variables.

Matlab

- **Current Folder window**: is the one where the user can see the different files stored in the current directory. The current directory is the one that Matlab uses to store and read files.
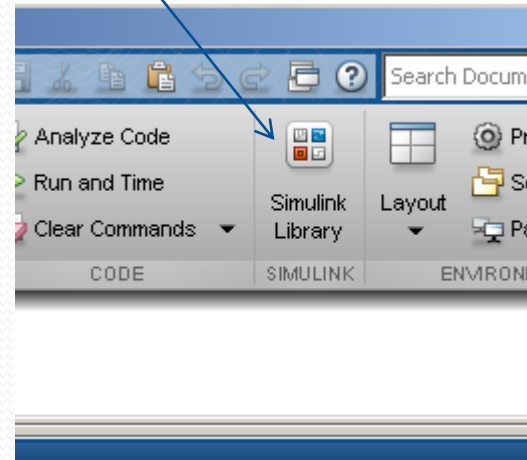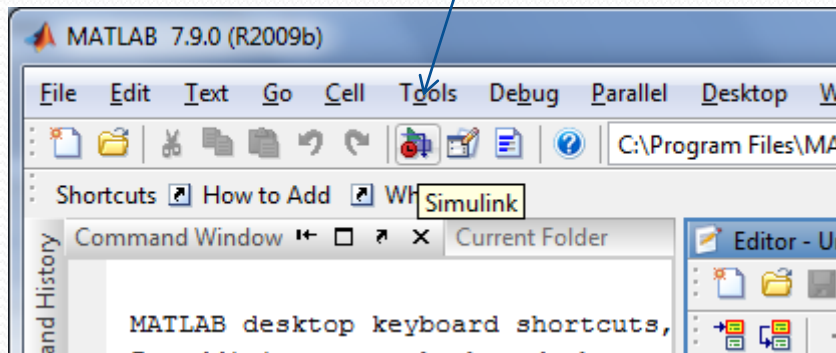

- **Command History window** that shows us all the commands written in the Command Window.

Simulink

- Simulink is part of Matlab. Simulink works by interconecting blocks. Each block is in fact a matlab function with input and output parameters.
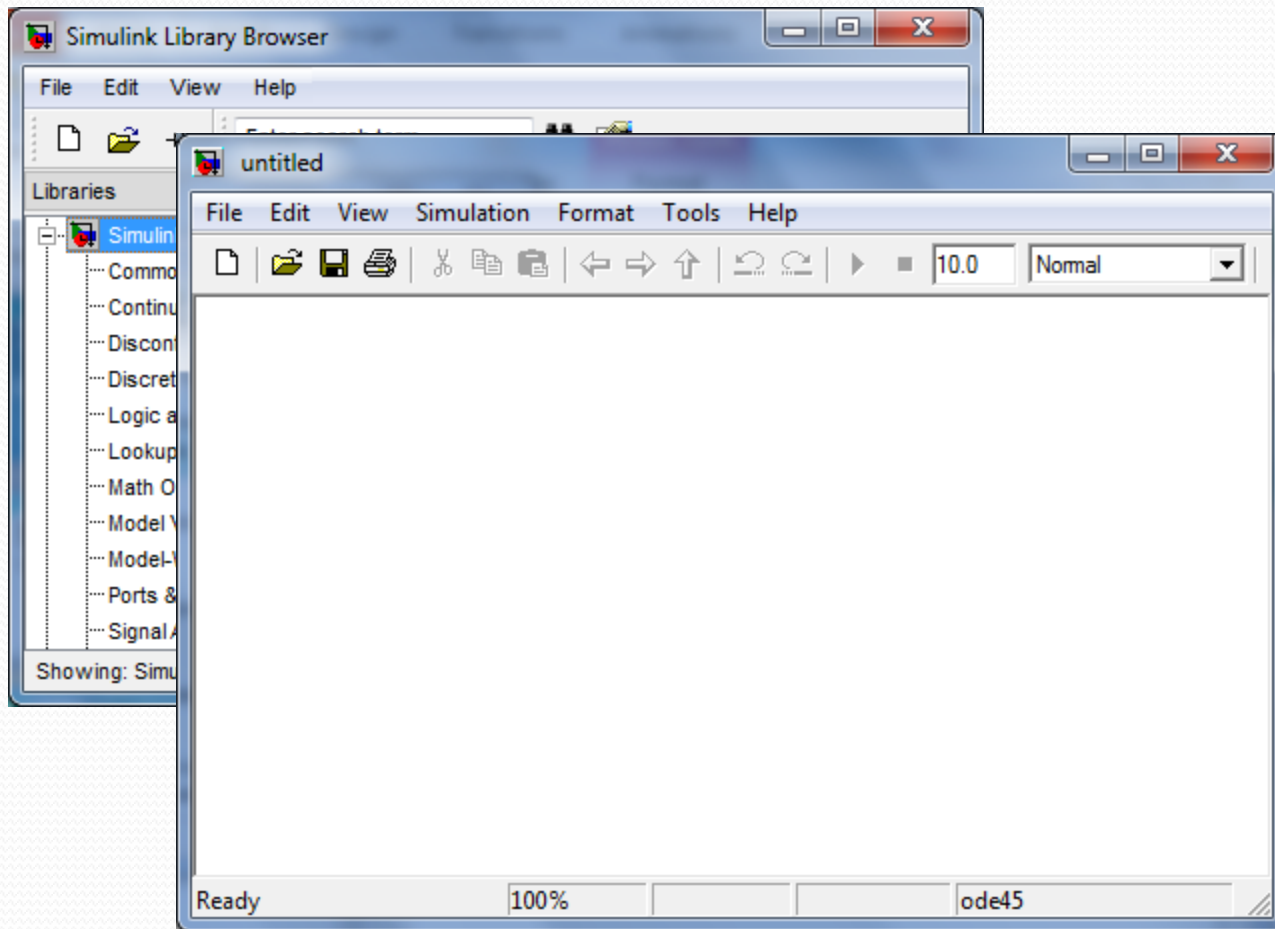
- To open simulink click on the Simulink icon as shown:

