Computer Aided Design (CAD)

Lecture 11

Simulation of Analog Communication Systems using Simulink (3)

Dr.Eng. Basem ElHalawany

Schedule (Updated 28-10)

Topics	Estimated Duration (# Lectures)
Introduction	1
Introduction to Matlab Environment	1
Matlab Programing (m-files) (1)	5
Modeling using Matlab Simulink Tool (1)	3
Midterm	7th Week
Communication Systems Simulation (Applications)	3 **(1/3)**
Introduction to FPGA + Review on Digital Logic/Circuits	2
VHDL Modeling Language	4
VHDL Application	2
~~Introduction to OPNET Network Simulator~~ (Projects)	2
Course Closeout / Feedback/ project (s) Delivery	1

The Lecture is based on :

1. **Modeling of Digital Communication Systems using simulink**
2. **Online Tutorials, You can find complete links on Instructor "External Links" on University website**

www.bu.edu.eg/staff/basem.mamdoh-external-Links

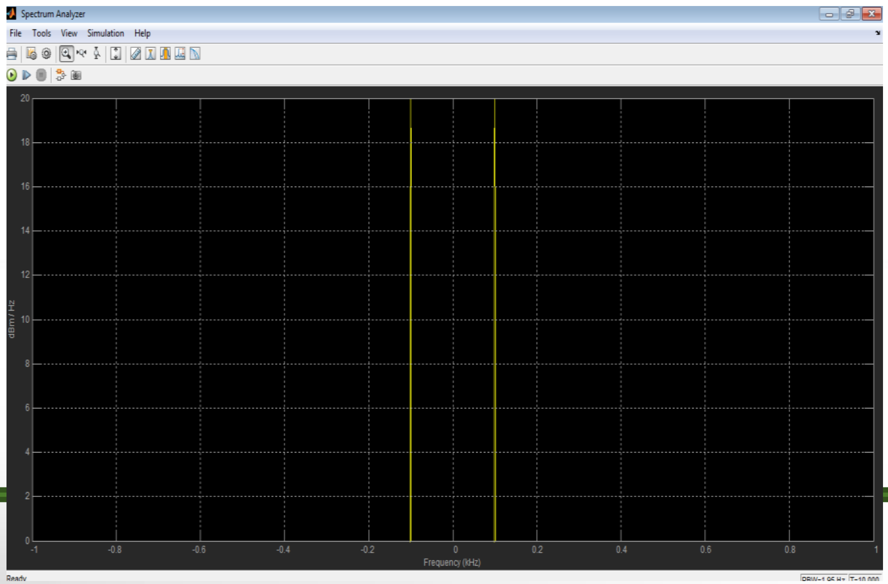
Spectrum Analyzer

- The spectrum Analyzer is used to find the frequency content of a signal
- How much power in each frequency

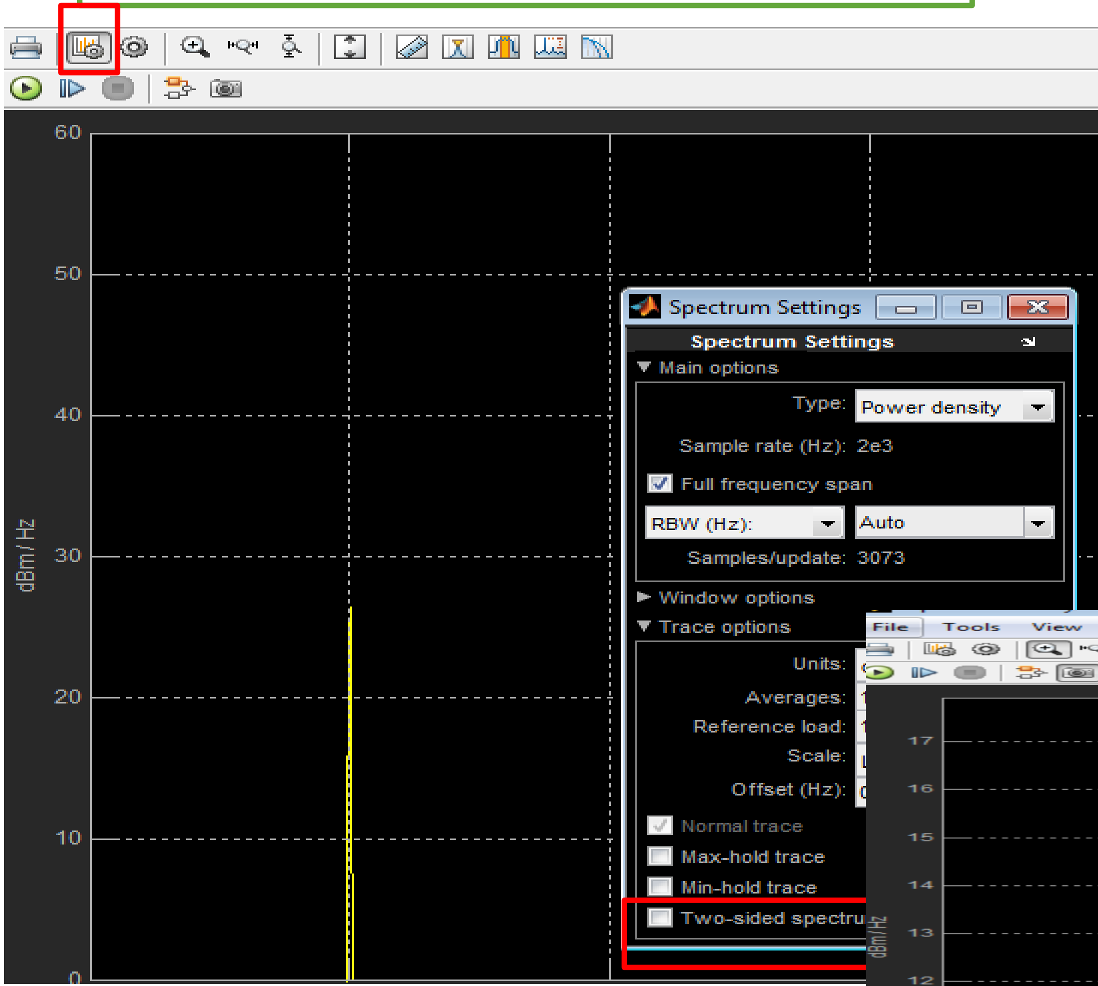
From DSP Toolbox-->DSP sinks

Spectrum cannot be displayed for continuous or infinite sample times.

