Computer Aided Design (CAD)

Lecture 9

Introduction to Simulink (2)

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	4 (2/4)
Midterm	7th Week
Communication Systems Simulation (Applications)	3
Introduction to FPGA + Review on Digital Logic/Circuits	2
VHDL Modeling Language	4
VHDL Application	2
Introduction to OPNET Network Simulator	3
Course Closeout / Feedback/ project (s) Delivery	1

The Lecture is based on :

1.8 SENDING DATA TO WORKSPACE

- By adding the "**To Workspace**" block from Simulink **Sinks**
- The To Workspace block causes the output data from the Sine Wave block to be saved and examined for subsequent use such as plotting.

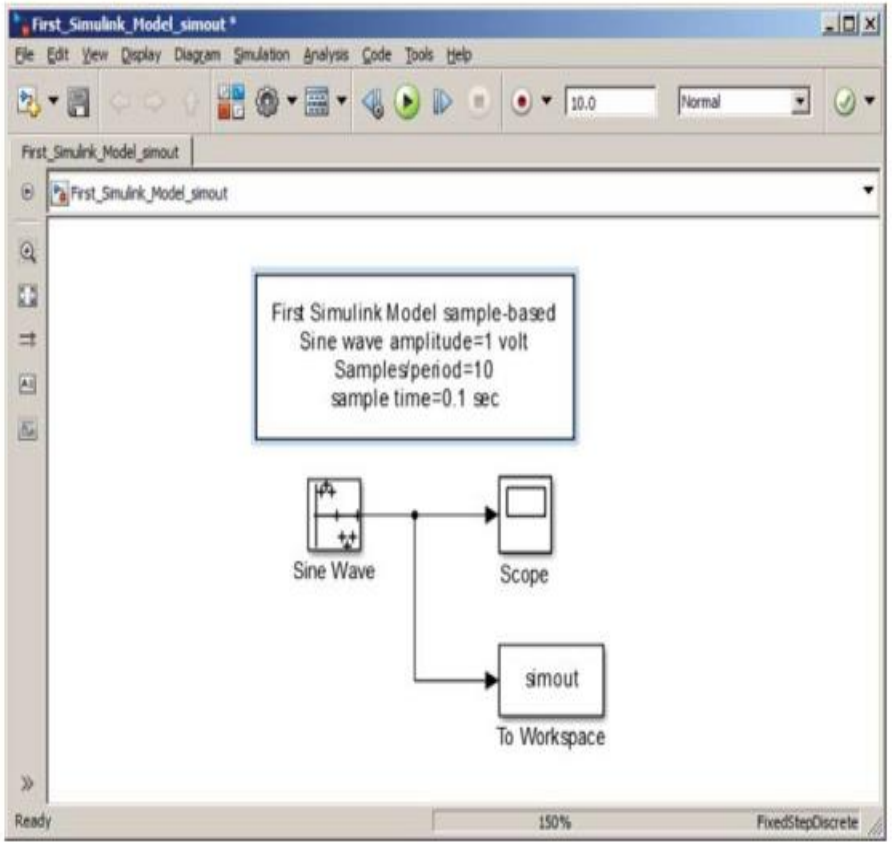
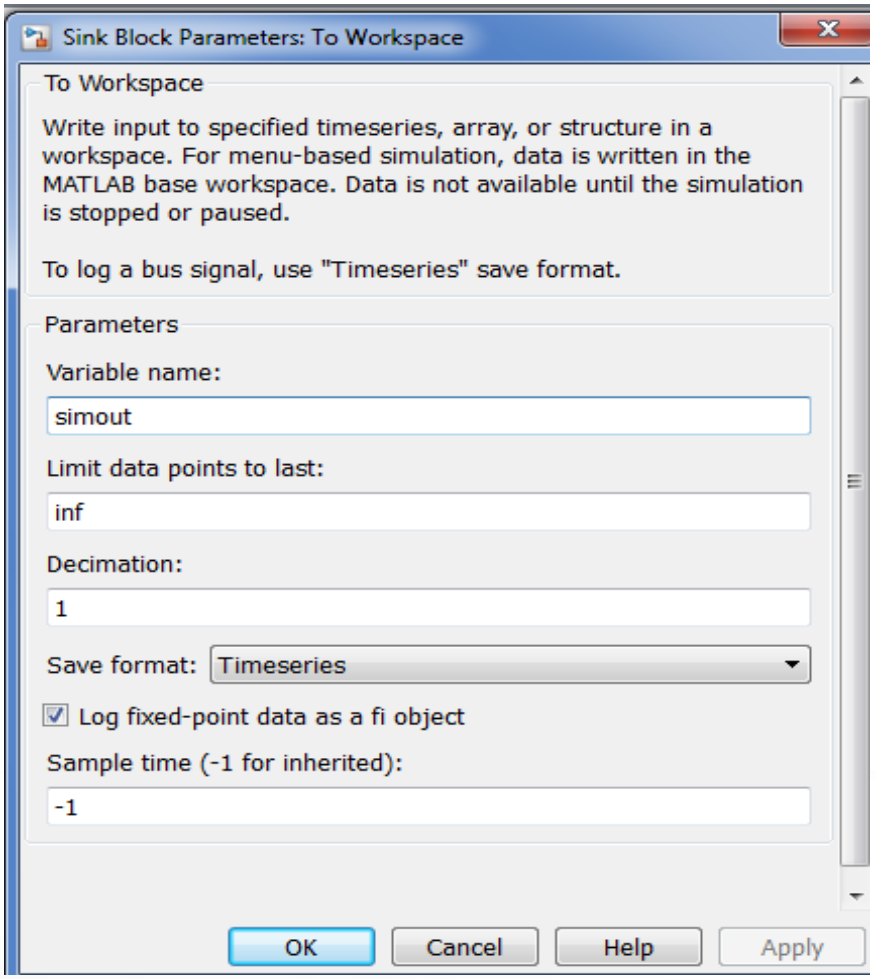
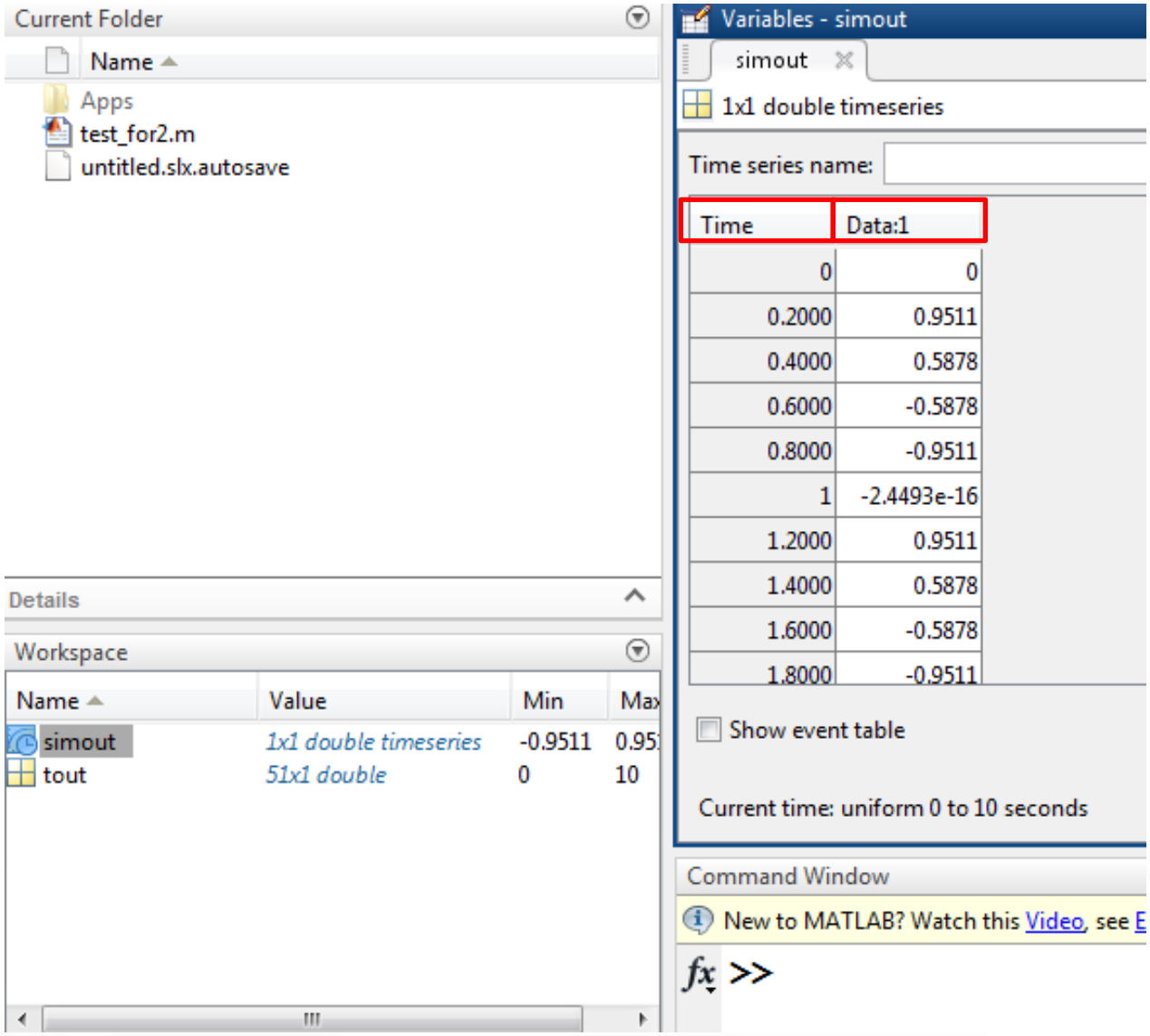


