PROGRAMMING WITH MATLAB

WEEK 12





- Simulink is a toolbox for modeling, simulating, and analyzing dynamic systems.
- With Simulink you can easily build a system model,
 modify it, and observe the behavior of the system.
 > simulink

This command opens the Simulink Start Window Click on the Blank Model pain



🎦 untitled - Simulink — 🗆 🗙	Simulink Library Browser ×
File Edit View Display Diagram Simulation Analysis Code Tools Help	Enter search term
▶ · · · · · · · · · · · · · · · · · · ·	Simulink/Continuous
untitled	V Simulink
Image: Second seco	$\checkmark \qquad \qquad$
Θ.	Dashboard Derivative Integrator Integrator,
	Discontinuities
	Discrete $y_{\frac{1}{2}} \int x $ $y_{\frac{1}{2}} \int x$ $y_{\frac{1}{2}} \int x$ $y_{\frac{1}{2}} \int x$ $y_{\frac{1}{2}} \int x$
	Lookup Tables
	Math Operations Second-Order Limited
	Model Verification Limited
	Ports & Subsystems
	Signal Attributes
	Signal Routing PID Controller (2DOF) State-Space Transfer Fcn
	Surces
	User-Defined Functions
	Additional Math & Discrete Delay Time Delay Transport Transport Delay
	Aerospace blockset
»	> Communications System Toolbox
Ready 100% VariableStepAuto	Communications System Toolbox HDL Sut Zero-Pole
Click the icon in the toolbar to open the library browser	Computer vision System Toolbox
	Data Acquisition Toolbox
The Simulink Library Browser	> DSP System Toolbox
	DSP System Toolbox HDL Support Embedded Coder

- The necessary items for the system model in the Simulink Library browser are clicked and dragged to
- the new model window.
- Then the connections between the ports of the items are again done with the help of the mouse.
- Blocks have a Block Parameters window that opens when you double-click on the block.

	Block Parameters: Pulse Generator	Х
🎦 untitled * - Simulink	Pulse Generator	
File Edit View Display Diagram Simulation	Output pulses:	
untitled	if (t >= PhaseDelay) && Pulse is on $Y(t) = Amplitude$ else $Y(t) = 0$ end	
e.	Pulse type determines the computational technique used.	
	Time-based is recommended for use with a variable step solver, while Sample-based is recommended for use with a fixed step solver or within a discrete portion of a model using a variable step solver.	
	Parameters	
Generator	Pulse type: Time based	•
	Time (t): Use simulation time	•
	Amplitude:	
	1	
	Period (secs):	
E3	10	
»	Pulse Width (% of period):	
Ready	5	
	Phase delay (secs):	
	0	
	☑ Interpret vector parameters as 1-D	
	OK Cancel Help Apply	

Let's construct a Simulink model to solve the following equation:

$$\dot{y} + 3y - \cos 3t = 0$$
, $0 \le t \ll 5$ and $y(0) = 1$

or

$$\dot{y} = -3y + \cos 3t$$

- Select and place in your new model window the Sine Wave block from the Sources library
- Select and place the Gain block from the Math Operations library
- Select and place the Integrator block from the Continuous library
- Select and place the Scope block from the Sinks library
- Connect these blocks as shown in the figure



Change the block parameters according to our equation:

Sine Wave

Amplitude:	
3	
Bias:	
0	
Frequency (rad/sec):	
3	

Sum

Main	Signal Attributes
Icon sha	pe: round 🗸
List of si	gns:
+-	

Integrator

Initial	condition:	
1		



Enter 5 for the Stop time.

Run the simulation by clicking on the Start Simulation icon on the toolbar.

Then double-click on the Scope blocks to observe the results.



Now let's implement low-pass and high-pass filter applications in Simulink:

The transfer function of a first order low-pass filter is as follows

$$H(s) = \frac{1}{1 + Ts}$$

The transfer function of a first order high-pass filter is:

$$H(s) = \frac{Ts}{1+Ts}$$



Set the frequencies of the sinusoids as follows:

Sine Wave : 31.4159 rad/s

Sine Wave1 = 47.1239 rad/s

Sine Wave2 = 314.1593 rad/s

Sine Wave3 = 471.2389 rad/s



Toolboxes

Math Operations: Takes the signal and performs a math operation

Abs, Add, Gain, Product, Sign, Trigonometric Function ...

Continuous: Adds differential equations to the system

Derivative, Integrator, Transfer Function, State-Space ...

Discrete: Simulates discrete difference equations

Delay, Difference, Discrete Derivative, First-Order Hold ...

Toolboxes

Sources: Provides input to your system

White Noise, Clock, Constant, Pulse generator, Random Number, Sine Wave, Signal Generator ...

Sinks: Allows signals to be observed and analyzed

Scope, Display, To File, To Workspace ...