

Experiment 6

SIMULINK

Simulink®

Getting Started Guide

R2011b

**MATLAB®
& SIMULINK®**

 **MathWorks®**

Simulink

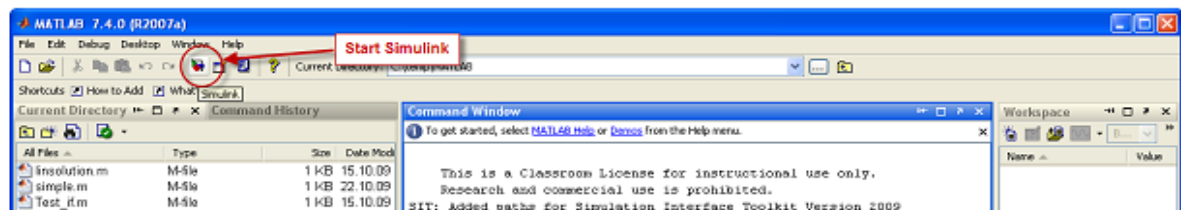
Introduction to simulink

SIMULINK is an interactive environment for modeling, analyzing, and simulating a wide variety of dynamic systems. *SIMULINK* provides a graphical user interface for constructing block diagram models using “drag-and-drop” operations. A system is configured in terms of block diagram representation from a library of standard components. *SIMULINK* is very easy to learn. A system in block diagram representation is built easily and the simulation results are displayed quickly. Simulation algorithms and parameters can be changed in the middle of a simulation with intuitive results, thus providing the user with a ready access learning tool for simulating many of the operational problems found in the real world. *SIMULINK* is particularly useful for studying the effects of nonlinearities on the behavior of the system, and as such, it is also an ideal research tool. The key features of *SIMULINK* are

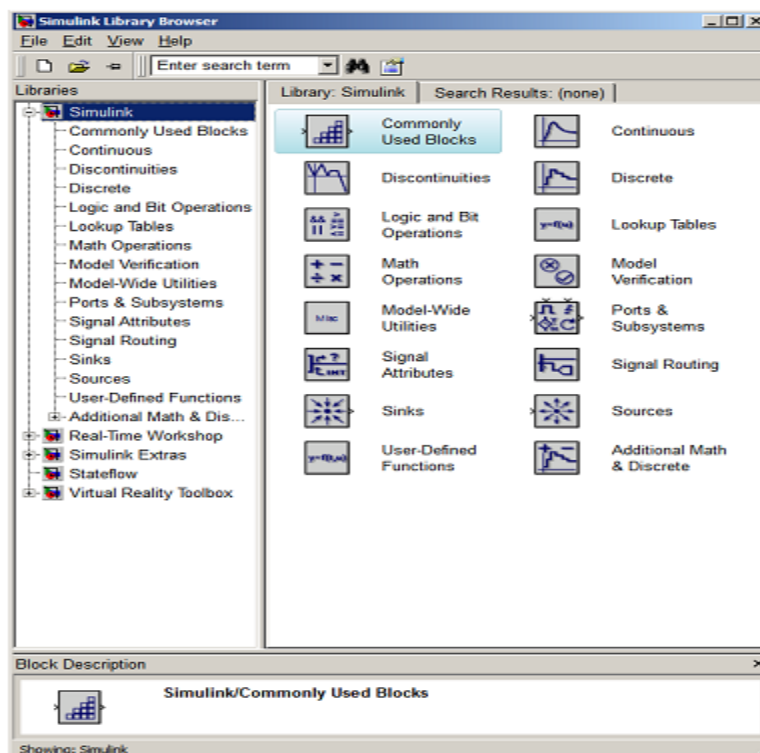
- Interactive simulations with live display.
- A comprehensive block library for creating linear, nonlinear, discrete or hybrid multi-input/output systems.
- Seven integration methods for fixed-step, variable-step, and stiff systems.
- Unlimited hierarchical model structure.
- Scalar and vector connections.
- Mask facility for creating custom blocks and block libraries. *SIMULINK* provides an open architecture that allows you to extend the simulation environment:
- You can easily perform “what if” analyses by changing model parameters – either interactively or in batch mode – while your simulations are running.
- Creating custom blocks and block libraries with your own icons and user interfaces from *MATLAB*, Fortran, or C code.
- You can generate C code from *SIMULINK* models for embedded applications and for rapid prototyping of control systems.
- You can create hierarchical models by grouping blocks into subsystems. There are no limits on the number of blocks or connections.
- *SIMULINK* provides immediate access to the mathematical, graphical, and programming capabilities of *MATLAB*, you can analyze data, automate procedures, and optimize parameters directly from *SIMULINK*.
- The advanced design and analysis capabilities of the toolboxes can be executed from within a simulation using the mask facility in *SIMULINK*.
- The *SIMULINK* block library can be extended with special-purpose blocksets. The DSP Blockset can be used for DSP algorithm development, while the Fixed-Point Blockset extends *SIMULINK* for modeling and simulating digital control systems and digital filters.