Figure 1.22 Sending Simulation Data to Workspace.



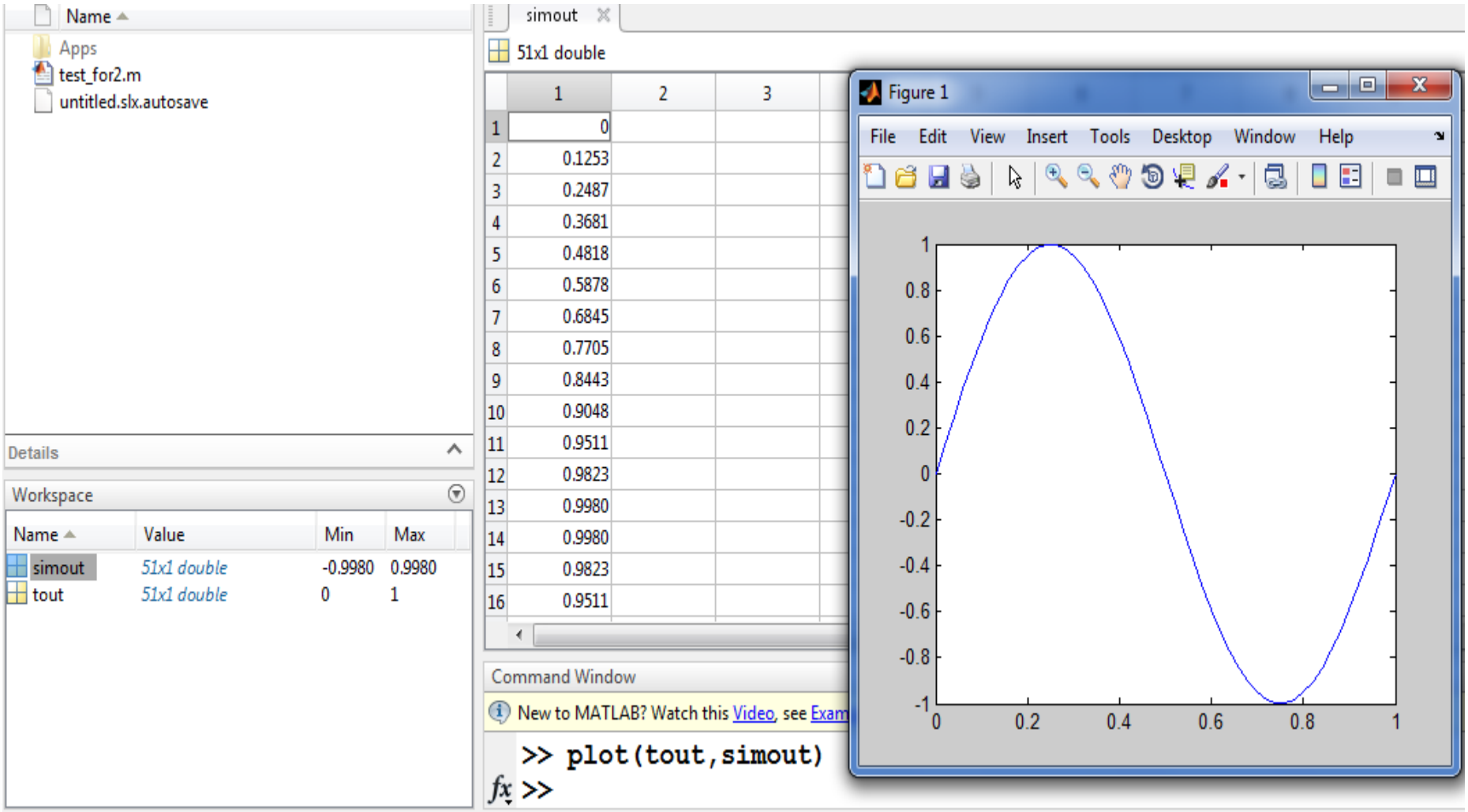
1.8 SENDING DATA TO WORKSPACE

Option: Timeseries



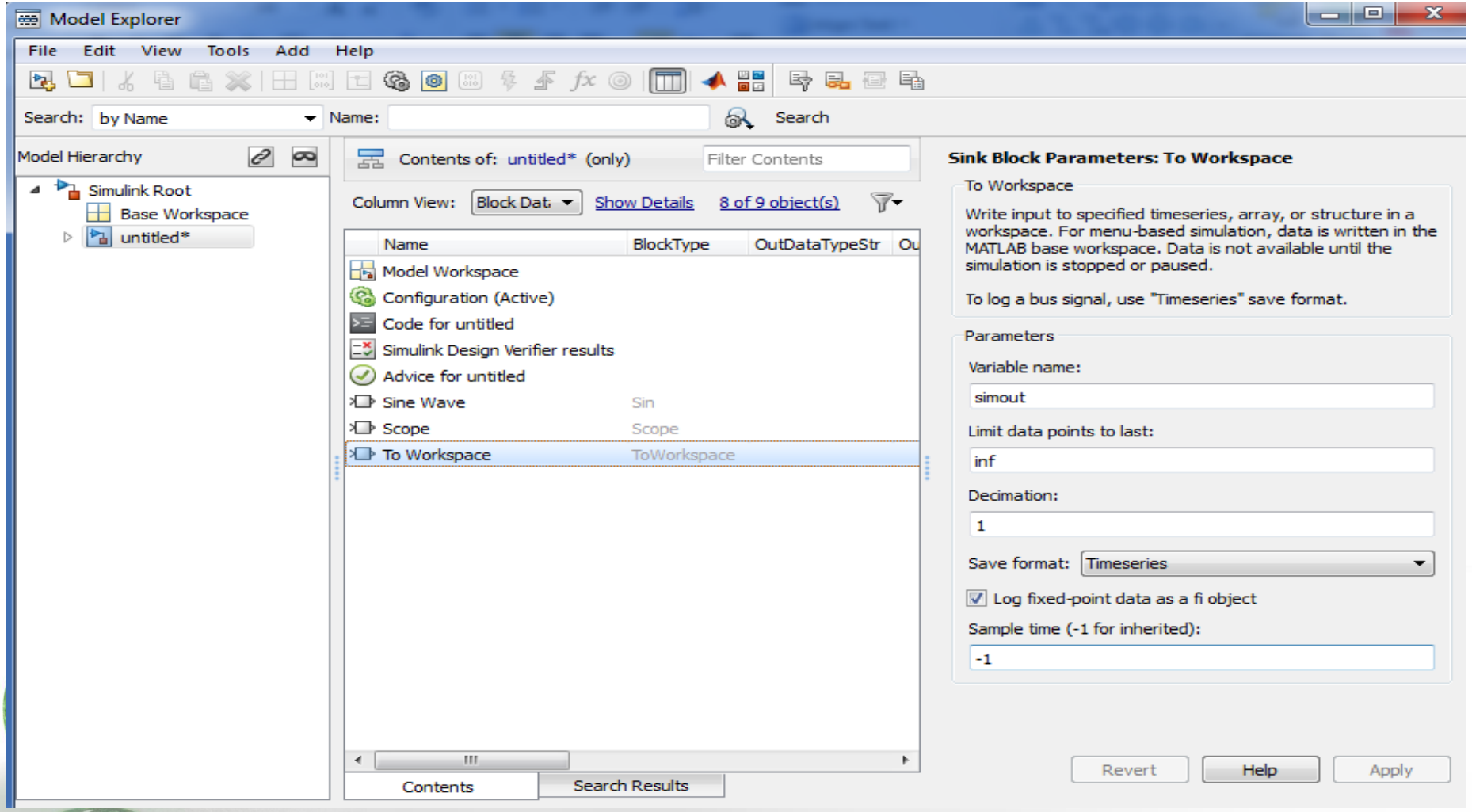