Simulink

- A new window appears, the library Browser: Notice Continuous, Math Operations, Source, and Sink groups that we will be using
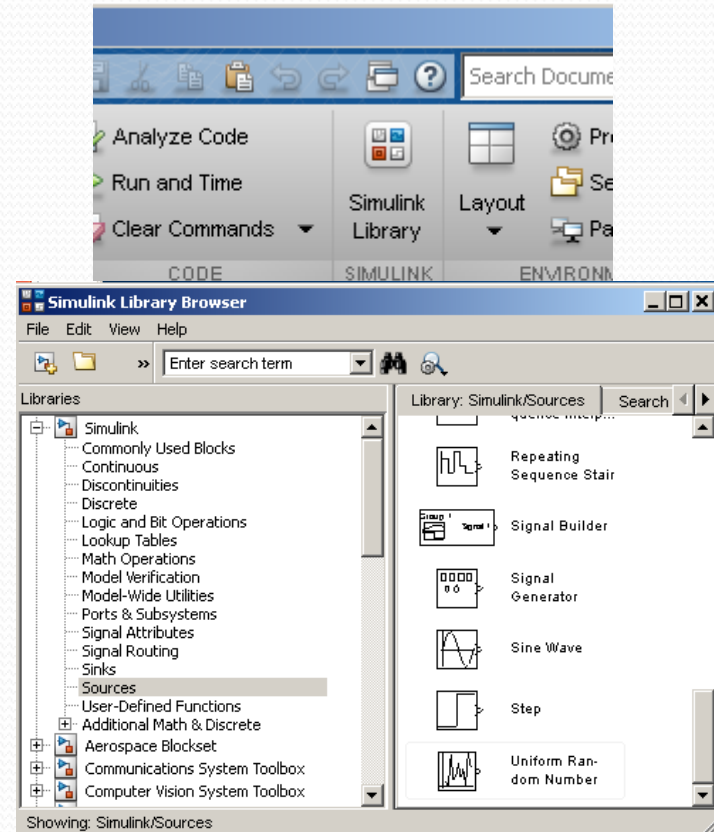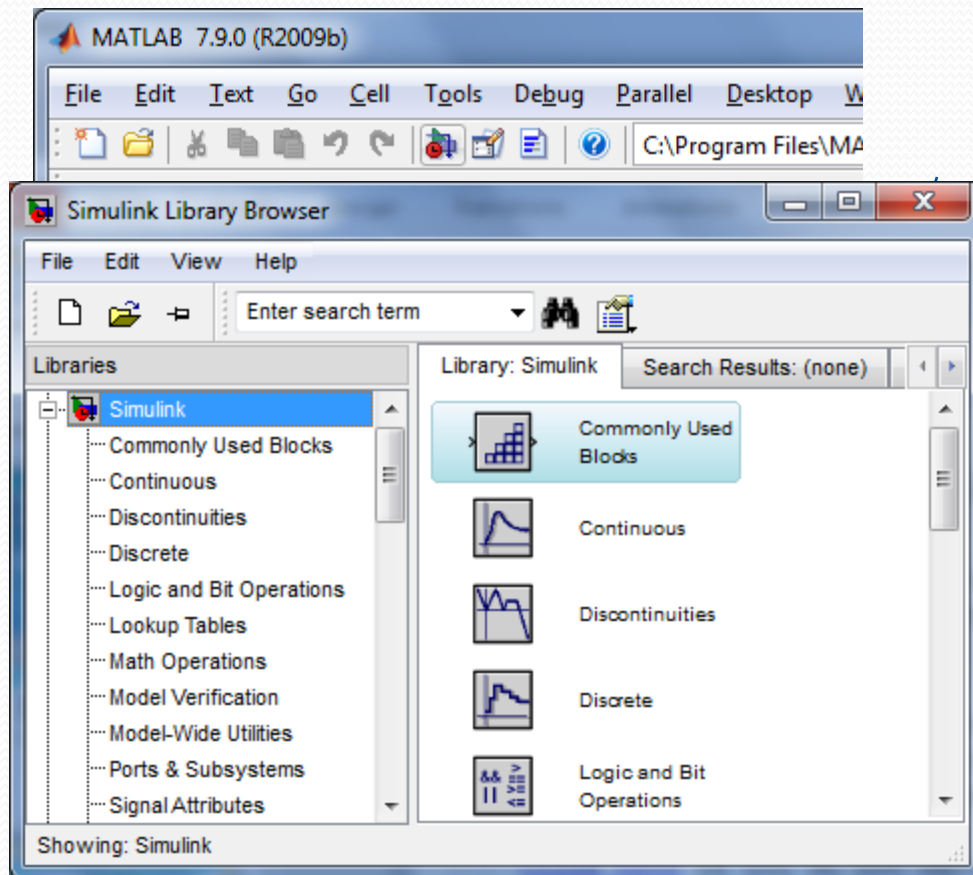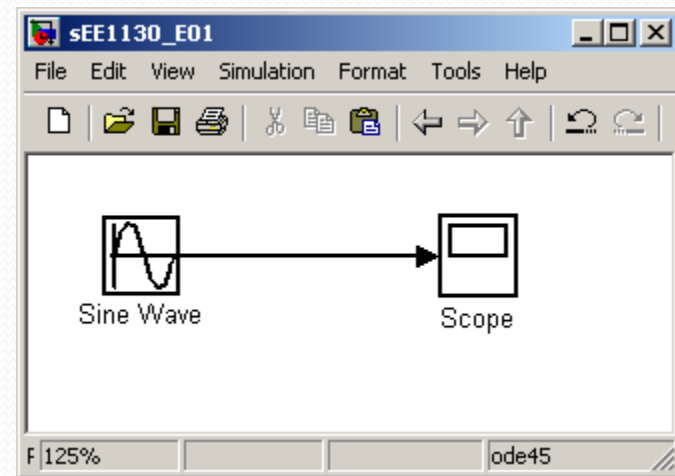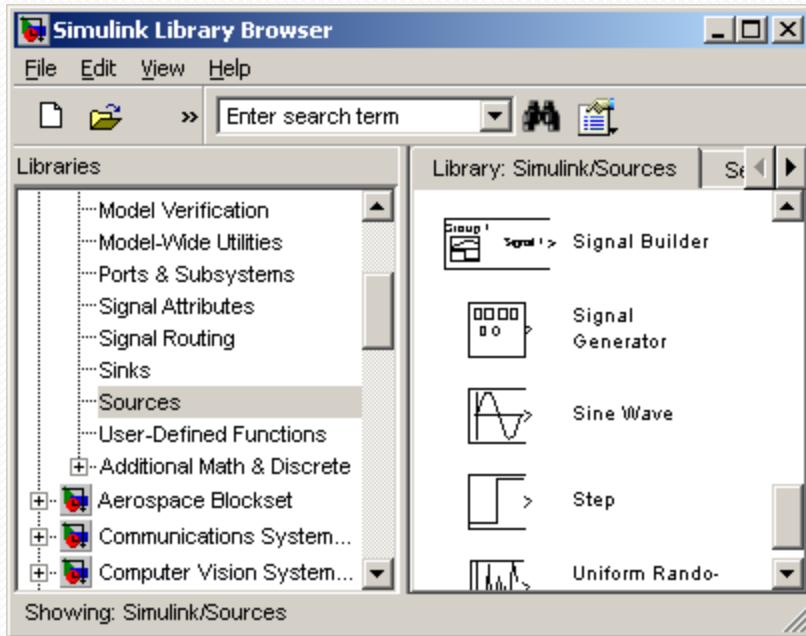
Simulink

