

EE 1130

Freshman Eng. Design for Electrical and Computer Eng.

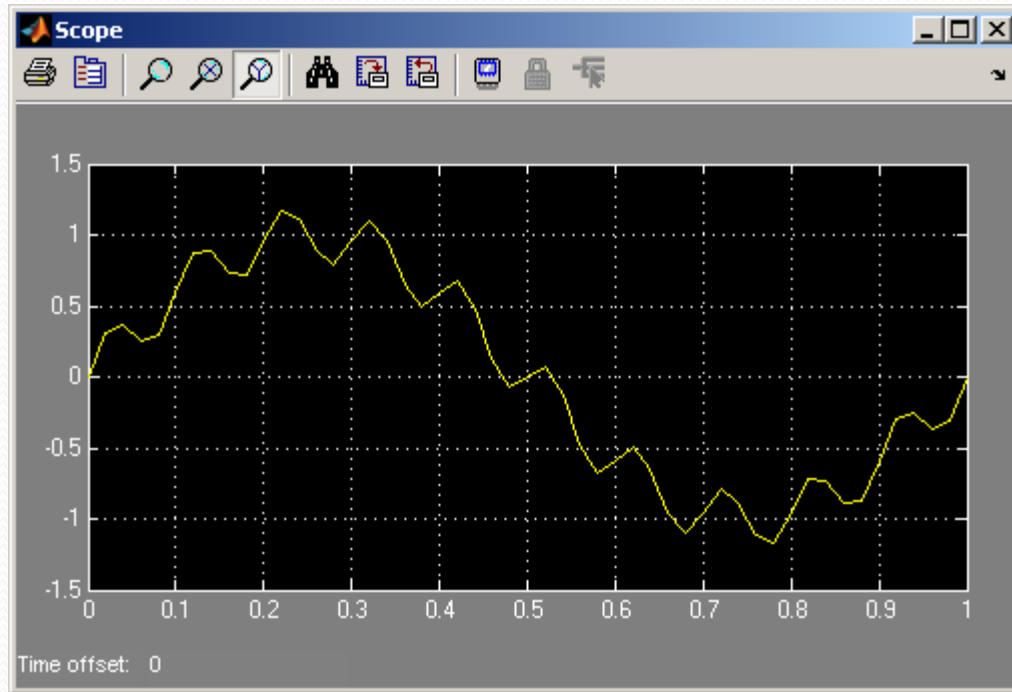
Class 4

Signal Processing Module (DSP).

- Matlab and Simulink.

Simulink: Signal Processing.

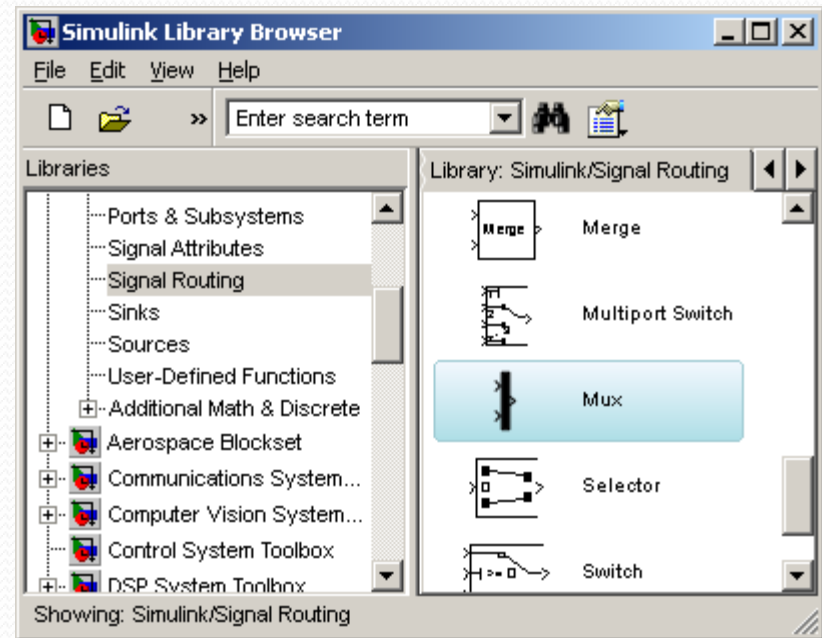
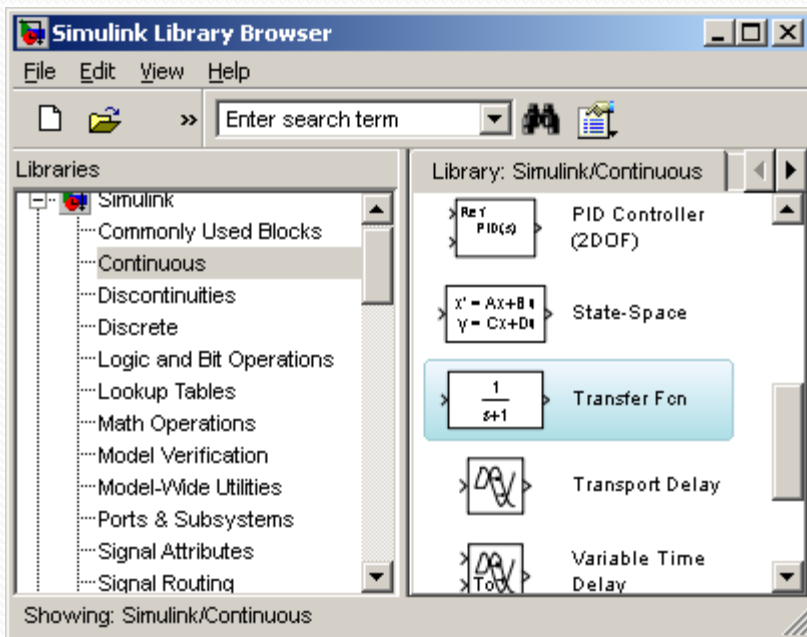
- Last lecture we ended up with a noisy signal as next figure shows:



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

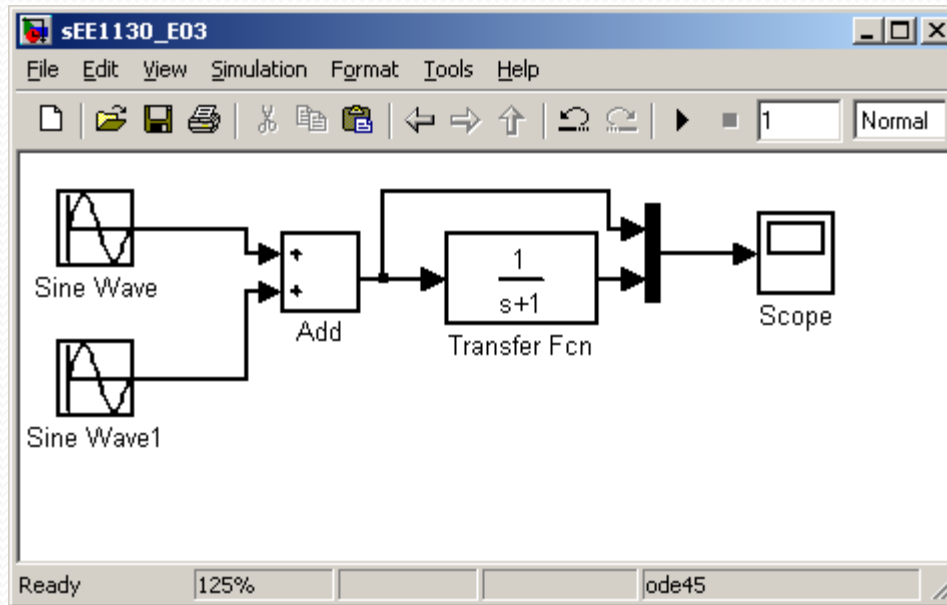
Simulink: Signal Processing.

- We will insert a system that will filter out the ripple.
- First option is to insert from the continuous library group a Transfer Function block.
- We also add a Mux from Signal Routing library group.



Simulink: Signal Processing.