1.8 SENDING DATA TO WORKSPACE

Option: Array



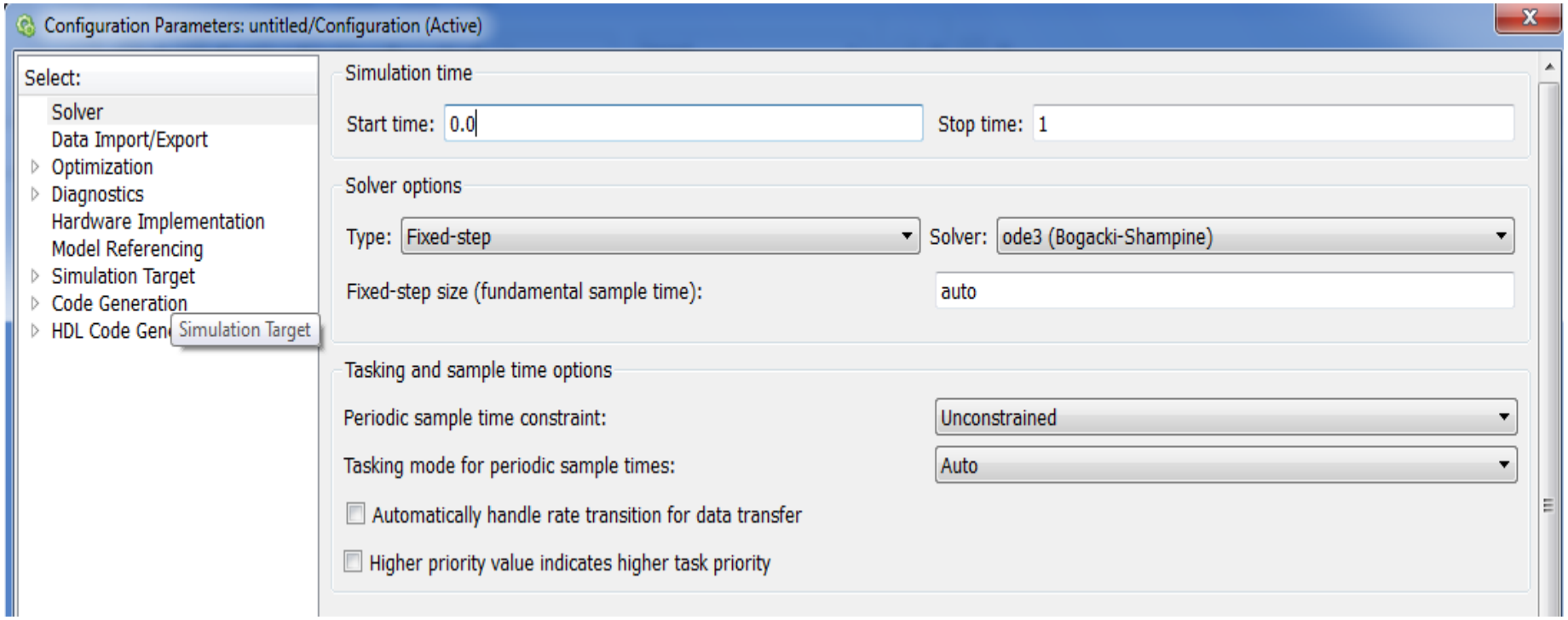
1.9 USING MODEL EXPLORER

- Model Explorer is a tool available to provide the user with the ability to view, modify or add elements in the Simulink model and workspace variables.
- To open the Model Explorer, select Model Explorer under the View tab in the Simulink model window.