- Click on the new document to open:

Simulink: Sinewaves.

- Lets build an easy example of a sinewave and scope it:

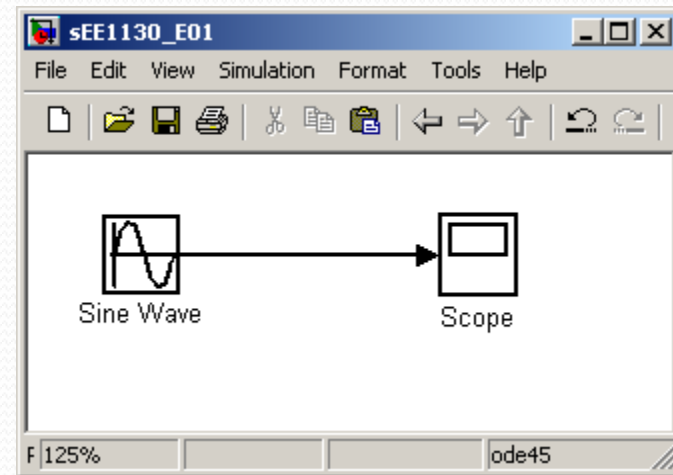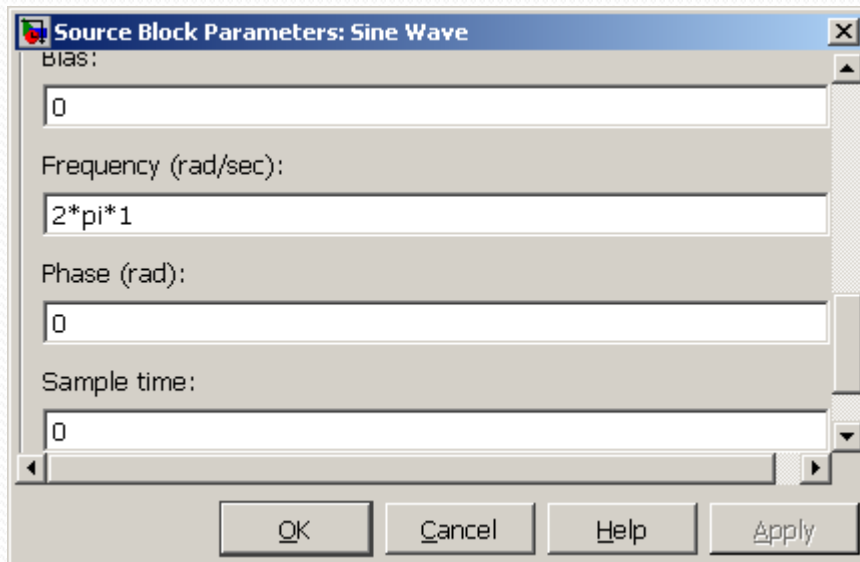$$x(t) = \sin(2\pi ft) \quad \text{with} \quad f = 1$$

- We inserted a sinewave from the sources, and a scope from the sink library groups respectively.

Simulink: Sinewaves.

- By double clicking on the Sine Wave box we open its properties box and set the angular frequecy to 2*pi*1:

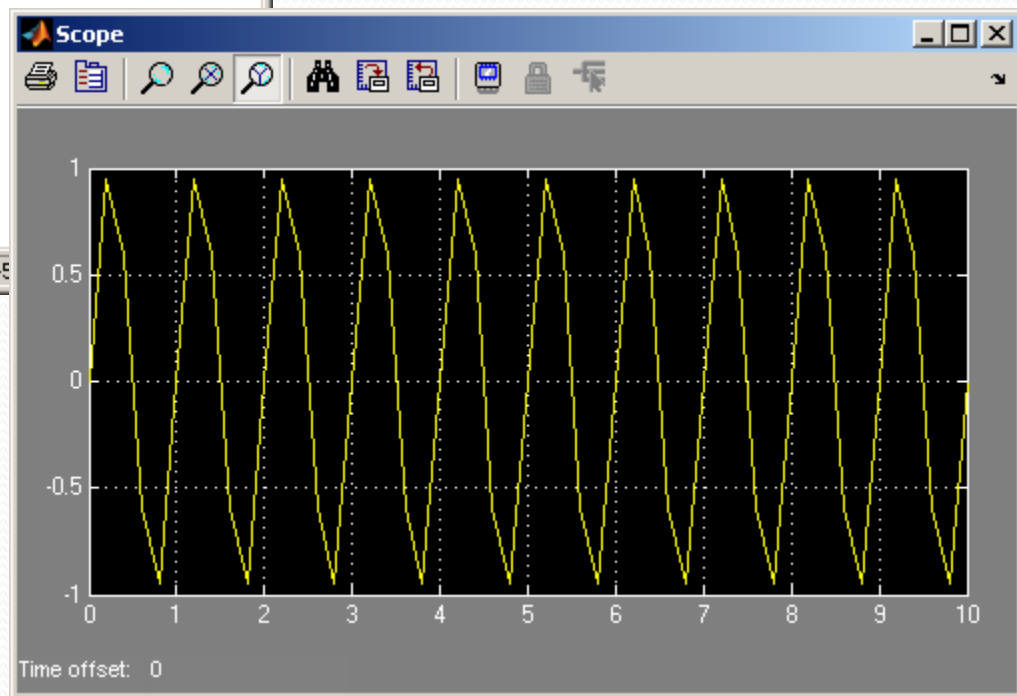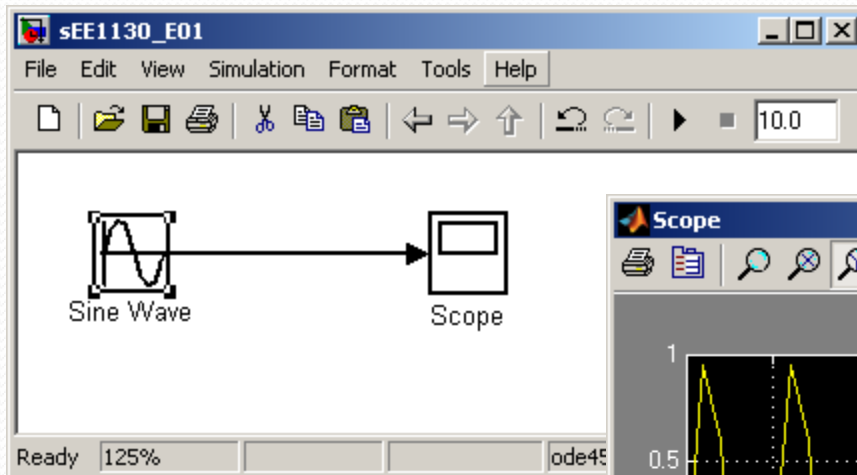$$x(t) = \sin(2\pi ft) \quad \text{with} \quad f = 1$$

Simulink: Sinewaves.

