

EE 1130

Freshman Eng. Design for Electrical and Computer Eng.

Class 2

Signal Processing Module (DSP).

- Matlab and Simulink.

Matlab

- Matlab is a powerful tool for mathematical/engineering research and development. It is also useful to students to easily compute or solve almost all mathematical and engineering problems.
- This Signal Processing Module will use Matlab as a development and teaching tool.
- We will use the Simulink part of Matlab to introduce and evaluate a Signal Processor that will eliminate a high frequency component (ripple or noise) from a low frequency sine wave.
- 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 sine wave.

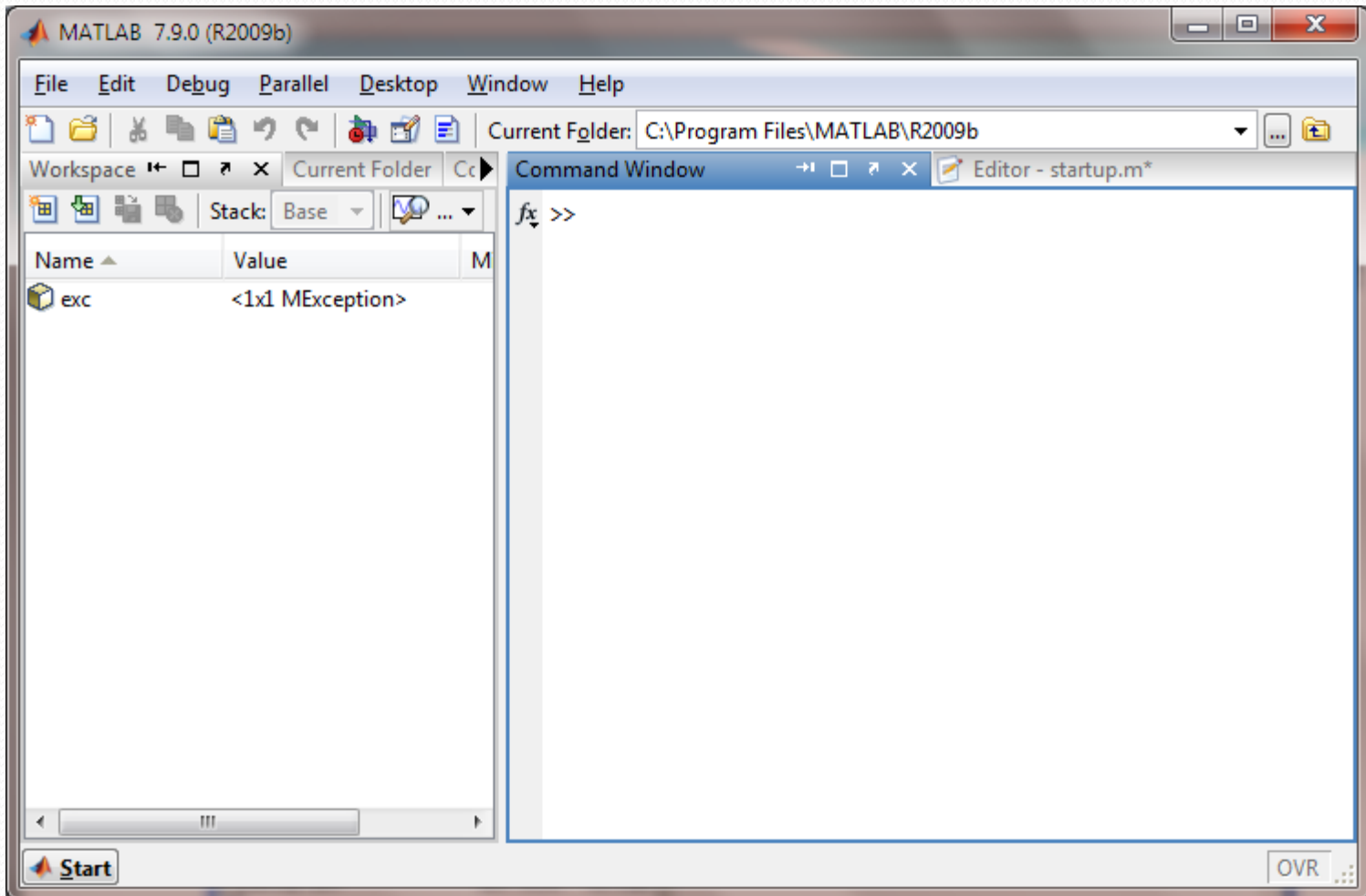
Matlab

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



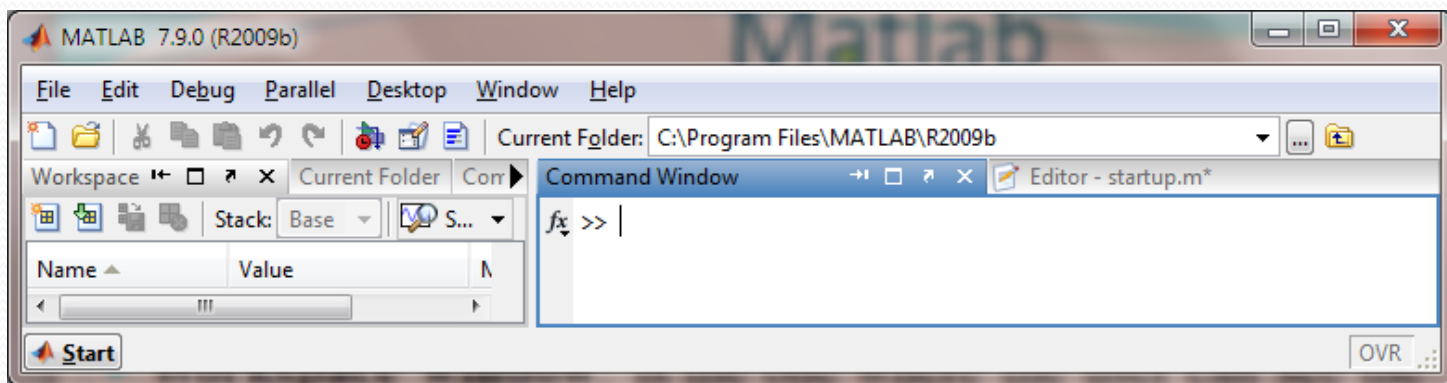
Matlab

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

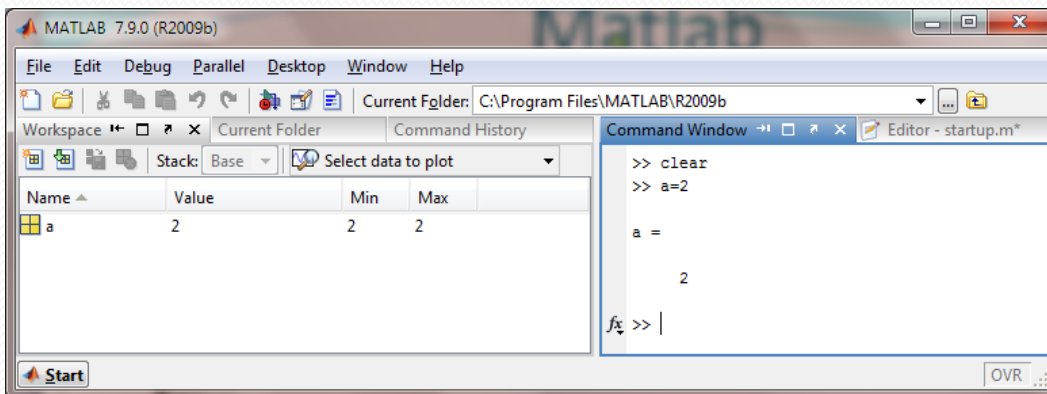


Matlab

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

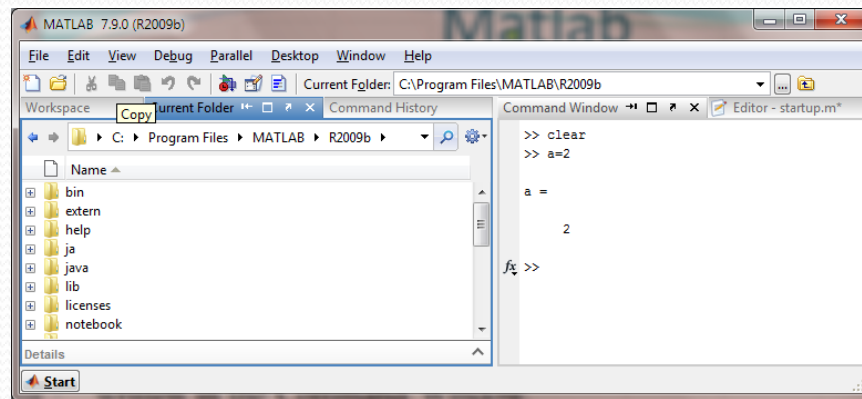


- **Workspace window:** is the one where the user can see the variables.

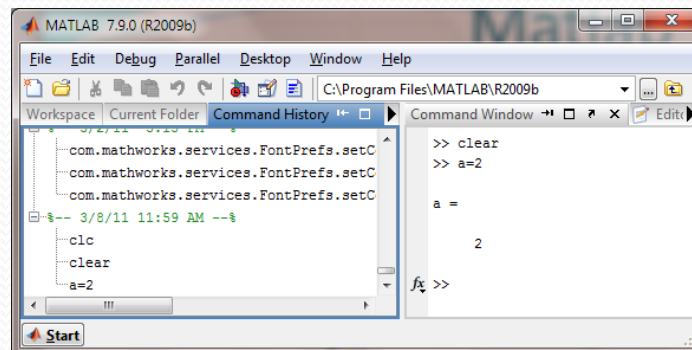


Matlab

- **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.

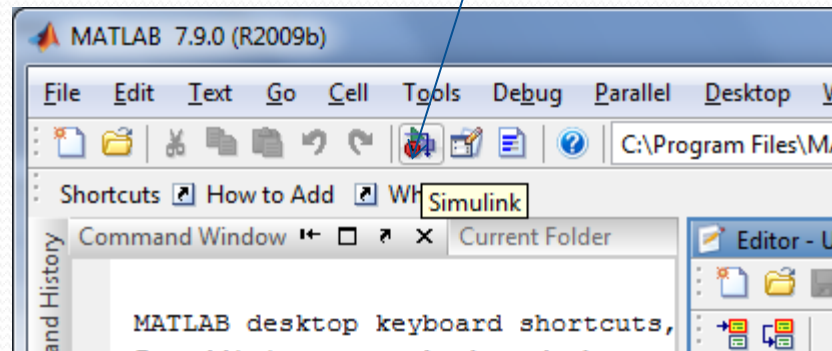


- **Command History window** that shows us all the commands written in the Command Window.