1.11 Selecting Model Configuration Parameters

- In the Simulink model window, pulling down the Simulation tab and selecting Model Configuration Parameters

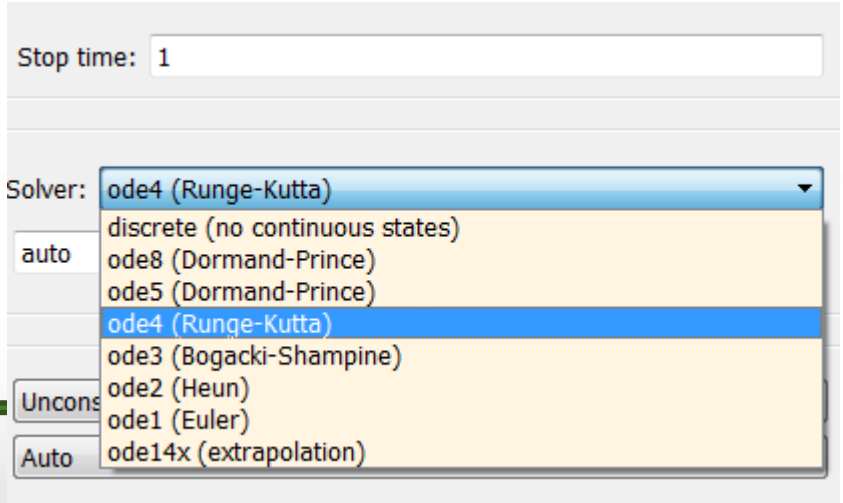


- User can specify the:
  - ✓ simulation start and stop time and
  - ✓ choose the solver for the simulation

Simulation: Simulink Solvers

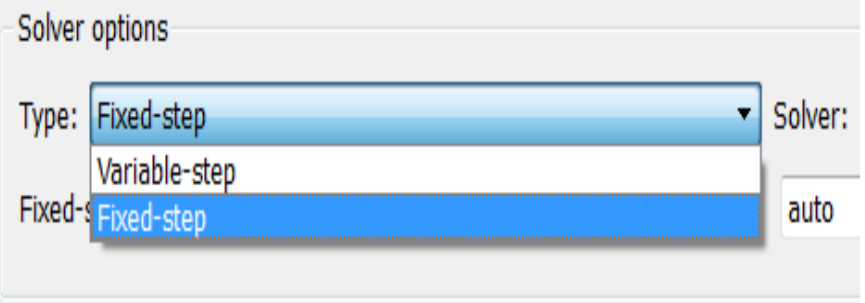
- A dynamic system is simulated by computing its states at successive time steps over a specified time span, using information provided by the model
- This entails repeatedly solving a set of difference or differential equations describing component blocks in the model of the system being simulated
- The process of solving the model at successive time steps is referred to as **simulating** the system that the model represents
- Simulink provides an assortment of solvers, each geared to solving a specific type of model

✓ The Solver is selected as ode-45, which, in general is the best first choice as a solver for most Simulink models.



1.11 Selecting Model Configuration Parameters

➢ Solver Options:



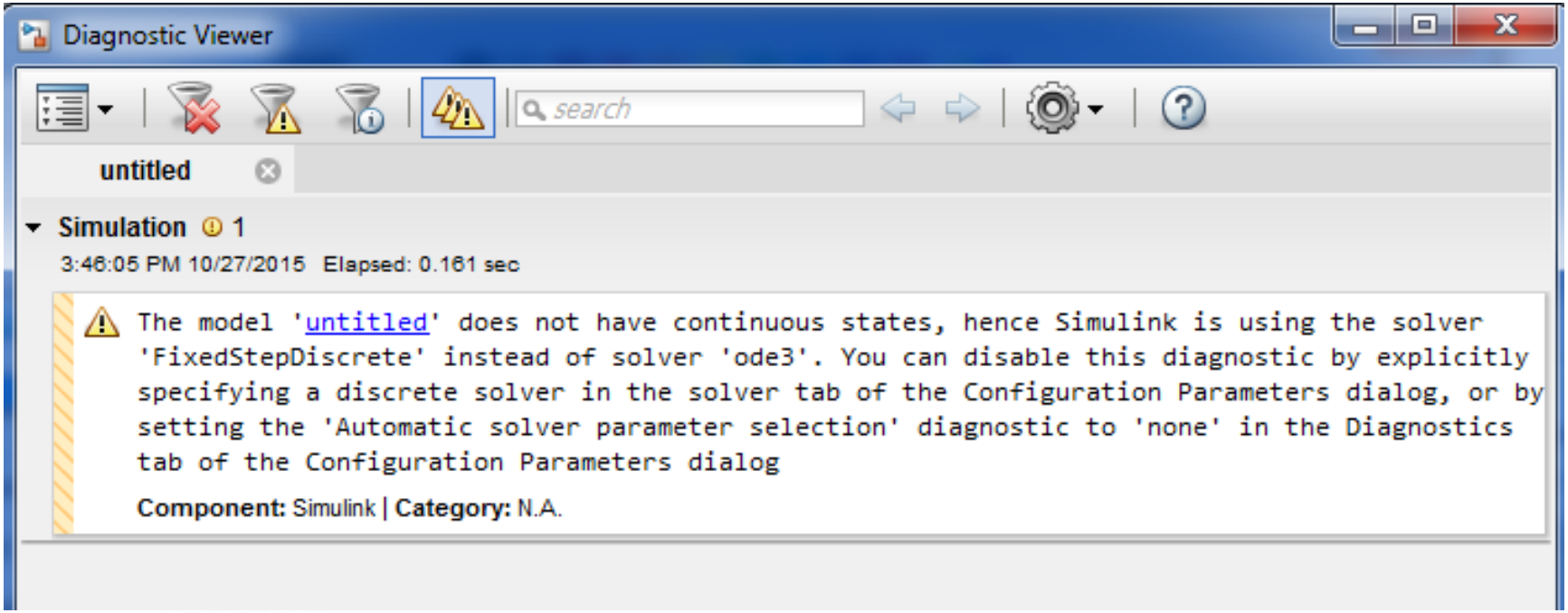
➢ For both fixed-step and variable-step solvers, the next simulation time is the sum of the current simulation time and the step size.