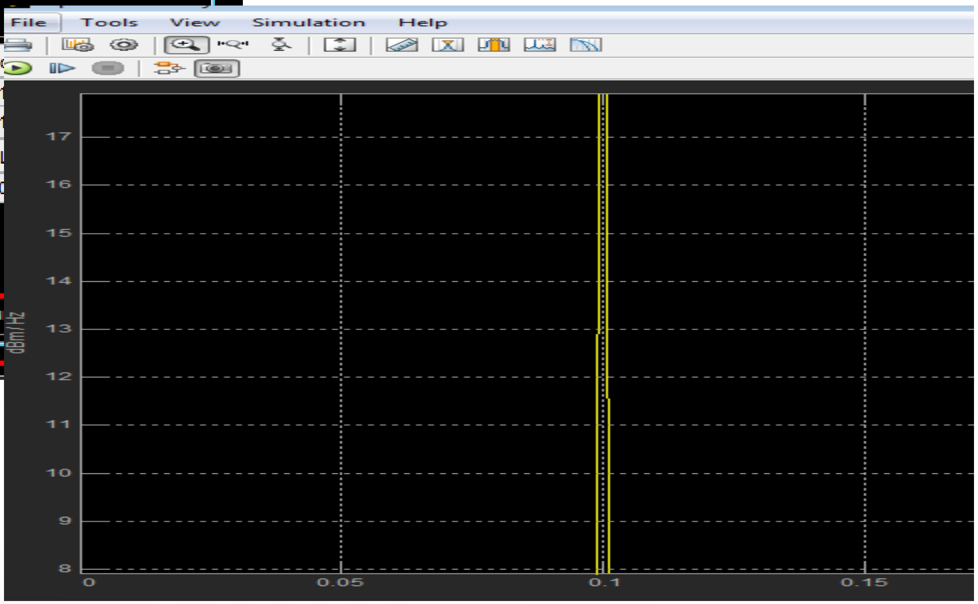
Two-sided Spectrum



➢ One versus Two-Sided Spectrum:

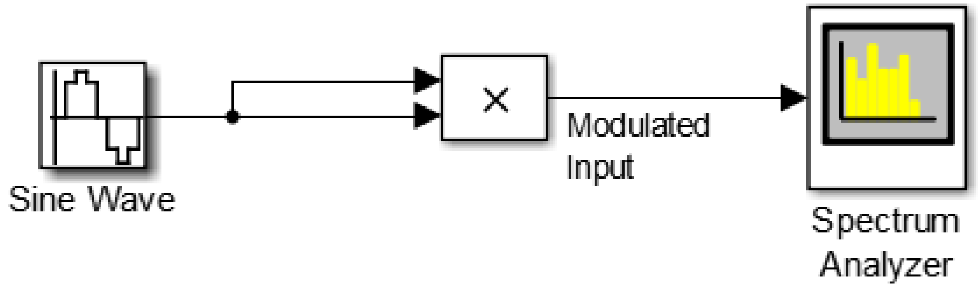


One-sided Spectrum



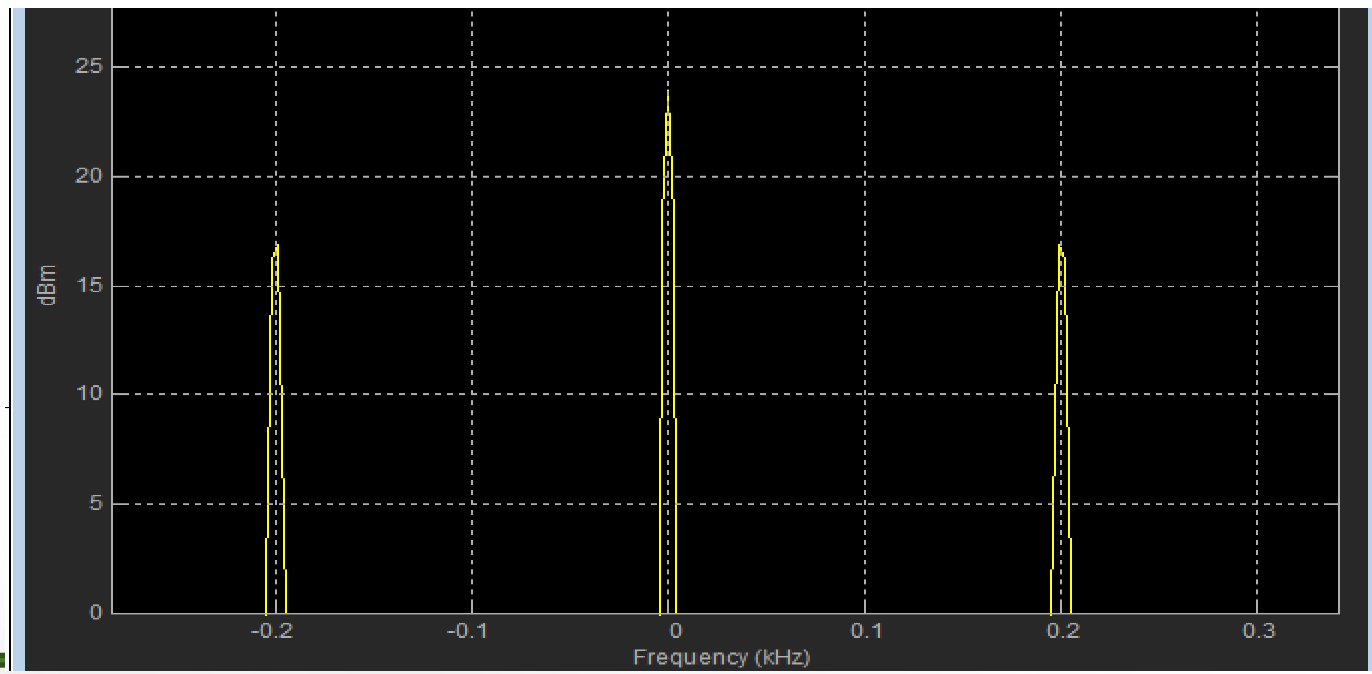
Spectrum of 2 multiplied sinusoidal

sin*sin=sin^2=Dc+ double the frequency



F =100 Hz

DSB modulation



Amplitude Modulation

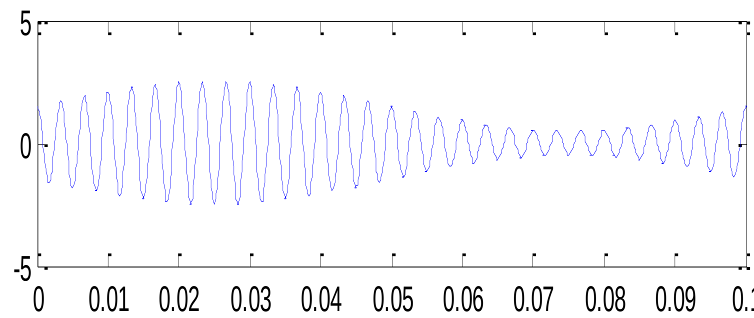
- Amplitude Modulation is a process where the amplitude of a carrier signal is altered according to information in a message signal.