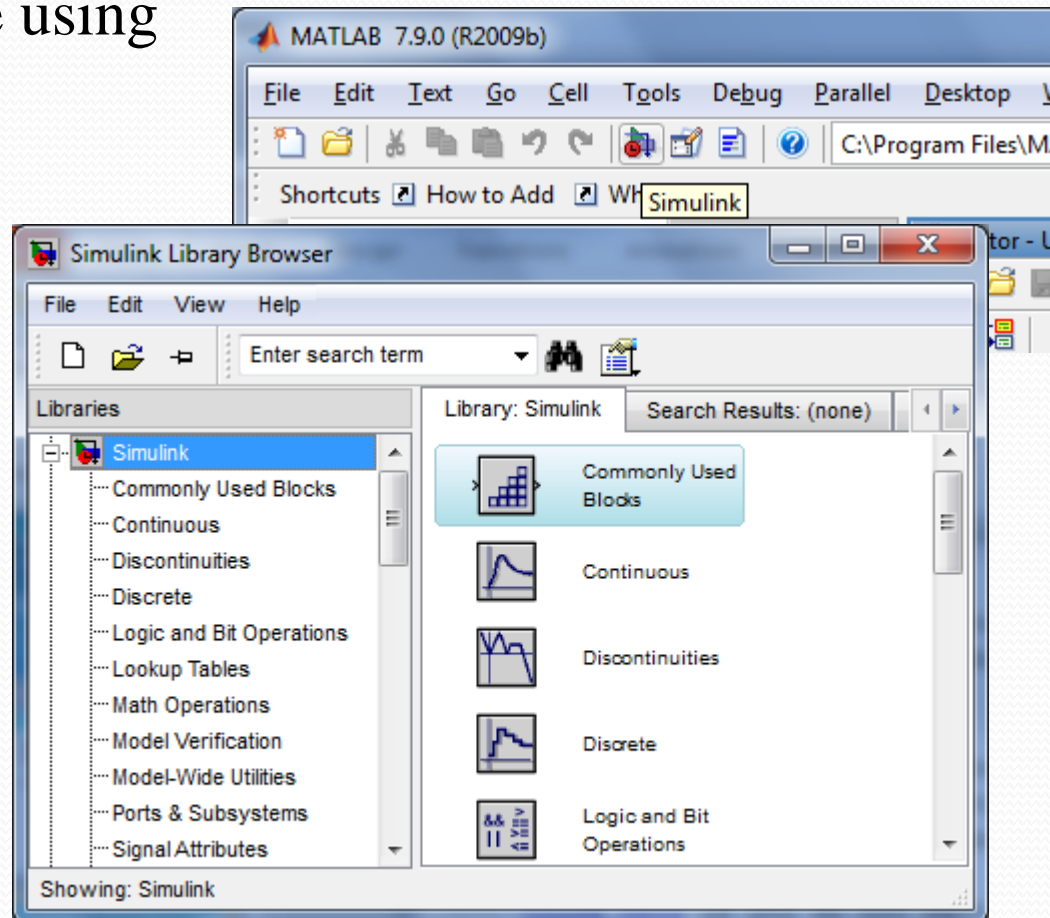
Simulink

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



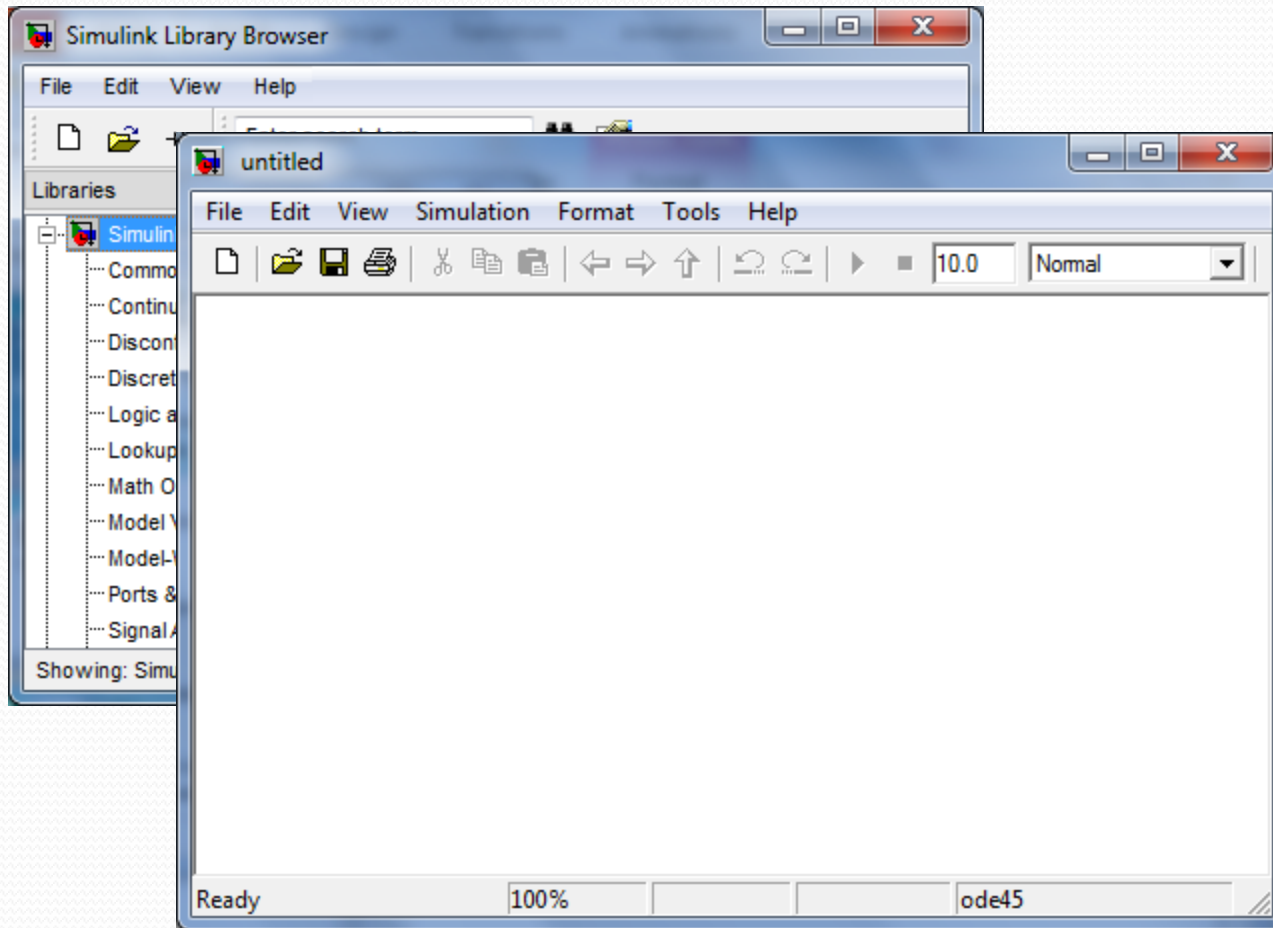
Simulink

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



Simulink

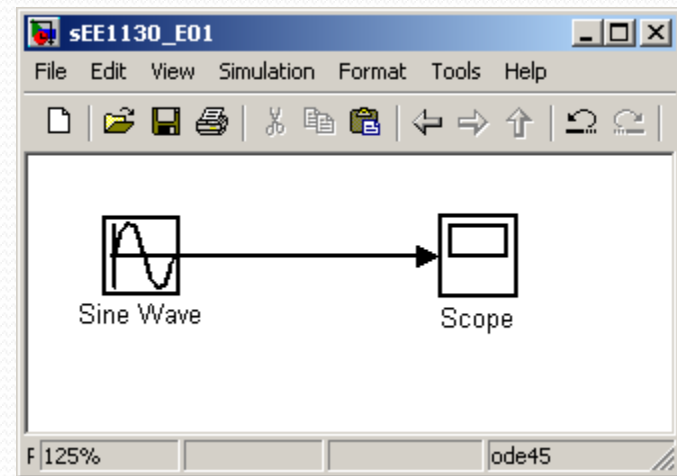
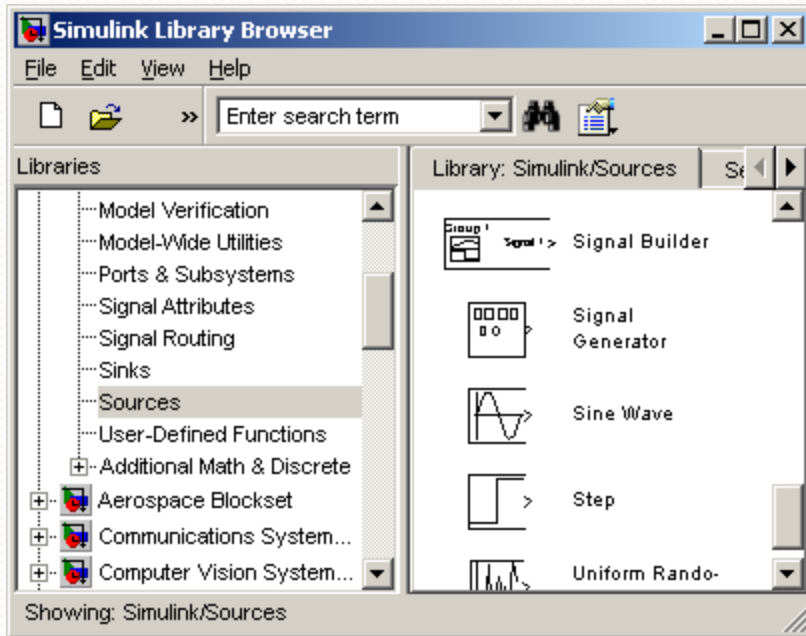
- Click on the new document to open:



Simulink: Sinewaves.

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

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

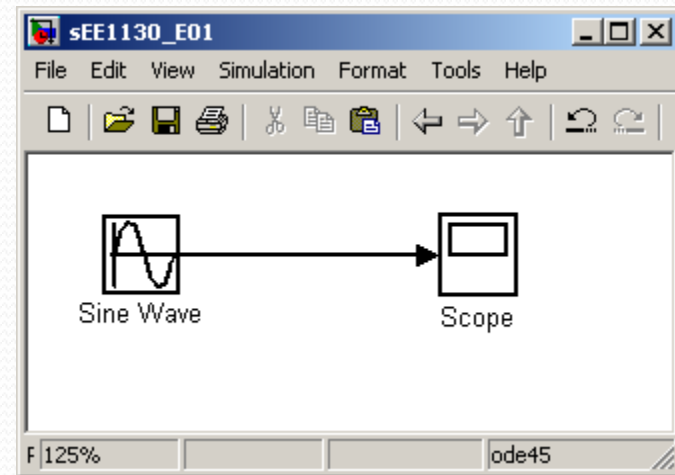
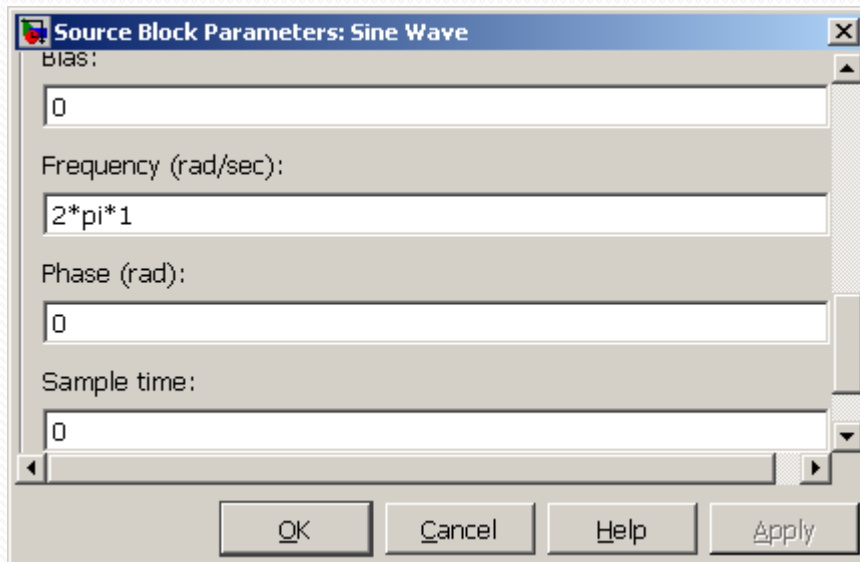


- We inserted a sinewave from the sources, and a scope from the sink library groups respectively.