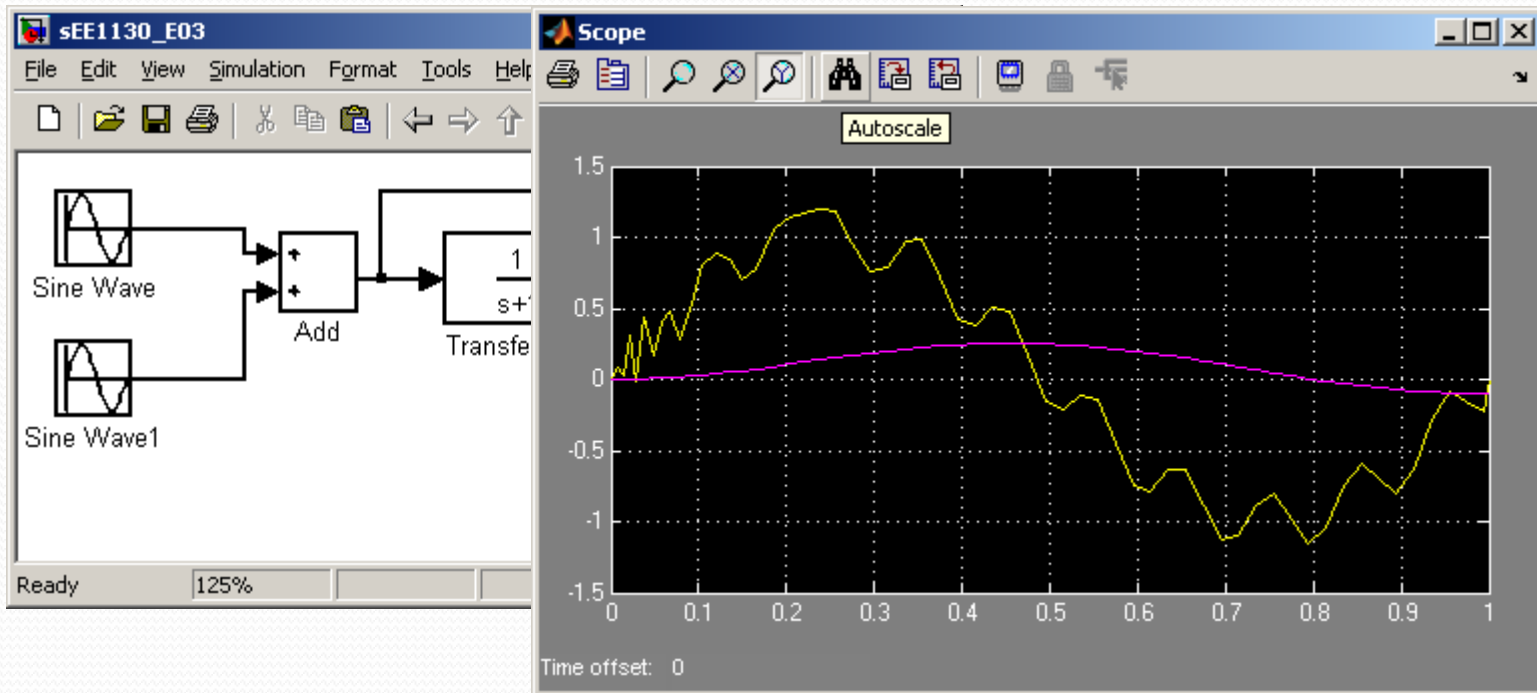
- We insert the Transfer Function after the summator and before the Mux.
- The Mux will allow the Scope to show two traces:



- Now, hit play and see:

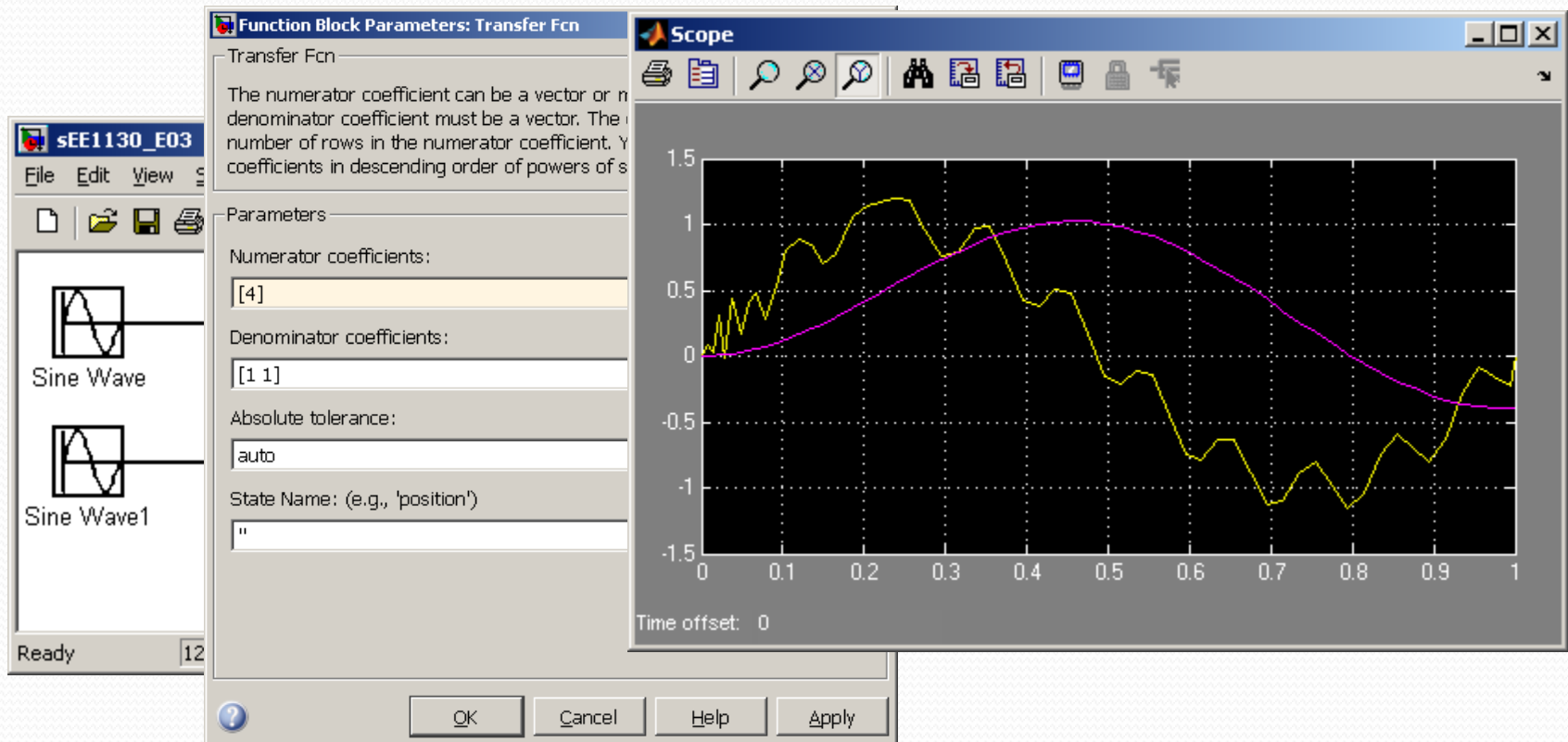
Simulink: Signal Processing.

- Now, hit play and see:
- Somehow we cleaned the signal, but we need to amplify its gain by a factor of 4. We open the transfer function and set 4 the numerator to do this.



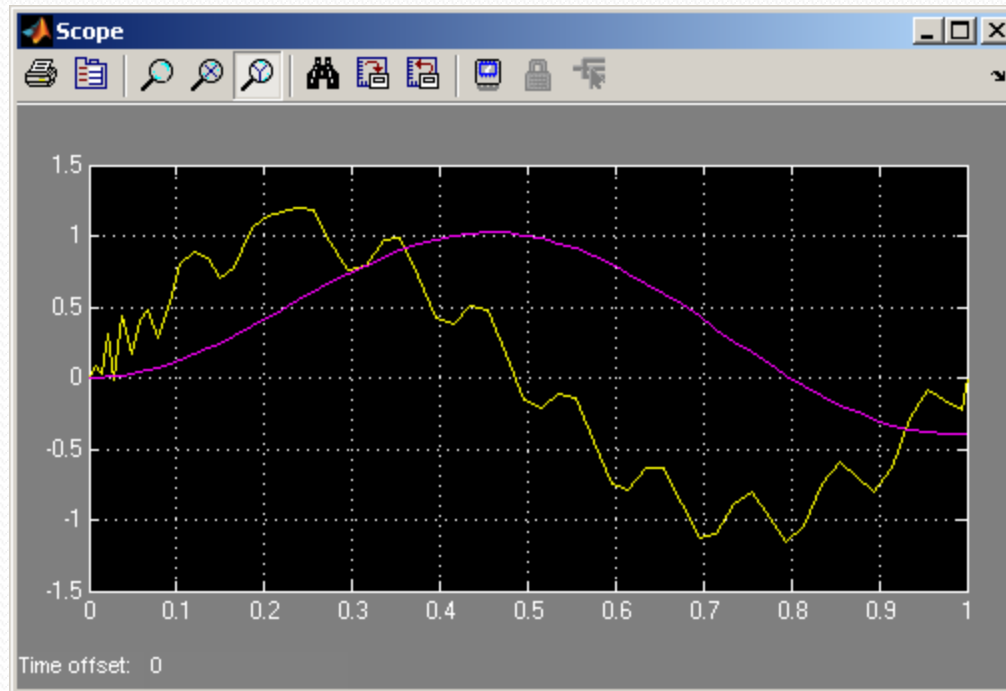
Simulink: Signal Processing.