Getting Start :

You start Simulink by clicking on the SIMULINK button on the MATLAB desktop tool bar.



As an alternative method: type **simulink** in the command window



There are several groups of Simulink blocks in the Simulink icon such as Commonly Used Blocks, Continuous, Discontinuities, Math Operations, Sinks and Sources, etc. Selecting Commonly Used Blocks will provide a list of blocks shown in Fig. 2.

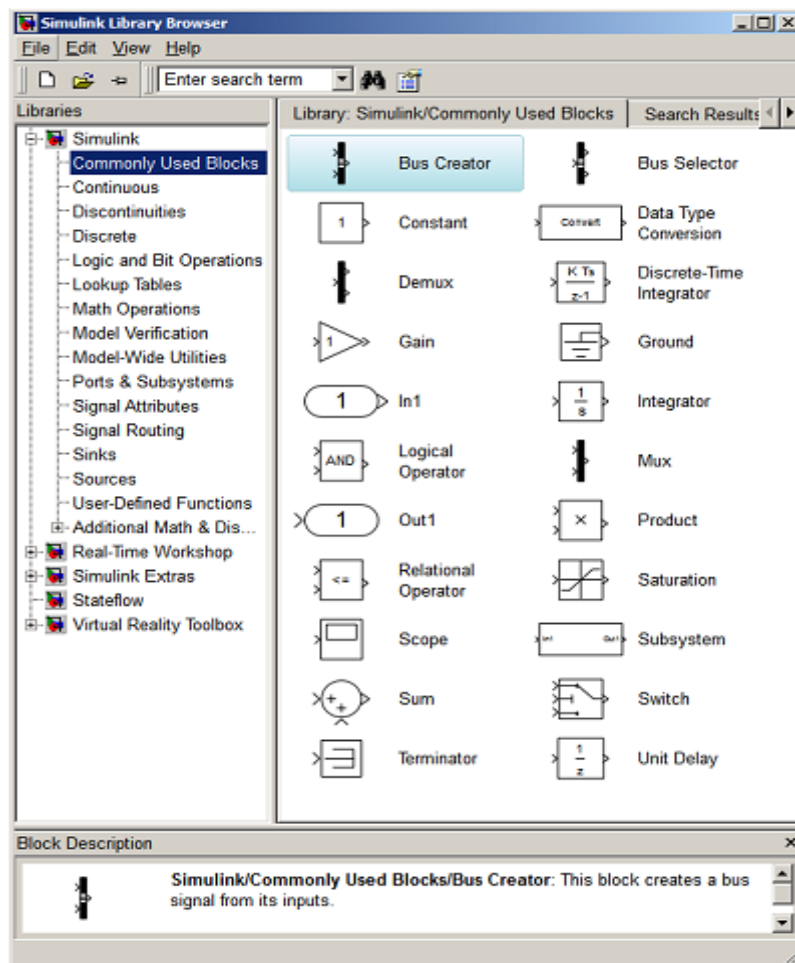


Fig 2 : a list of blocks in Commonly Used Block group

Selecting Continuous will provide a list of blocks shown in Fig. 3. The ones that we often use are Transfer Fcn, State-space and Integrator.