- To open the scope we double click on the Scope box.
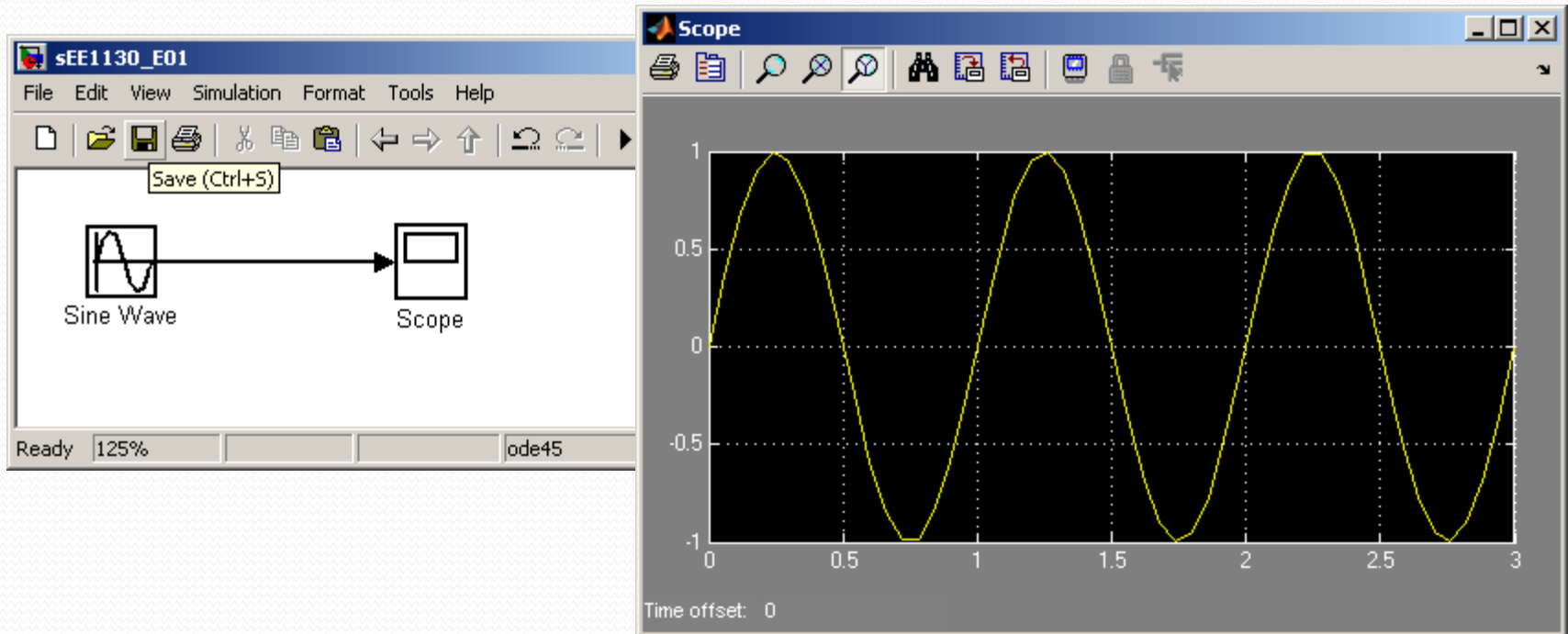- We hit the play icon to run the simulation.

$$x(t) = \sin(2\pi f t) \quad \text{with} \quad f = 1$$

Simulink: Sinewaves.

- To obtain a better view of the sinewave, we reduce the running time to 3 seconds as shown in next figure:

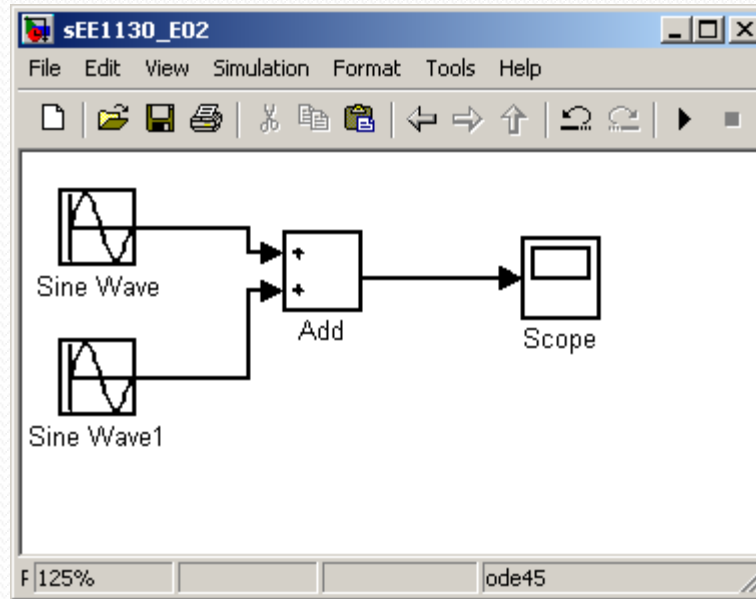$$x(t) = \sin(2\pi f t) \quad \text{with} \quad f = 1$$

- Click on the binoculars to zoom the signal so it fills the Scope.