- The frequency of the carrier signal is usually much greater than the highest frequency of the input message signal.

AM - Basic Definitions

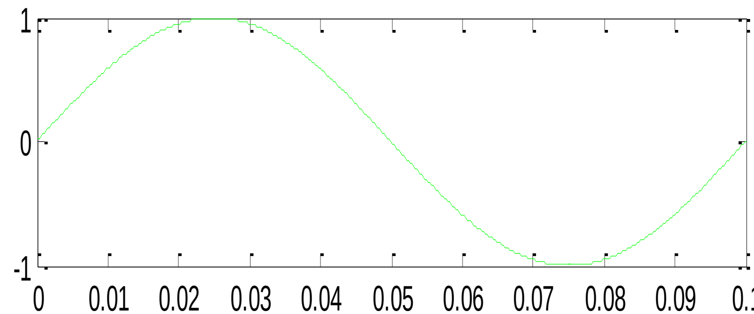
The AM signal

$$s(t) = A_c\left[1 + k \bullet m(t)\right]\mathbf{cos}\,\omega_c t$$



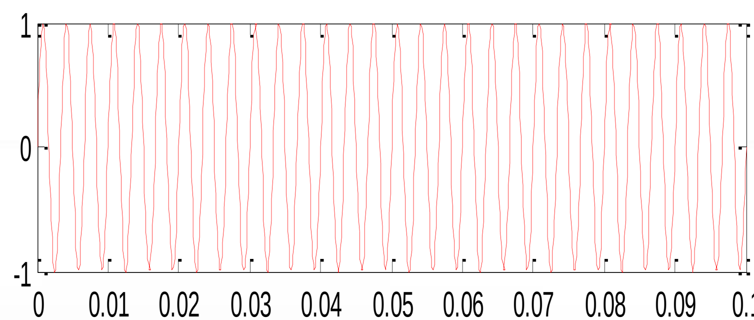
The modulating signal:

$$m(t)$$



The Carrier Signal:

$$c(t) = A_c\,\mathbf{cos}\,\omega_c t$$



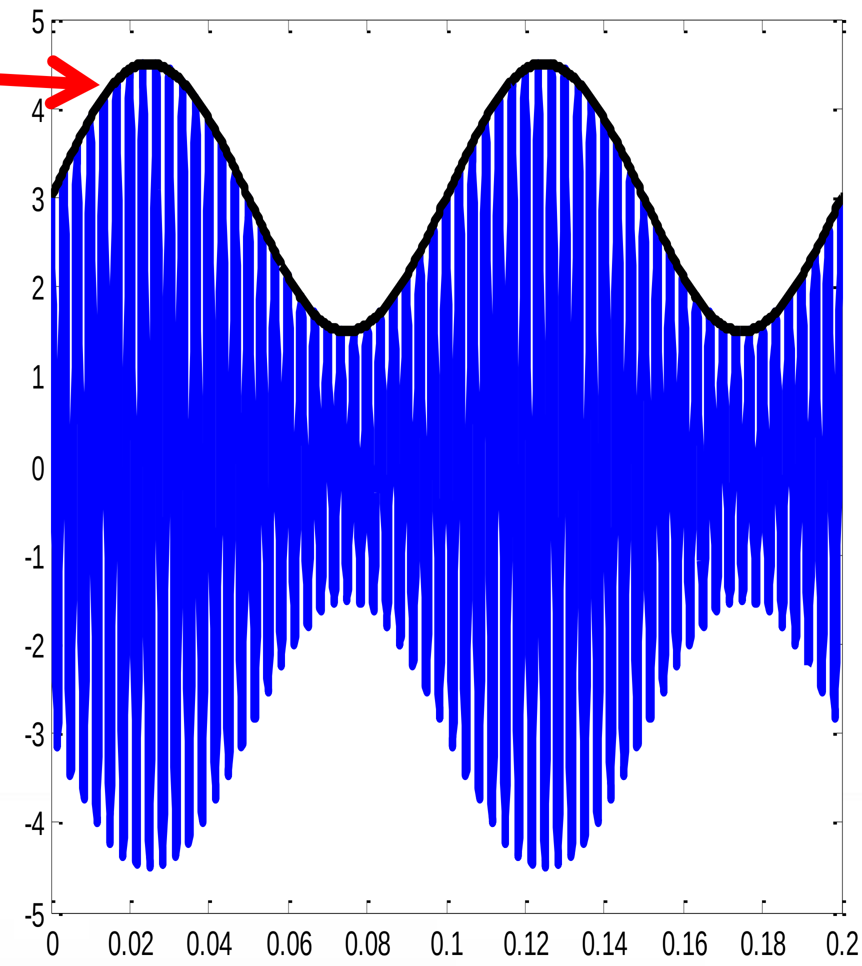
AM - Basic Definitions

The Envelope:

$$s(t) = A_c\left[1 + k \bullet m(t)\right]$$

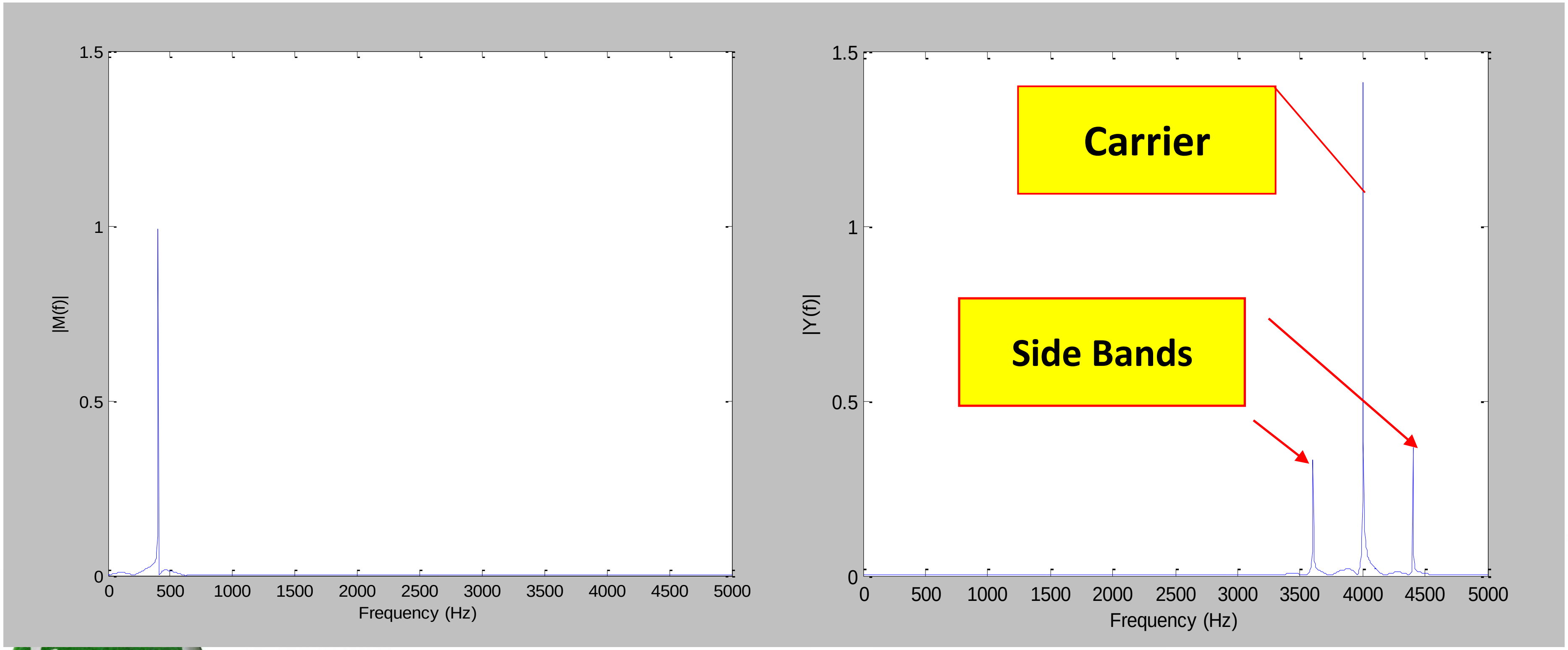
The AM Signal

$$s(t) = A_c\left[1 + k \bullet m(t)\right]\cos\omega_c t$$



AM Spectrum