Selecting the Sources icon yields the library shown in Fig. 4. The most commonly used sources are Clock (which is used to generate a time vector), Step (which generates a step input), and Constant (that generate a constant function).

The Sinks icon as shown in Fig. 5 provides a set of Sinks blocks that are used to display

simulated results. The most often used blocks may be To Workspace (to which a variable passed is written to a vector in the MATLAB Workspace), Scope (to represent data graphically).

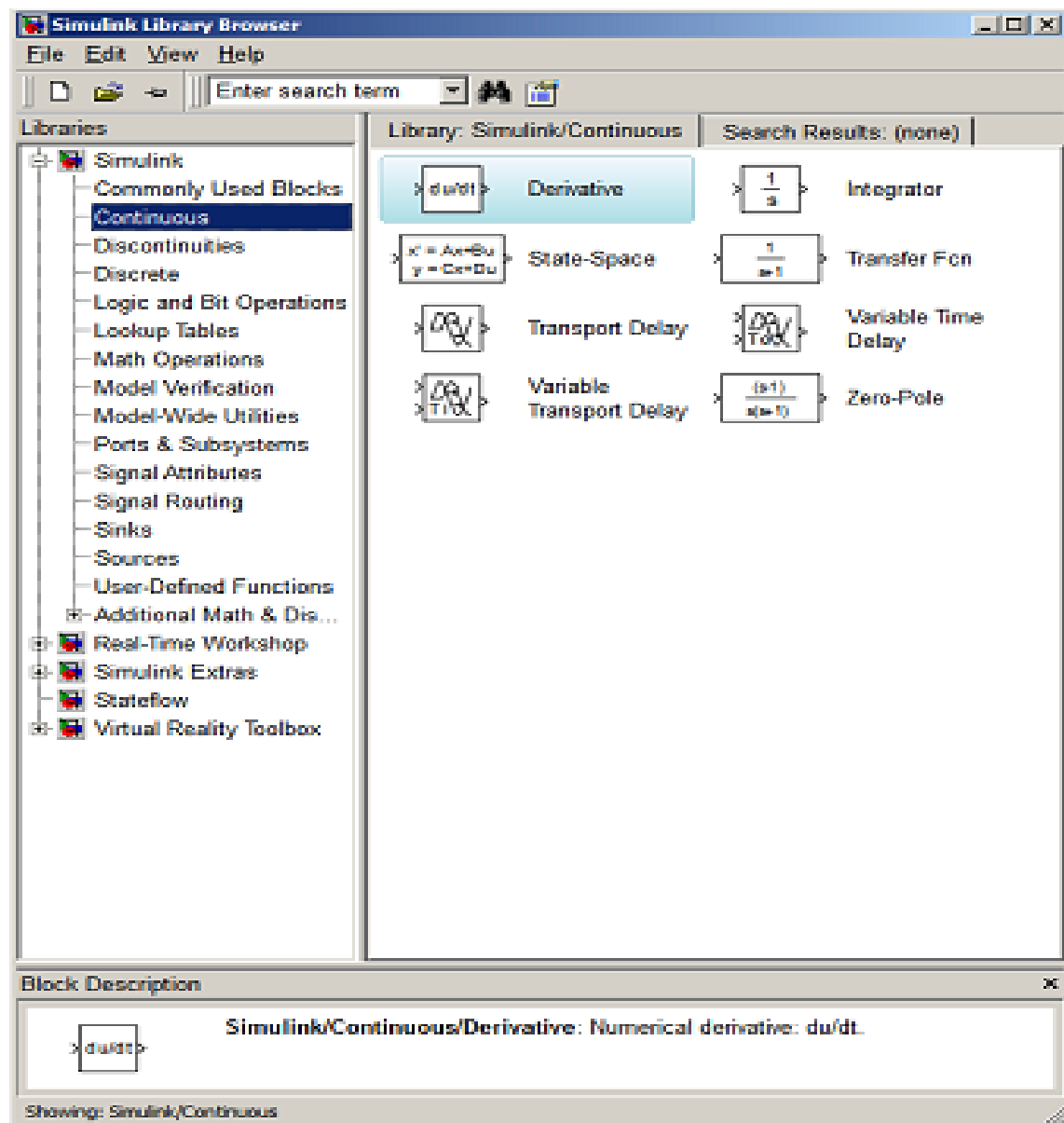


Fig 3: A list of blocks in Continuous group

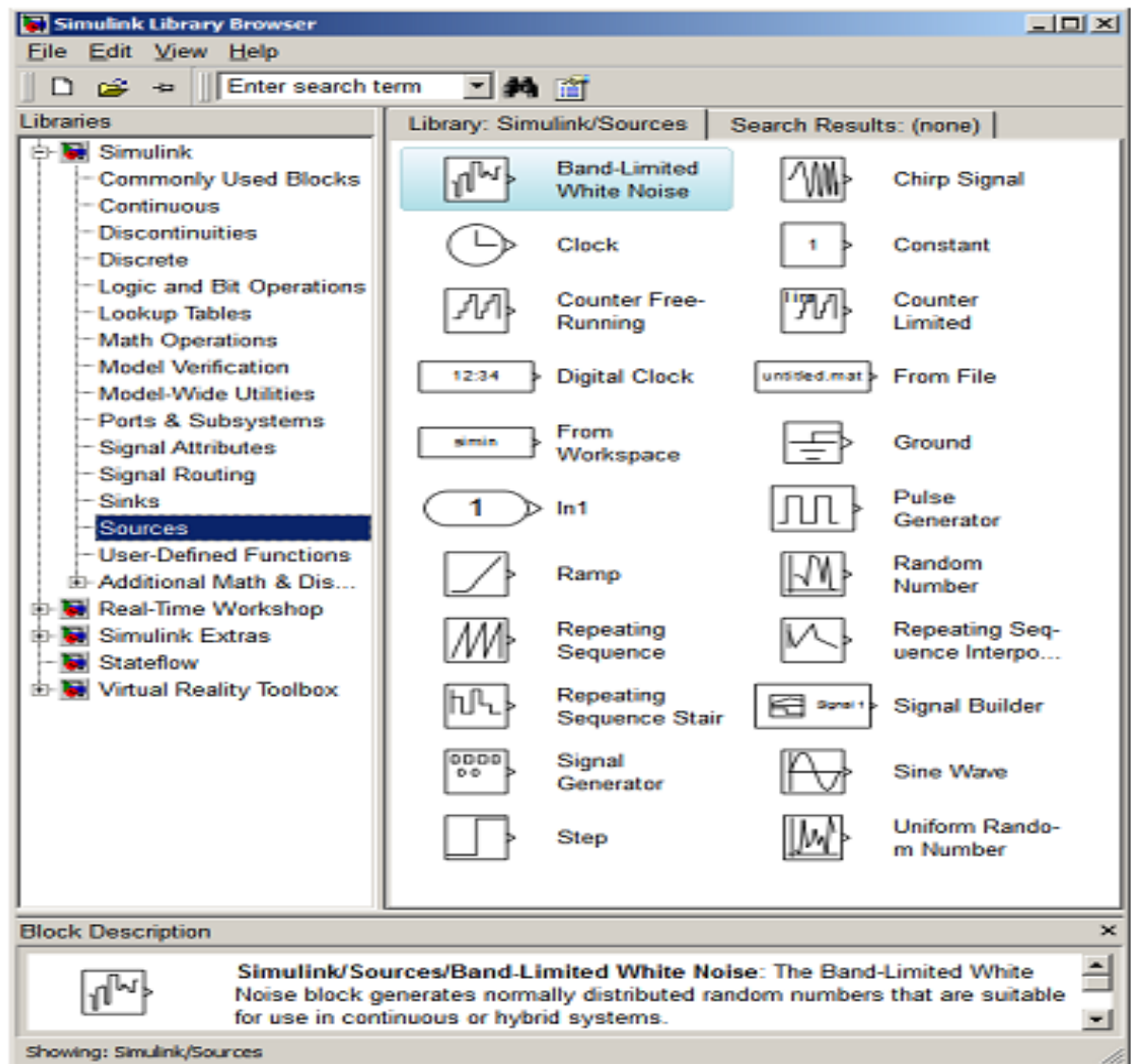


Fig 3: A list of blocks in source group