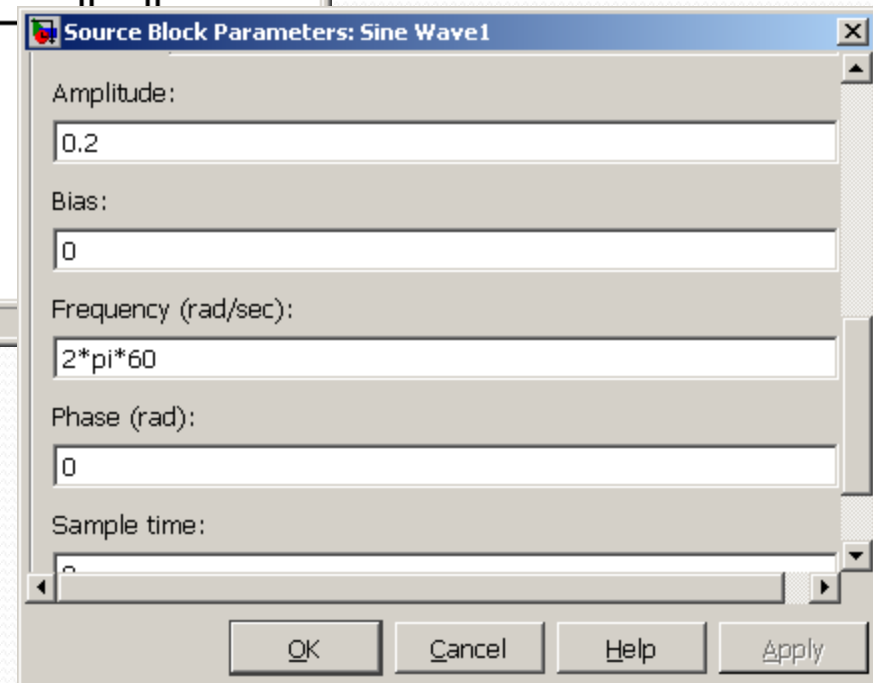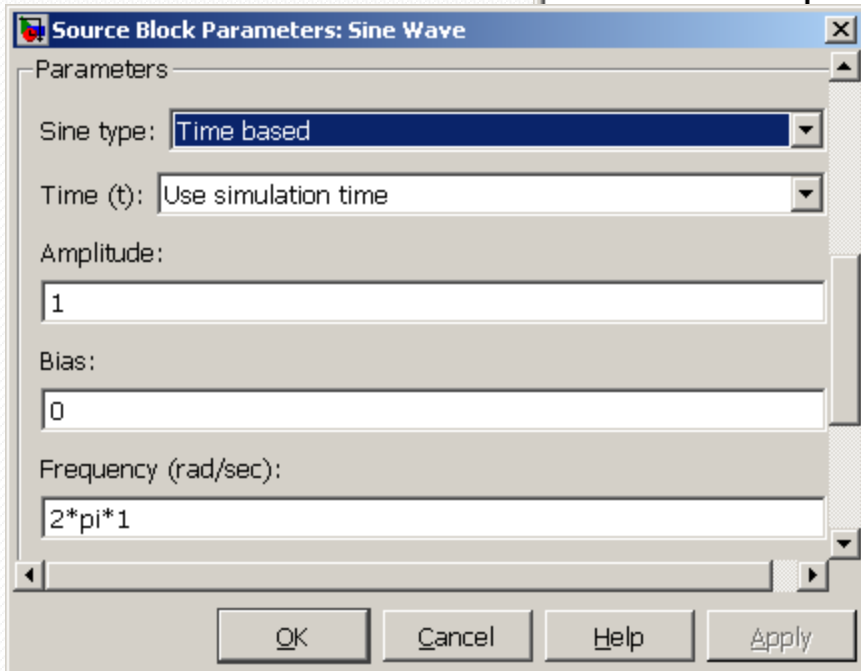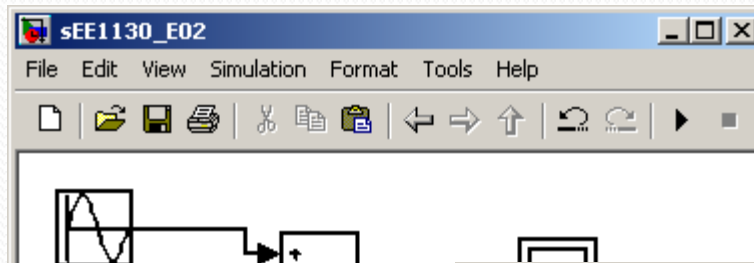# Simulink: Sum of Sinewaves.