Simulink: Sinewaves.

- By double clicking on the Sine Wave box we open its properties box and set the angular frequency to $2\pi \cdot 1$:

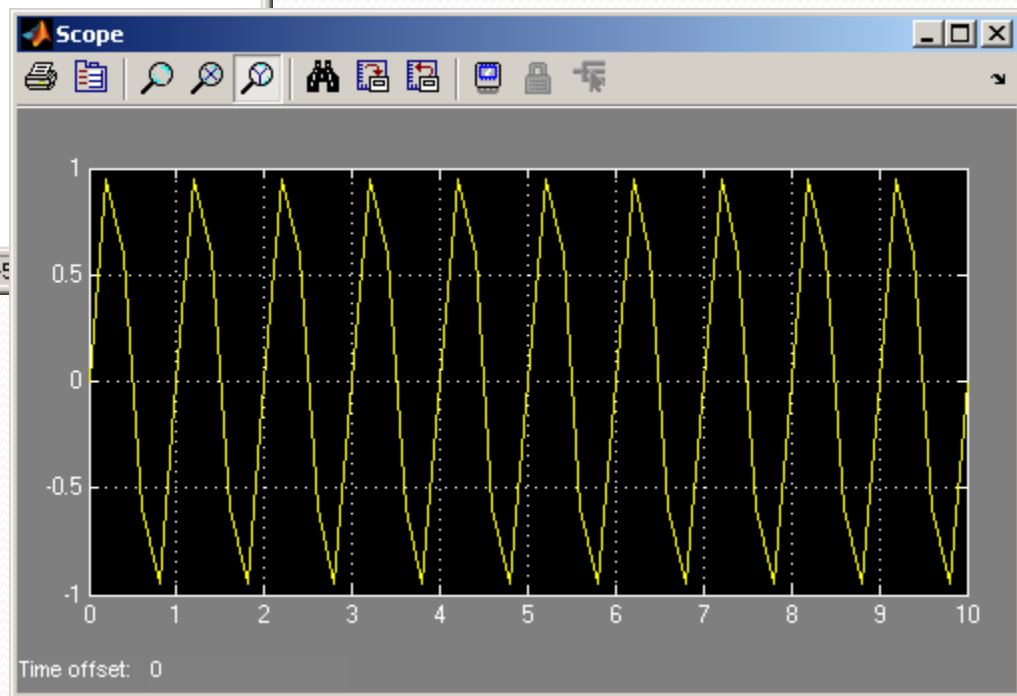
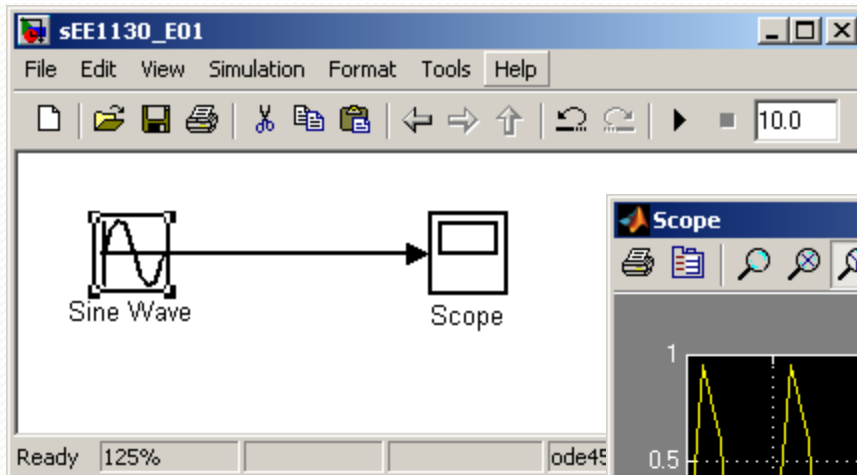
$$x(t) = \sin(2\pi f t) \quad \text{with } f = 1$$



Simulink: Sinewaves.