- With a fixed-step solver, the step size remains constant throughout the simulation
- With a variable-step solver, the step size can vary in an adaptive fashion from step to step to maximize efficiency, while meeting specified error tolerances

- Simulink also provides the choice of **continuous** versus **discrete** solvers
  - Continuous solvers use numerical integration to compute a model's continuous states at the current time step
  - Discrete solvers exist primarily to solve purely discrete models. They compute the next simulation time step for a model and each block in the model updates its individual discrete states

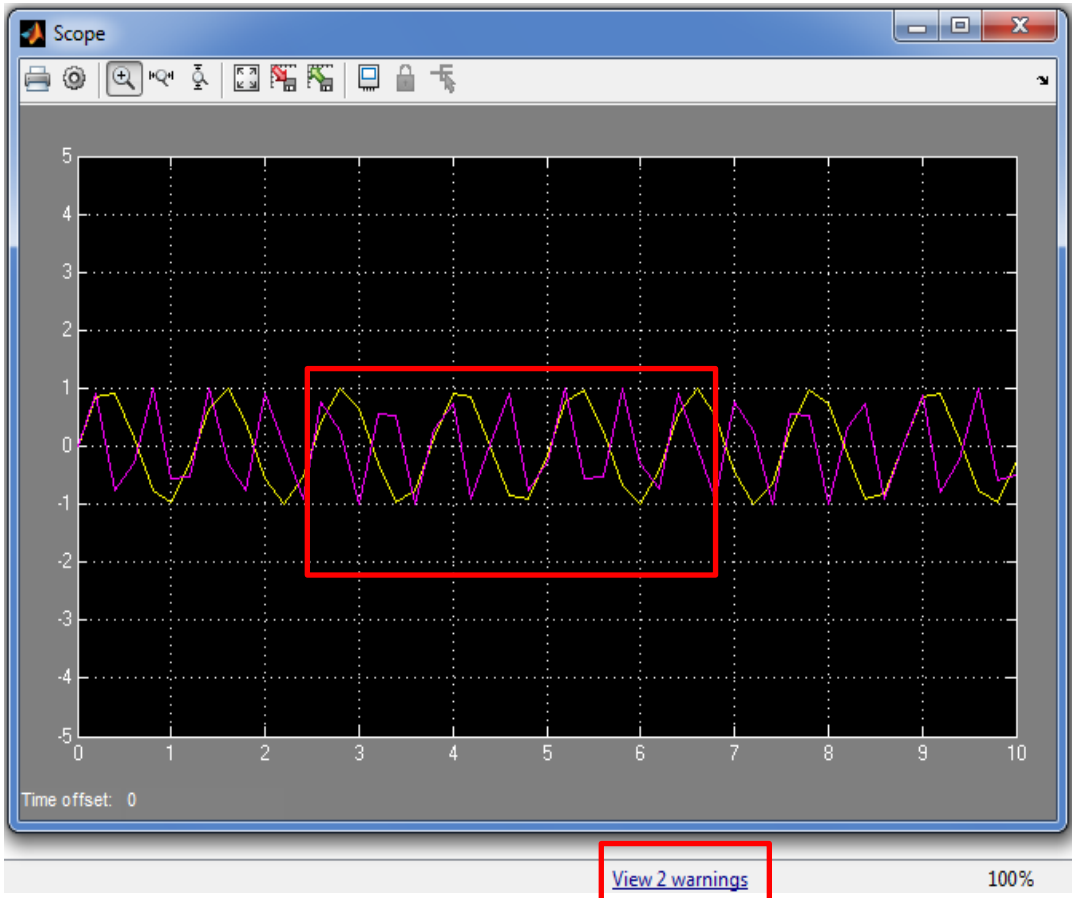
➢ Solver Warning Example (1)