$m(t)$ $\qquad\qquad$ $s(t)$



Block Diagram of the simulation Environment

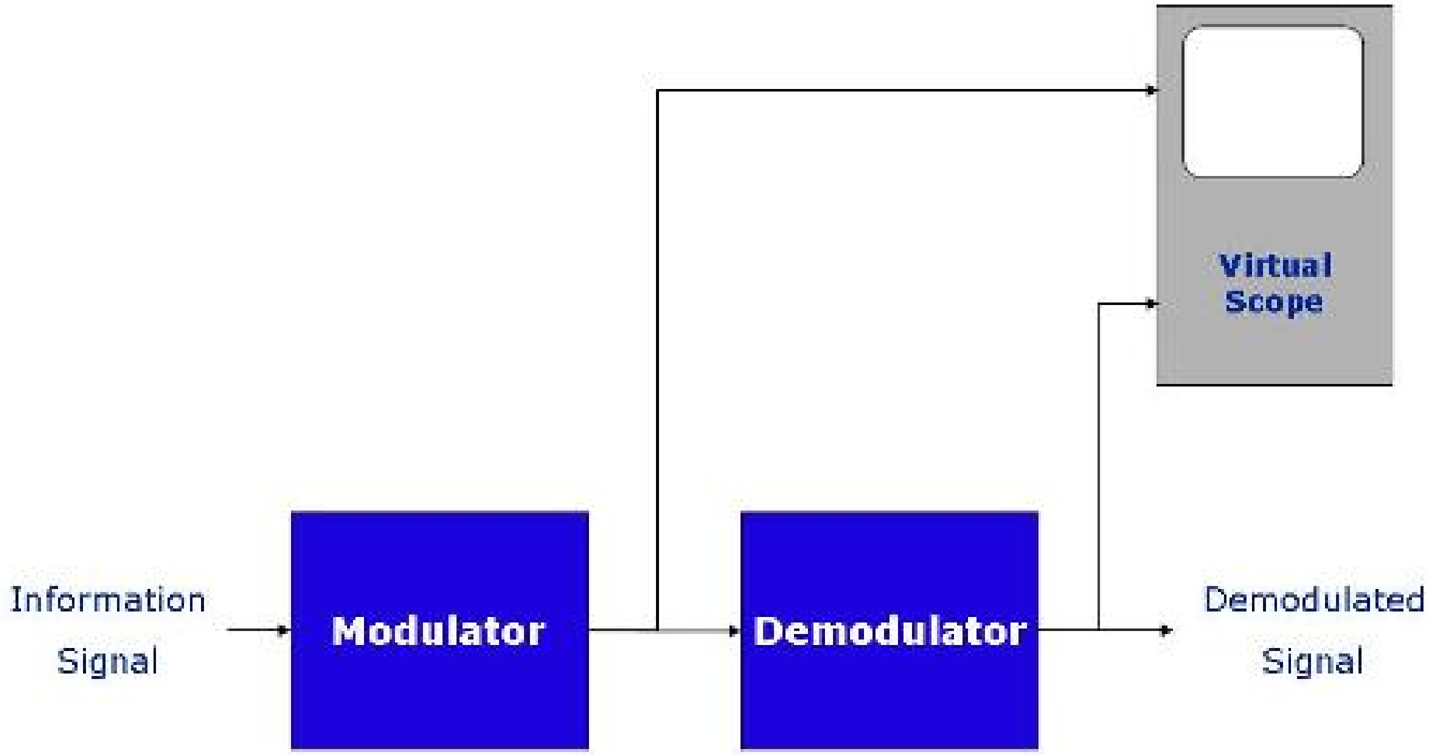
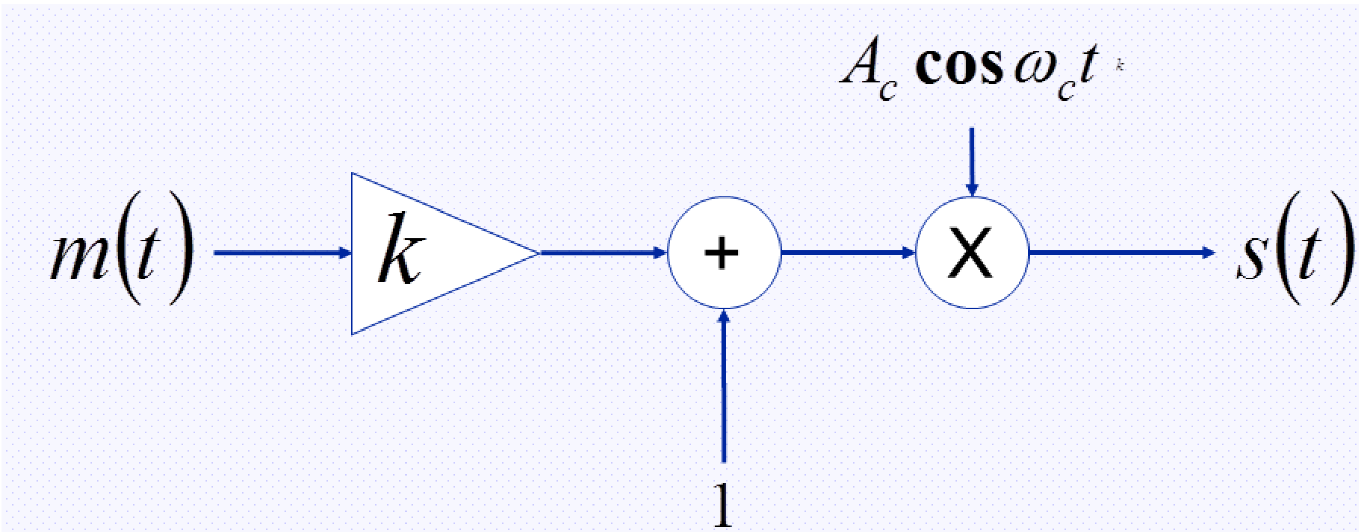
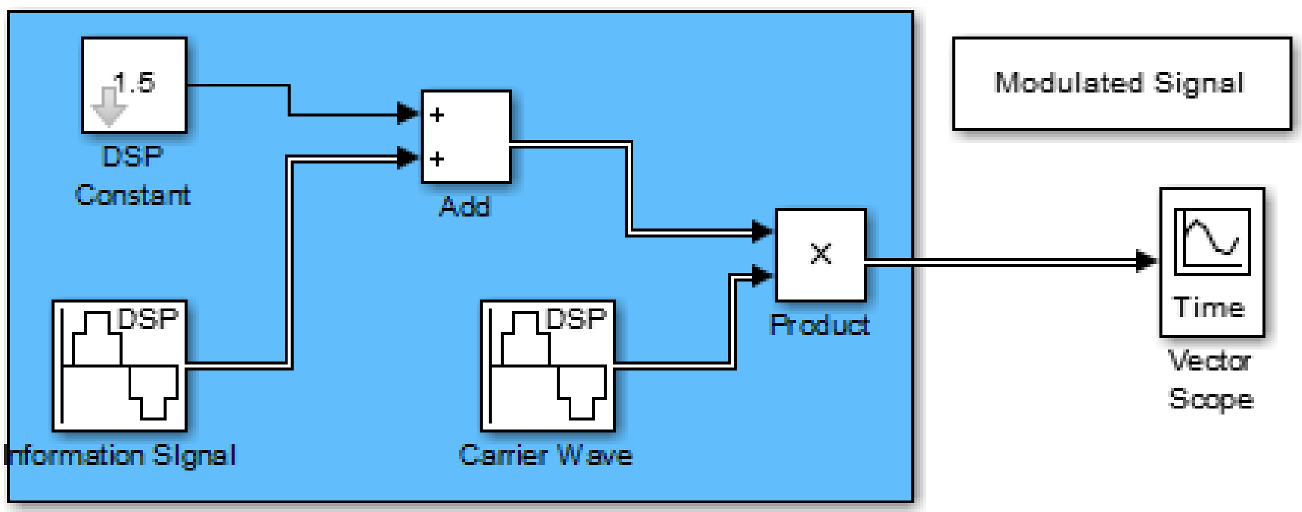