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

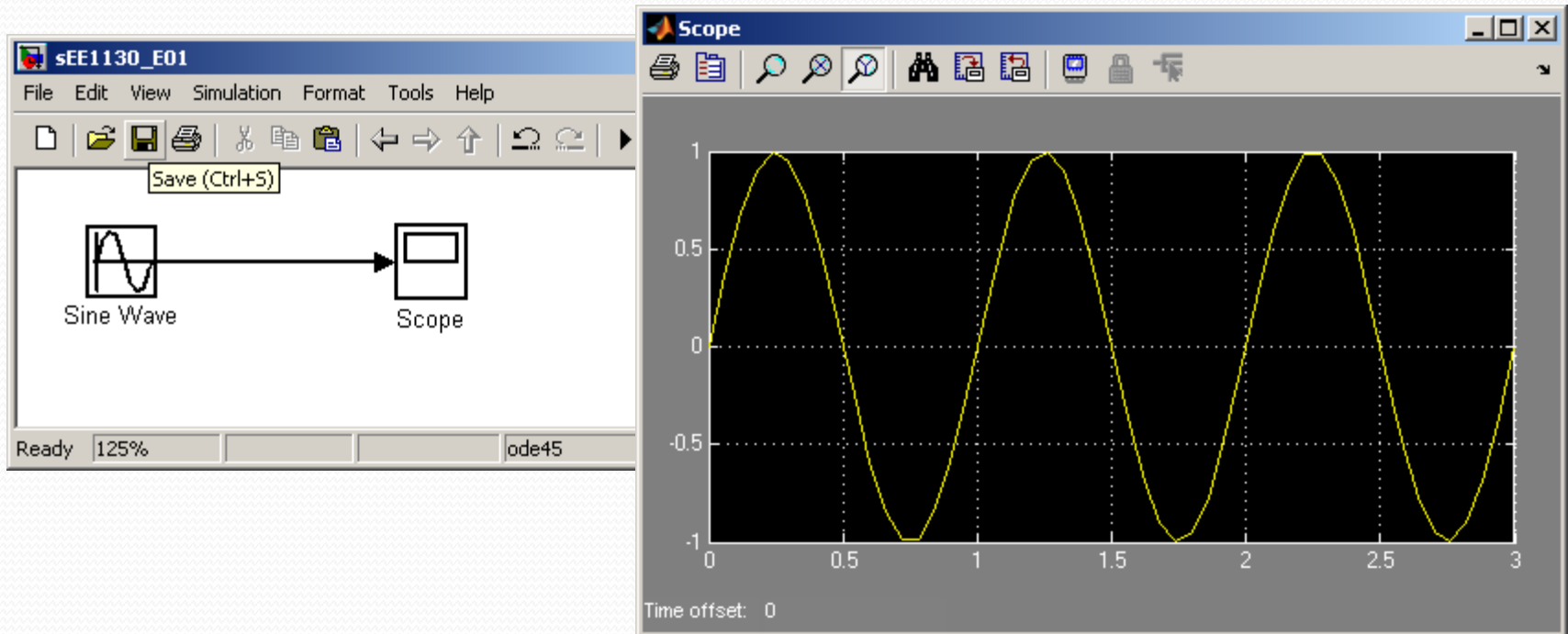
$$x(t) = \sin(2\pi ft) \quad \text{with } f = 1$$



Simulink: Sinewaves.

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

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

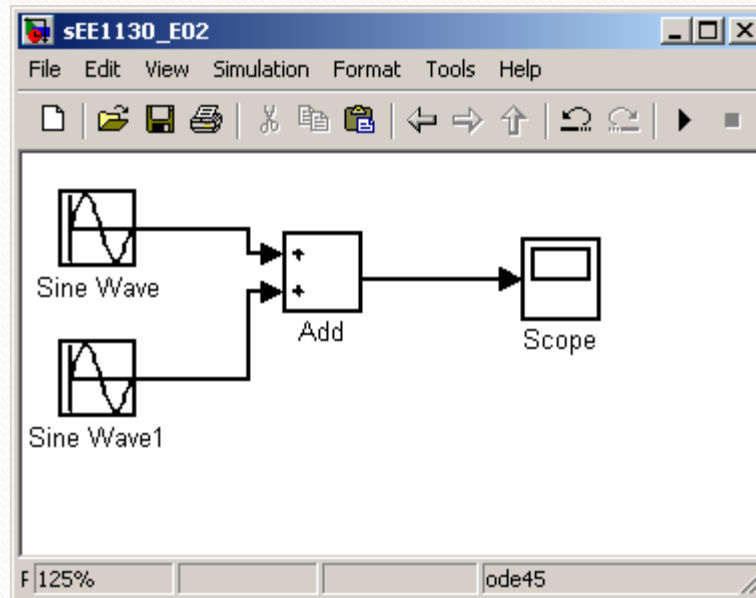


- Click on the binoculars to zoom the signal so it fills the Scope.

Simulink: Sum of Sinewaves.