- Lets perform a summation of two sinewaves. One of 1Hz of frequency and 1 volt of amplitude and another of 60Hz frequency and 0.2 volts of amplitude:

$$x(t) = \sin(2\pi 1 t) + 0.2\sin(2\pi 60 t)$$
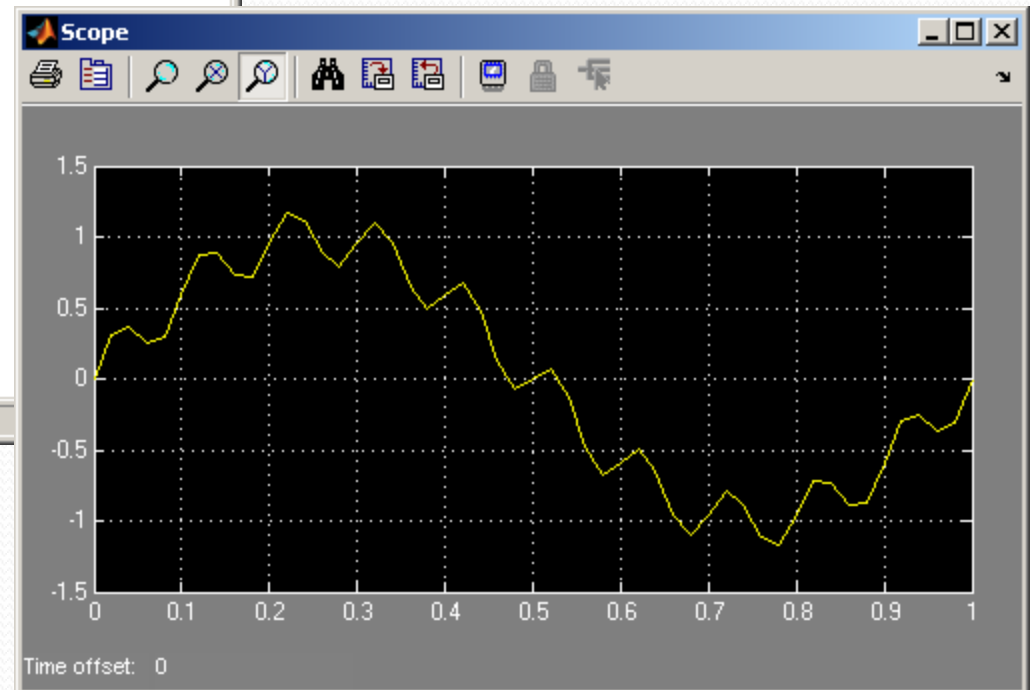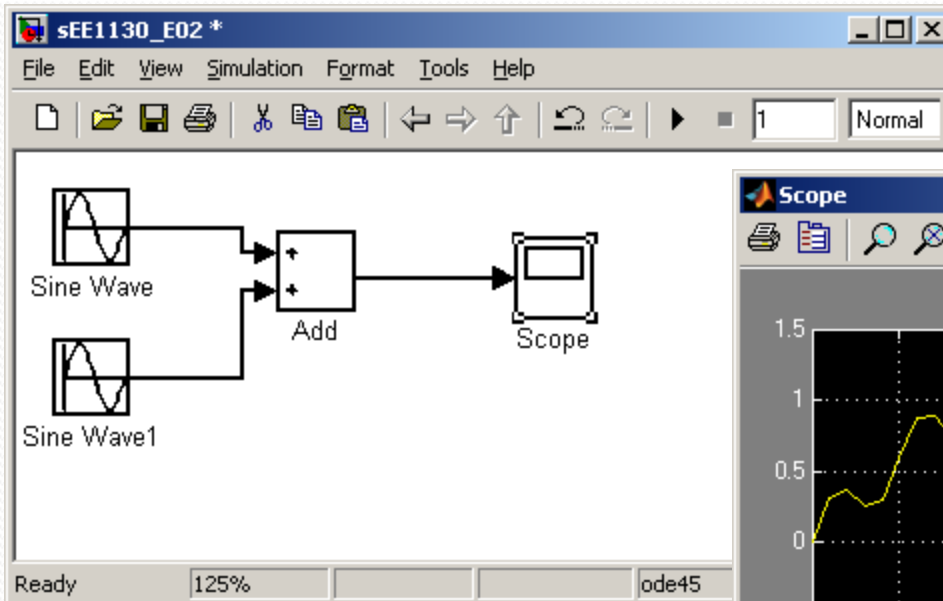
Simulink: Sum of Sinewaves.