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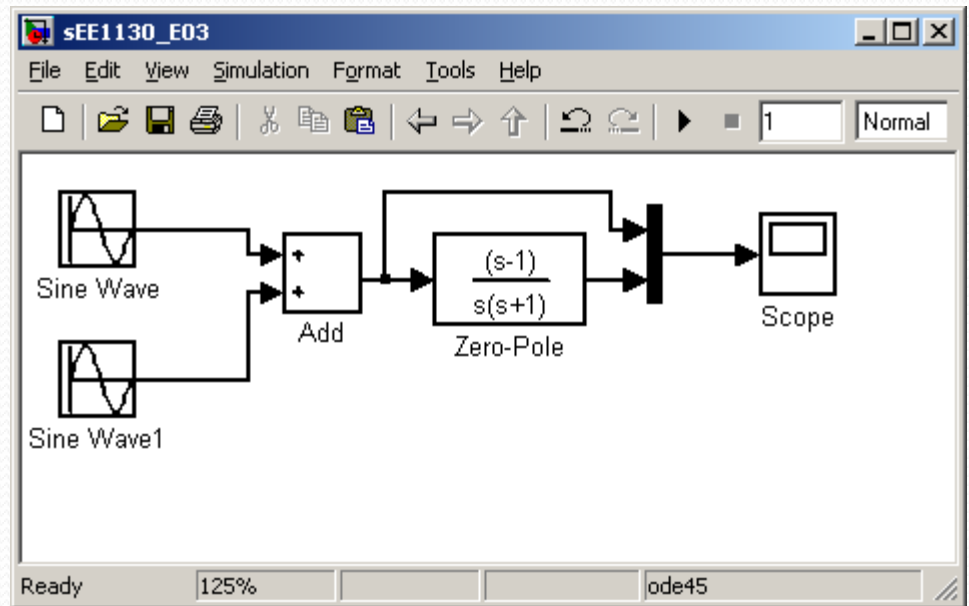
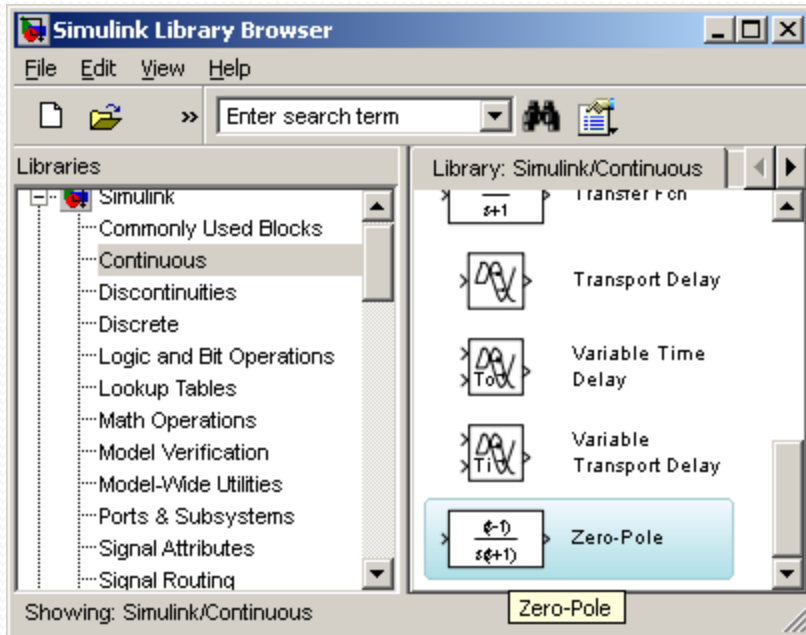
Simulink: Signal Processing.