Figure 1. Simulation Environment

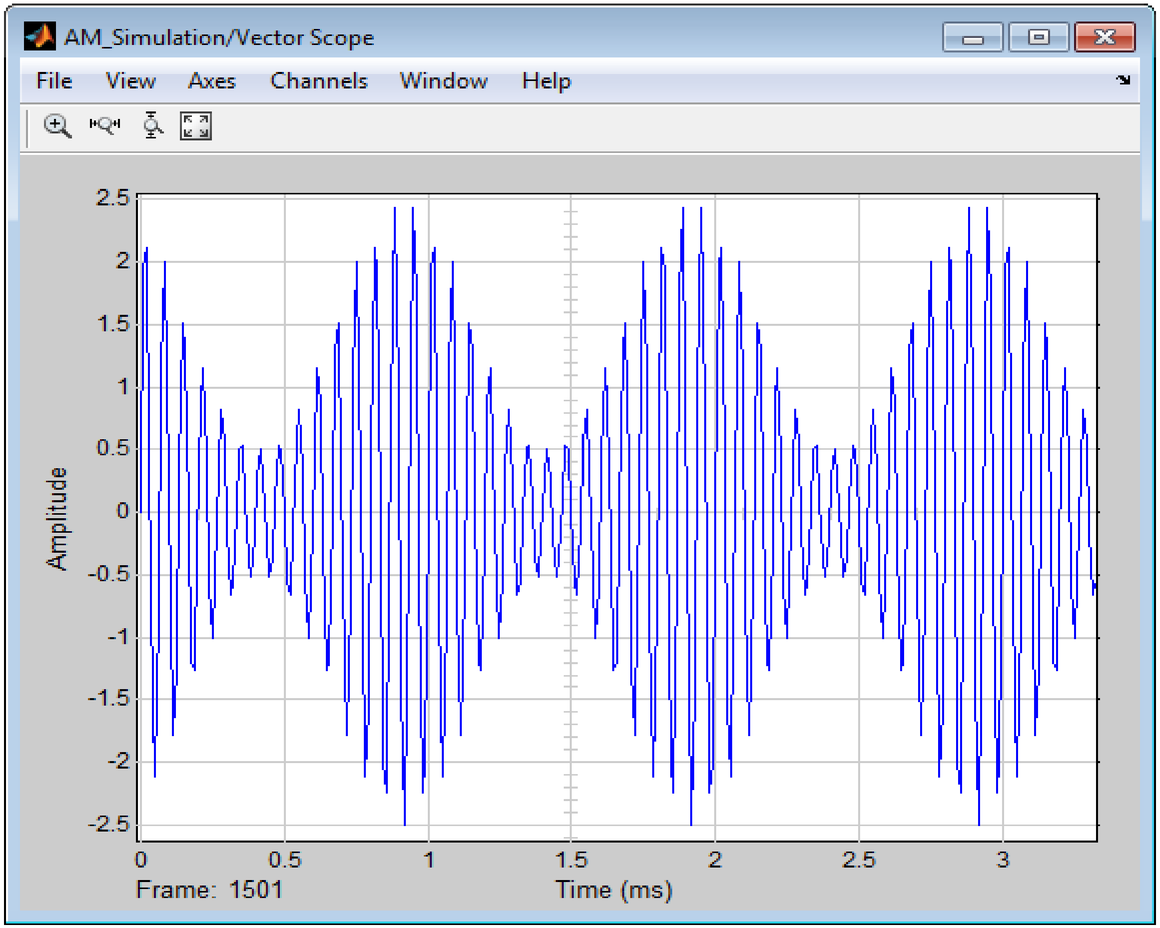
AM Modulation Scheme



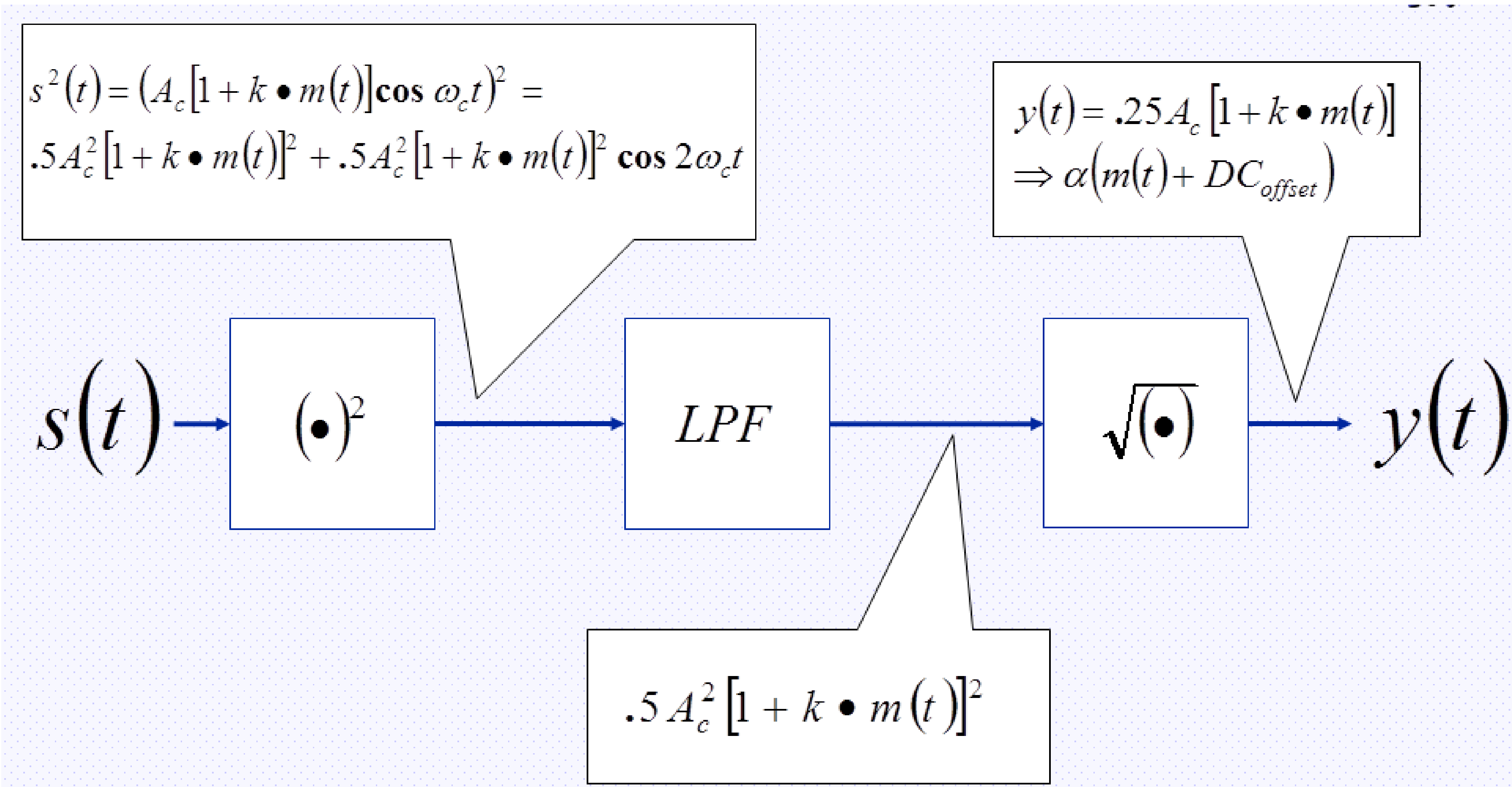


AM Transmitter