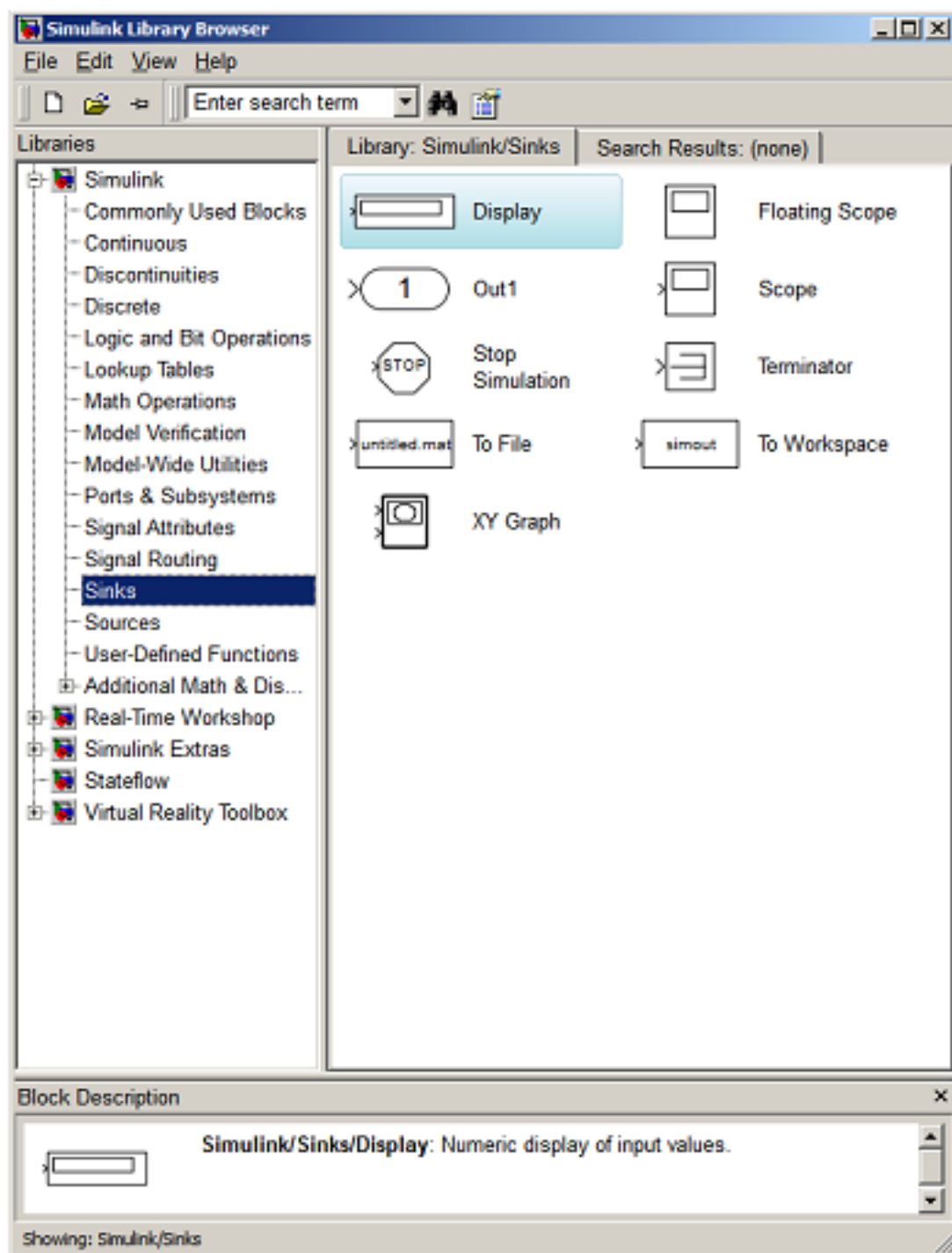
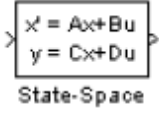
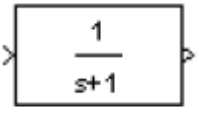
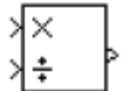
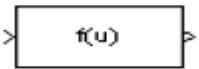
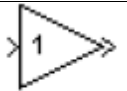
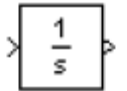
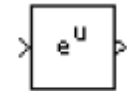
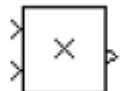