- We have cleaned the signal, but introduced a time delay (time shift). This is common in any kind of filters.



Simulink: Signal Processing.

- Now, let's design a filter that particularly eliminates the signal of 60Hz. We do that using the Zero-Pole Transfer function



Simulink: Signal Processing.

- When studying Filter Theory you will learn that the roots of the numerator must be $(s - 2\pi 60j)$ and $(s + 2\pi 60j)$. The use of complex conjugated roots is to have real coefficients because:

$$(s - 2\pi 60j)(s + 2\pi 60j) = s^2 + 4\pi^2 60^2$$

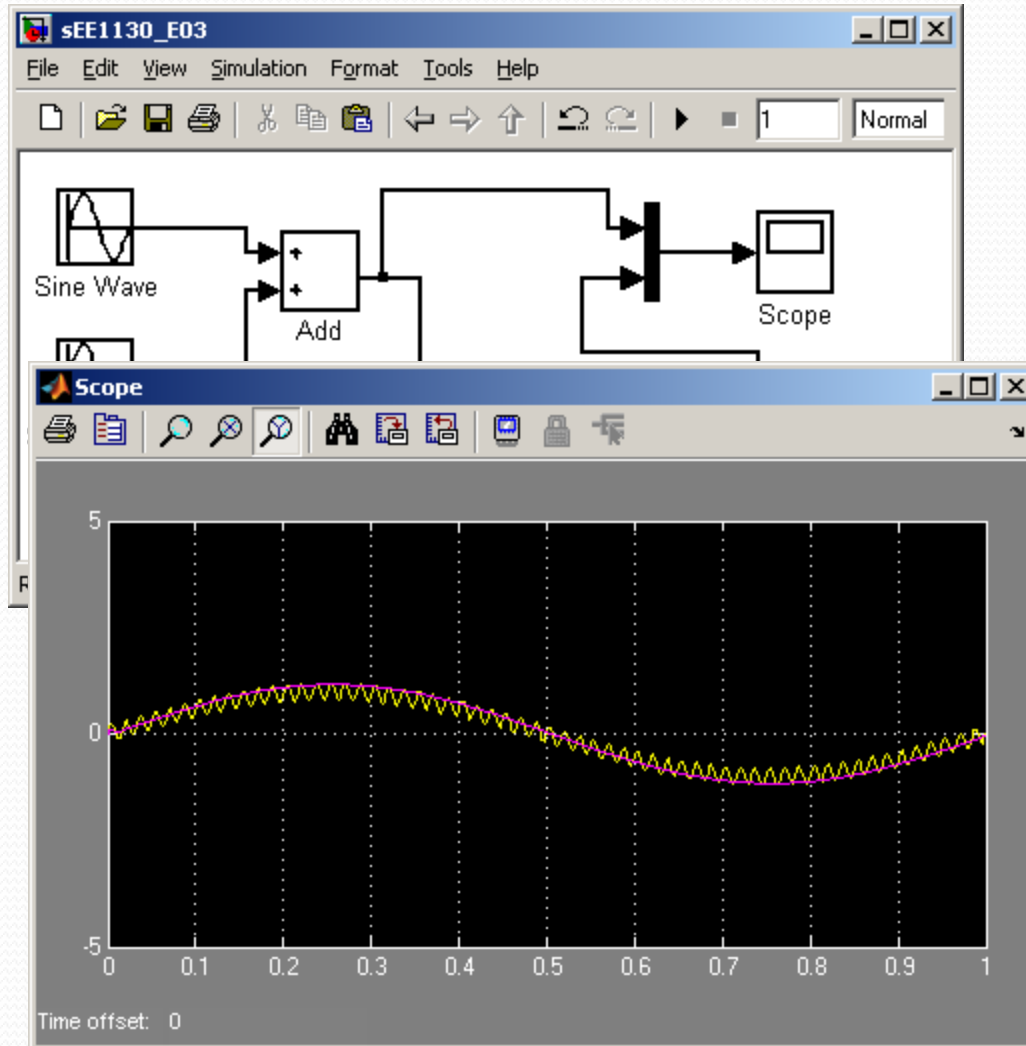
- At the denominator we just set roots to.