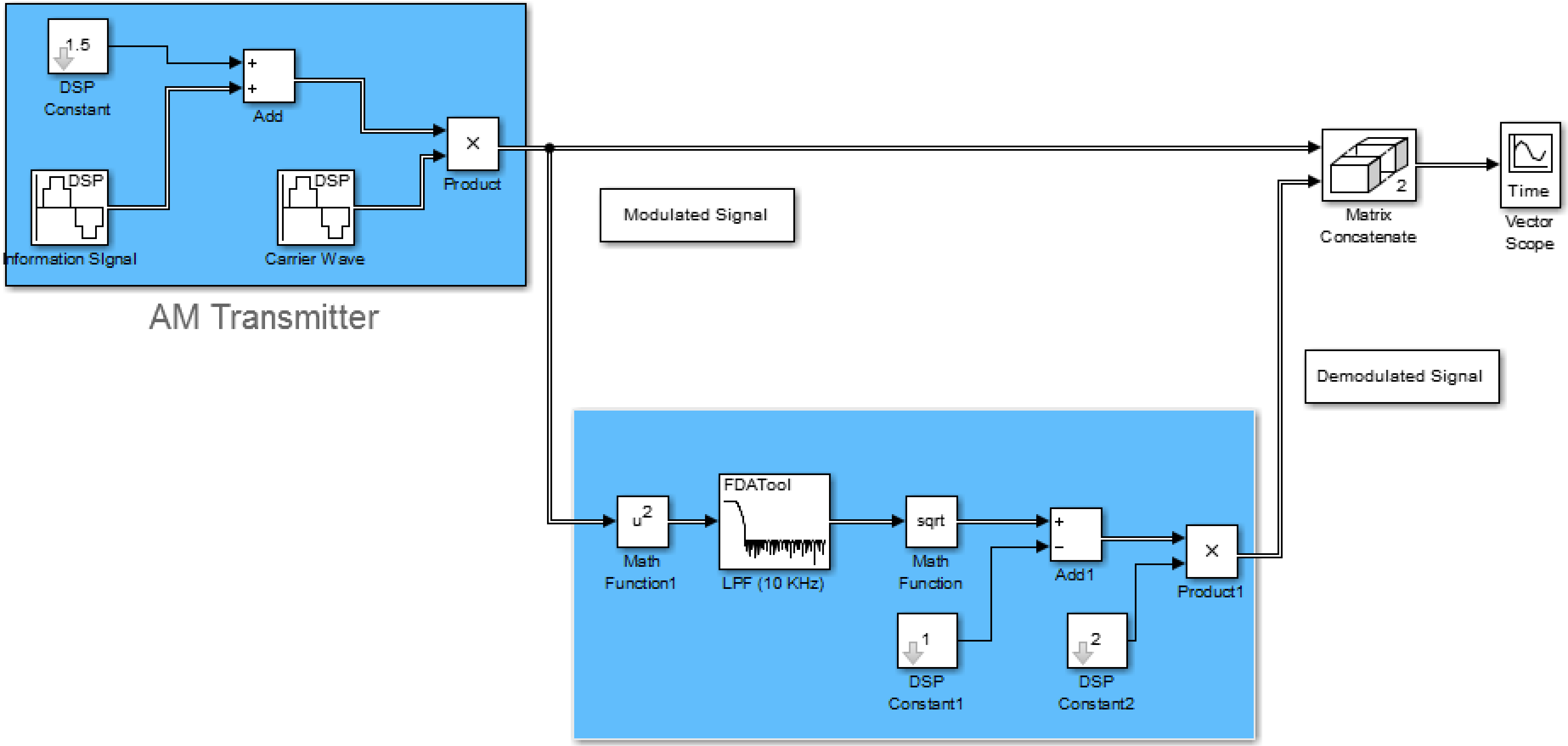
AM Modulation Scheme Results



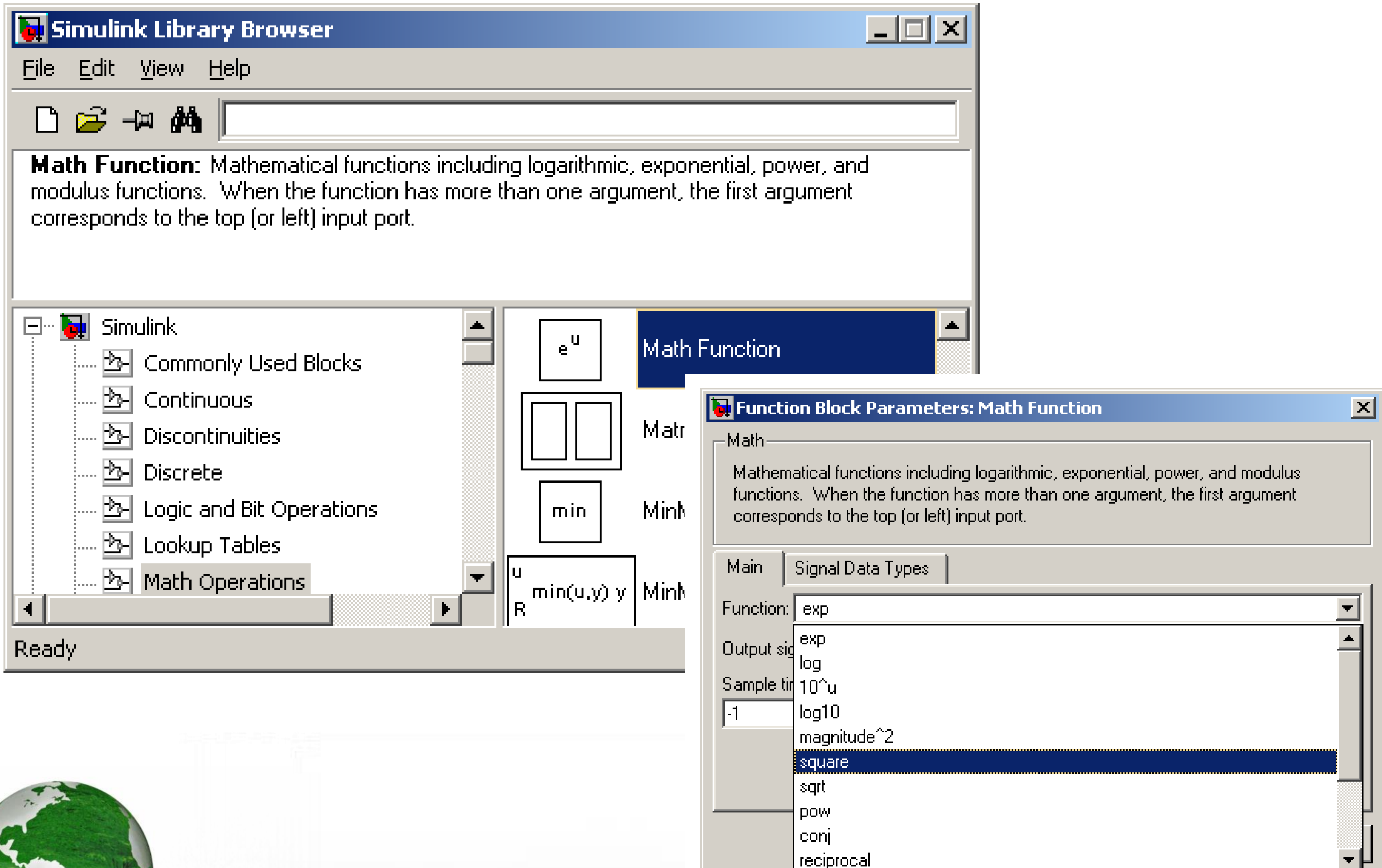
AM Demodulator (Square-Law Demodulator)