Fig 3: A list of blocks in Sinks group

Block Libraries

Block icon	Name	Use
Continuous		
 State-Space	State-Space	Implement a linear state-space system
 Transfer Fcn	Transfer Fcn	Implement a linear transfer function
Math Operations		
 Derivative	Derivative	Merge scalar, vector or matrix signals
 Divide	Divide	Multiply or divide inputs
 Fcn	Function	Apply a specified expression to the input
 Gain	Gain	Multiplies the input by a constant value (gain)
 Integrator	Integrator	Integrate the input signal
 Math Function	Math Function	Perform a mathematical function
 Product	Product	Multiply inputs
 Sum	Sum	Add or subtract inputs
 Transport Delay	Transport Delay	Delay the input by a given amount of time

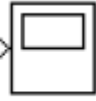
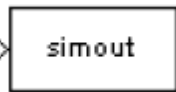
Signal Routing		
	Demux	Split vector signals into scalars or smaller vectors
	Mux	Extract and output the elements of a bus or vector signal
Sinks		
 Scope	Scope	Display signals generated during a simulation
 To Workspace	To Workspace	Write data to the workspace
 XY Graph	XY Graph	Display an X-Y plot of signals using a MATLAB figure window
Sources		
 Clock	Clock	Generate a time vector
 Constant	Constant	Generate a constant
 Ramp	Ramp	Output a ramp signal
 Sine Wave	Sine Wave	Generate a sine wave signal
 Step	Step	General a step signal

Table 1 Summary of Commonly Used Simulink Blocks

Example 1. Simulation of an Equation.

In this example we will use Simulink to model an equation. Let's consider

$$x(t) = A \cos(\omega t + \varphi)$$

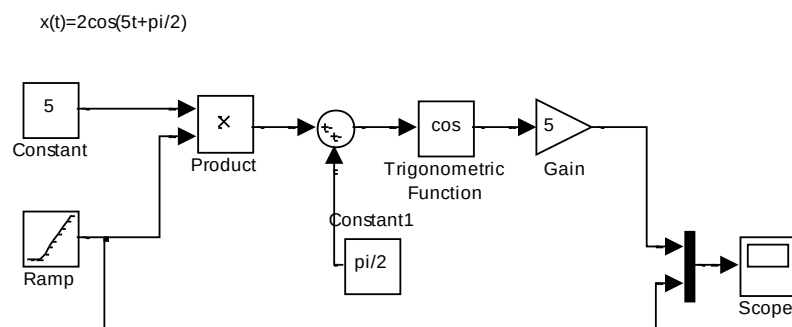
where the displacement x is a function of time t , frequency ω , phase angle φ , and amplitude A . In this example the values for these parameters are set as follows:

frequency=5 rad/sec; phase=pi/2; A=5.