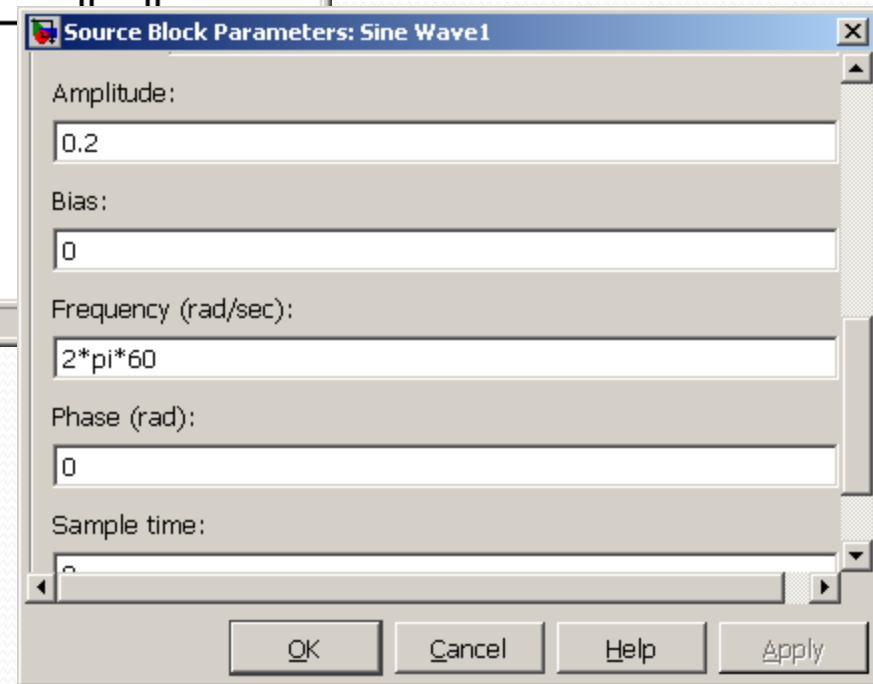
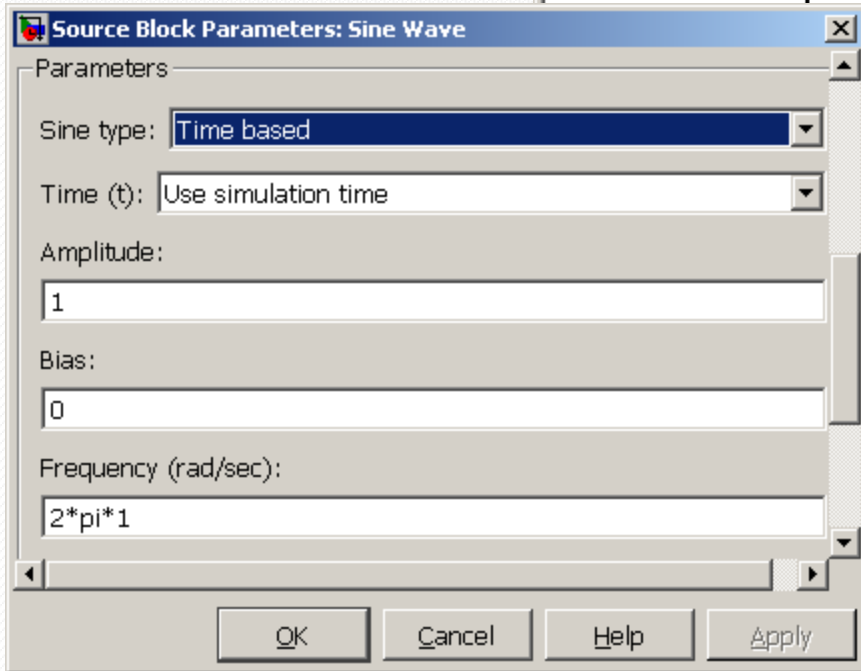
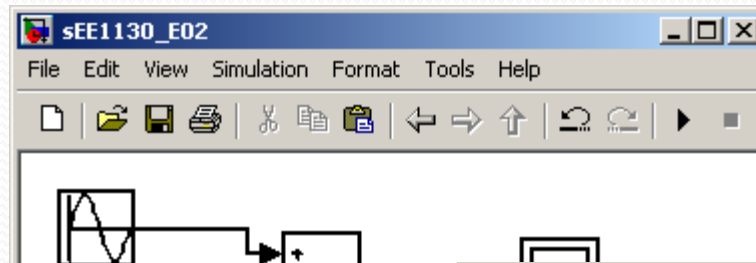
- Lets perform a summation of two sinewaves. One of 1Hz of frequency and 1 volt of amplitude and another of 60Hz frequency and 0.2 volts of amplitude:

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



Simulink: Sum of Sinewaves.

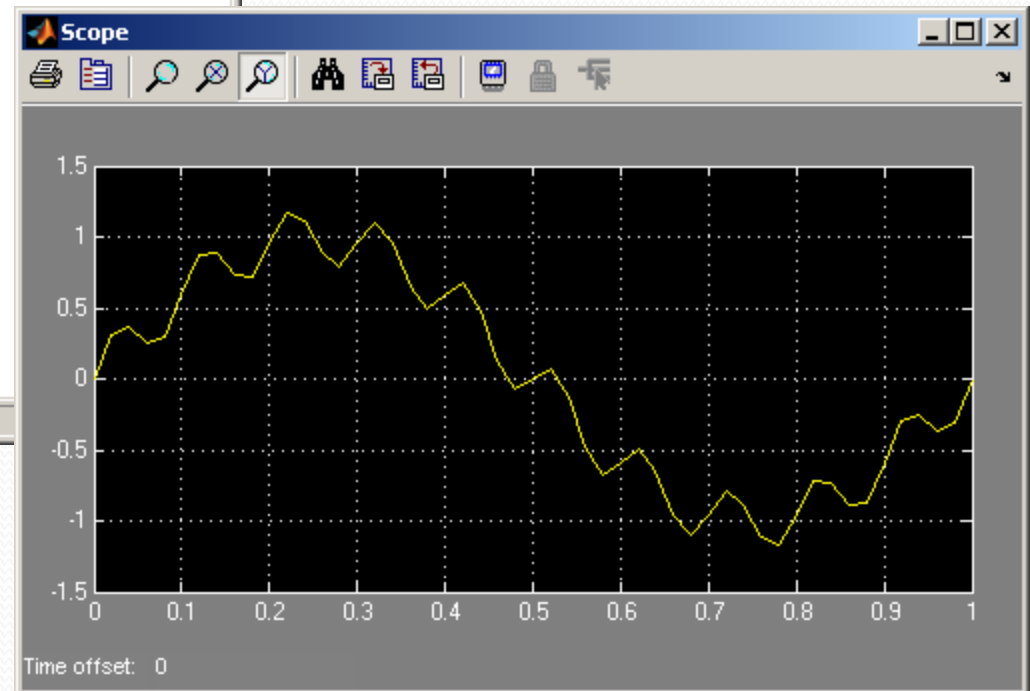
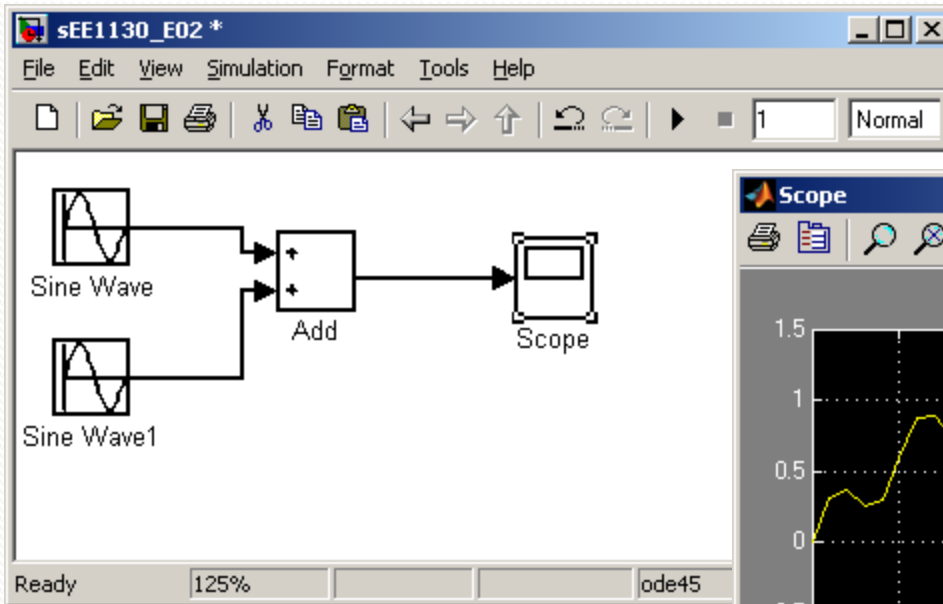
- We need to click on each sinewave box to set up the amplitude and frequencies: $x(t) = \sin(2\pi 1t) + 0.2 \sin(2\pi 60t)$