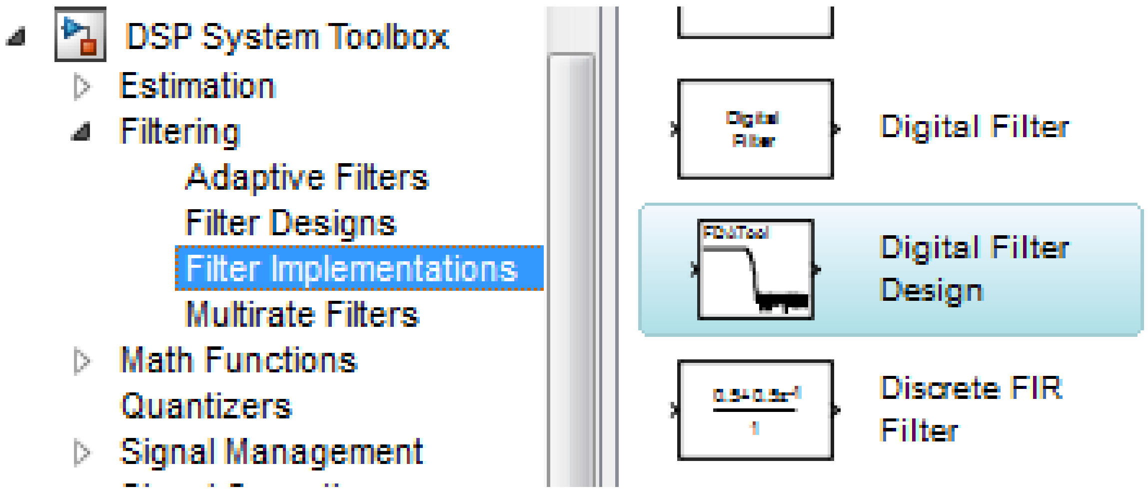
AM Modulator/Demodulator



AM Demodulator sub-blocks

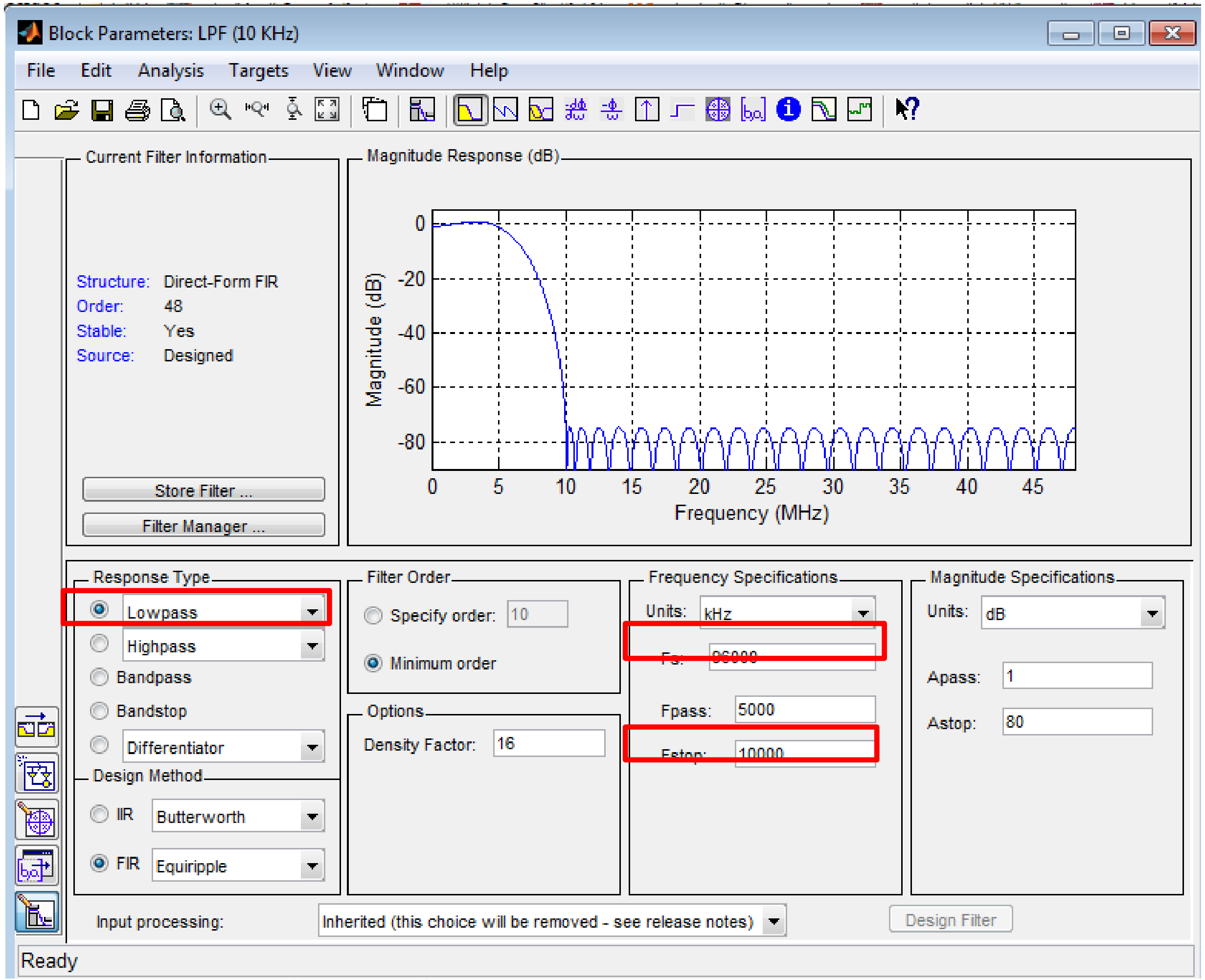


AM Demodulator sub-blocks



- Select "Digital Filter Design" and add it to the model
- Double click and configure as the next slide

AM Demodulator sub-blocks



- Since the carrier frequency (fc) is 15 KHz and the maximal frequency of the information is 1 KHz,
- The filter will be designed to pass frequencies below 5 KHz, and rejects frequencies higher than 10 KHz.

AM Demodulator sub-blocks