$$(s + 350)(s + 350)$$

- If you set smaller roots, the output becomes too large. Please try other values to check out by yourself

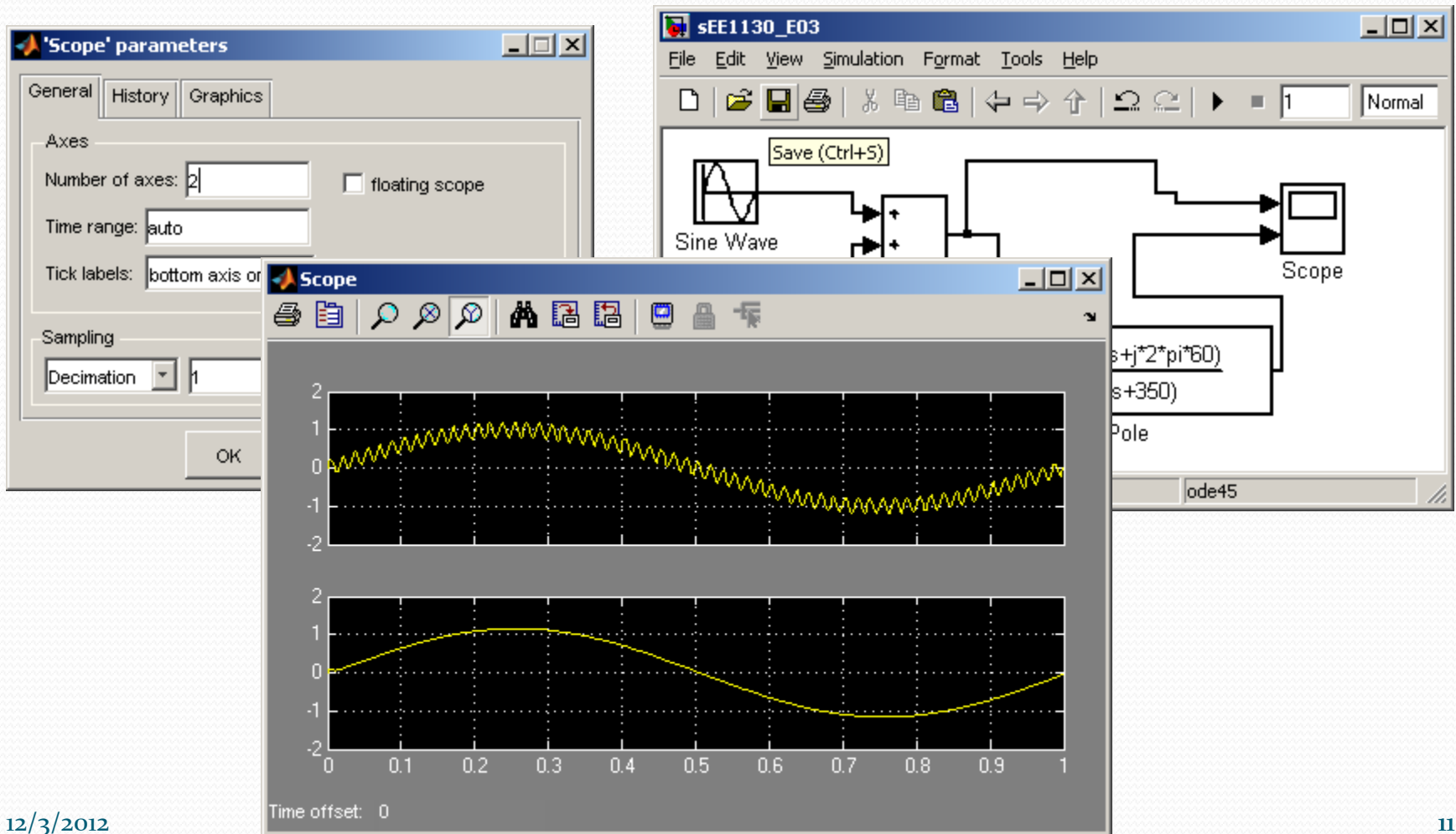
Simulink: Signal Processing.

- Now we hit play and compare input and output in the Scope



Simulink: Signal Processing.

- We notice the dark trace is completely clean of noise. We could add another trace to the scope and see both signals separated:





End of Class