1. From Simulink's library drag the following blocks to the Model Window

Blocks to be dragged to the model window	Where located in Simulink library browser
Ramp	Sources
Constant	Sources
Gain	Math Operation
Sum	Math Operation
Product	Math Operation
Trigonometry Function	Math Operation
Scope	Sinks
Mux	Signal Routing

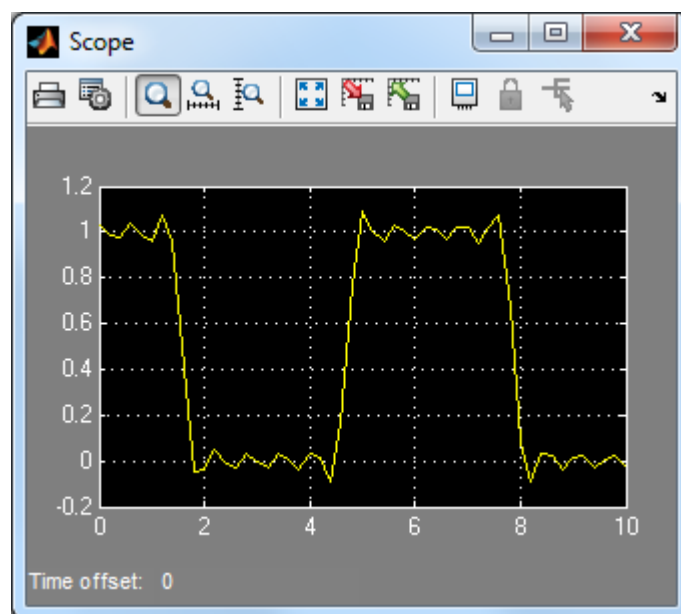
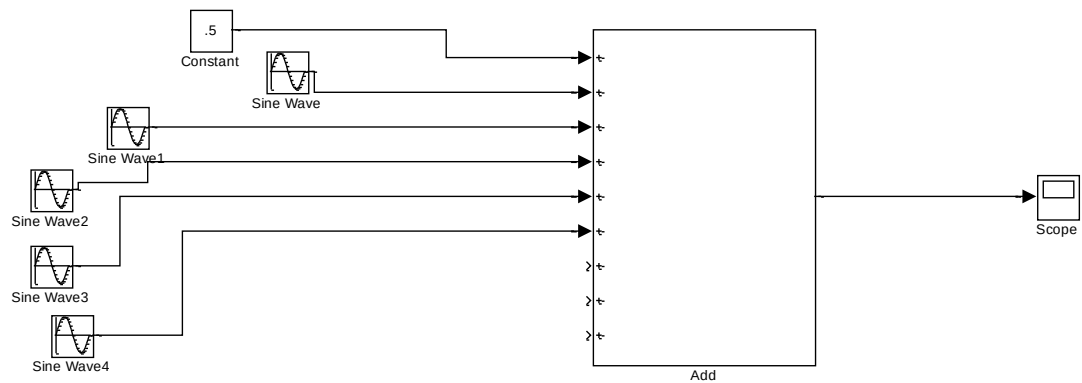
2. The next step is to connect these blocks as shown.



NOW, make this example:

Using Simulink plot this function

$$x(t) = .5 + \frac{2}{\pi} \left(\cos t - \frac{1}{3} \cos 3t + \frac{1}{5} \cos 5t - \frac{1}{7} \cos 7t + \frac{1}{9} \cos 9t \dots \right)$$



Solve Differential Equations

$$\frac{d^2x}{dt^2} + 3\frac{dx}{dt} + 4x = 5\cos(2t)$$

$$x(0) = 0$$

$$\frac{dx}{dt}(0) = 0$$