- We need to click on each sinewave box to set up the amplitude and frequencies: $x(t) = \sin(2\pi 1 t) + 0.2\sin(2\pi 60 t)$
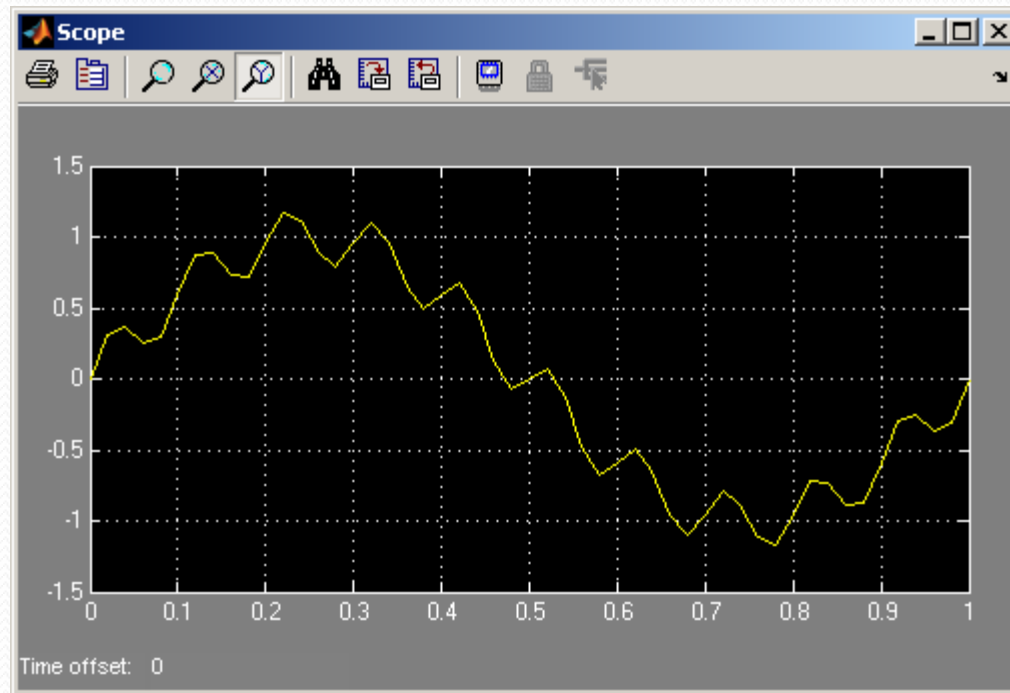
Simulink: Sum of Sinewaves.

- Set the running time to 1 second, double click on the Scope box to open it up and hit play:

$$x(t) = \sin(2\pi 1t) + 0.2\sin(2\pi 60t)$$
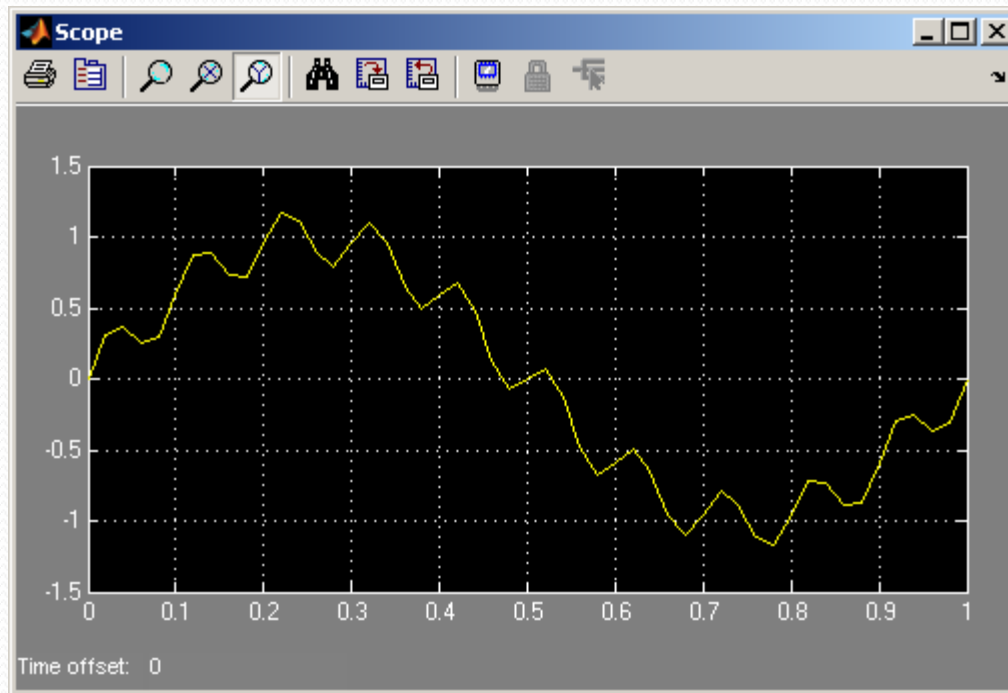
Simulink: Sum of Sinewaves.

- We see the 60Hz wave riding on the 1Hz wave. This is called 60Hz noise or ripple.

$$x(t) = \sin(2\pi 1t) + 0.2\sin(2\pi 60t)$$

Simulink: Sum of Sinewaves.

- The objective of next class is to get rid of the ripple and keep the 1Hz sinewave clean of noise!!! This is Signal Processing!!

$$x(t) = \sin(2\pi 1 t) + 0.2\sin(2\pi 60 t)$$

End of Class