Simulink: Sum of Sinewaves.

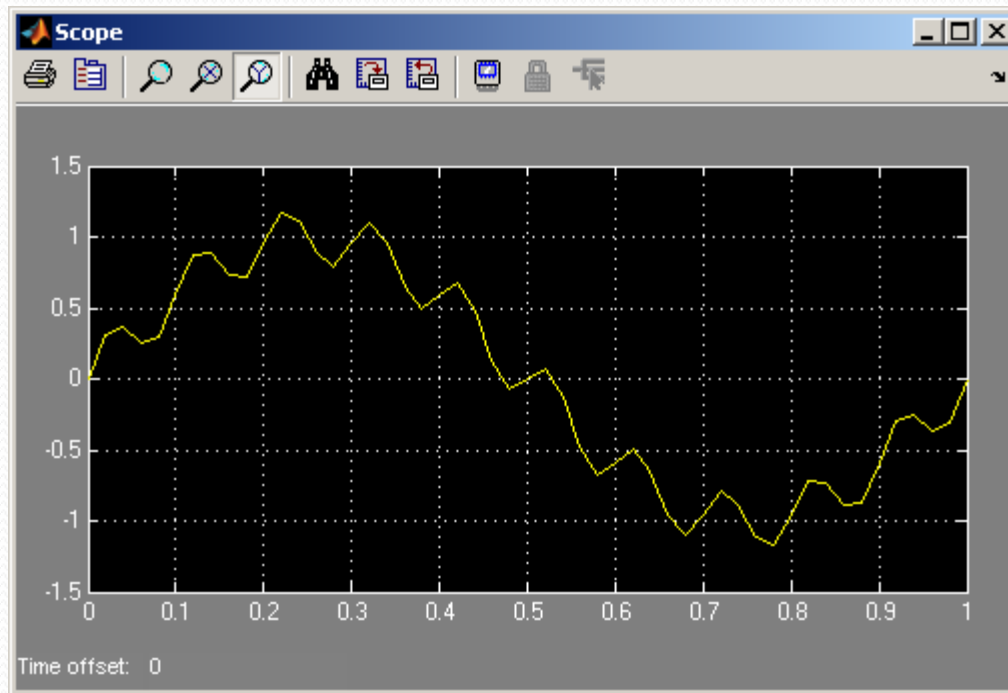
- Set the running time to 1 second, double click on the Scope box to open it up and hit play:

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



Simulink: Sum of Sinewaves.

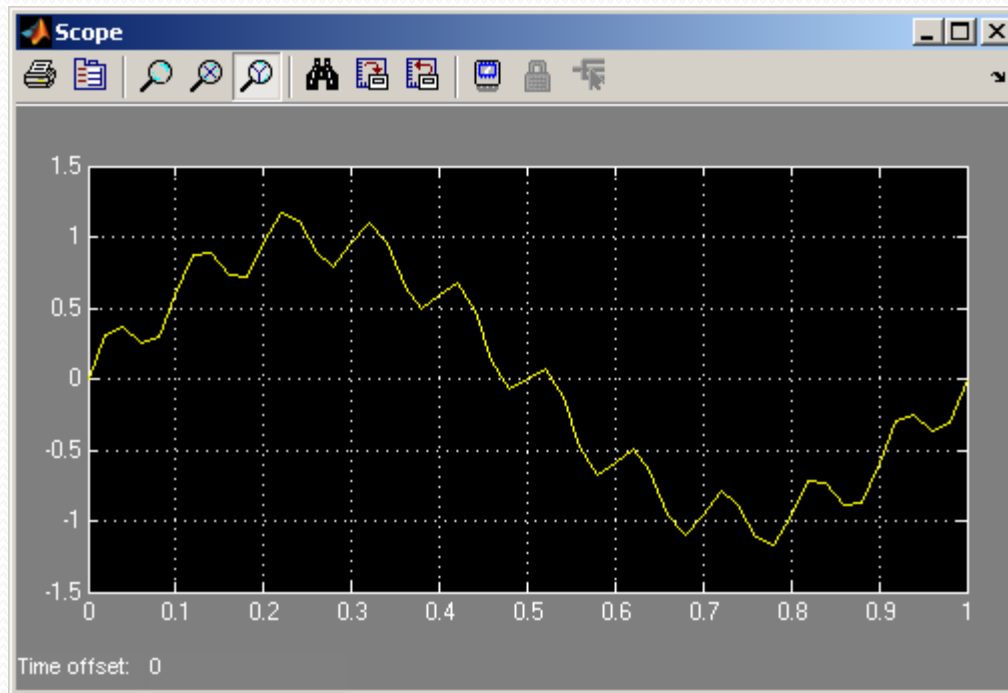
- We see the 60Hz wave riding on the 1Hz wave. This is called 60Hz noise or ripple.



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

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!!



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



End of Class