- If the model is modified where the Sine Wave block is chosen to have a Sample-based Sine type and a 0.1 s Sample time is entered,
- The model execution will produce a warning message seen at the bottom of the Simulink model.



- The model 'untitled' does not have continuous states, hence Simulink is using the solver 'FixedStepDiscrete' instead of solver 'ode3'.

➢ Solver Warning Example (2)

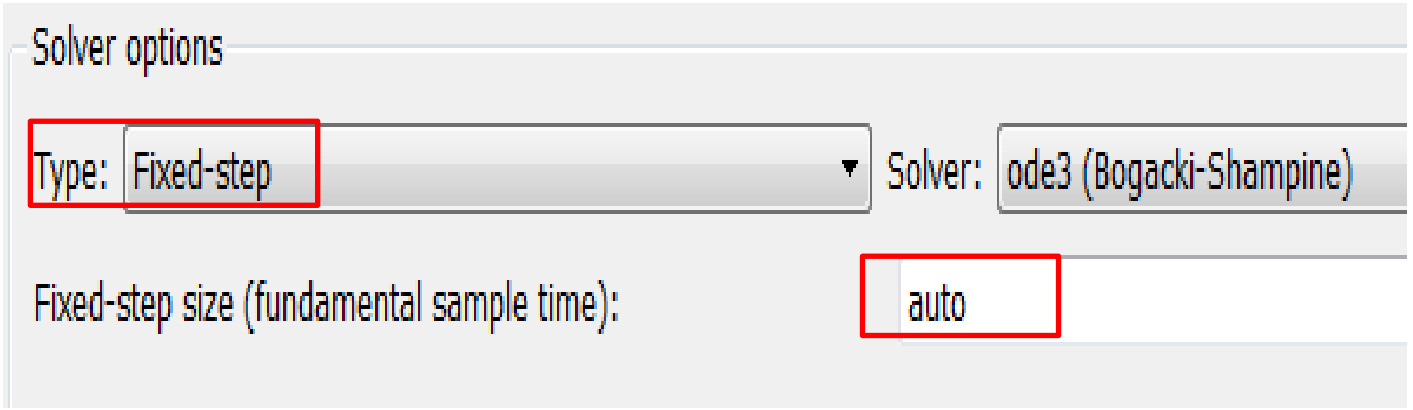


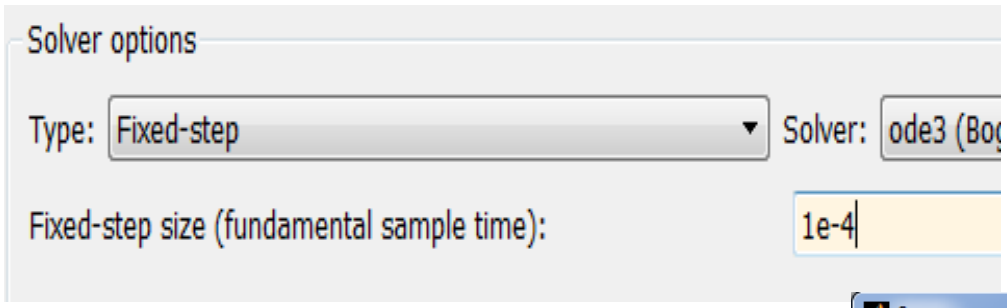
➢ Bad resolution

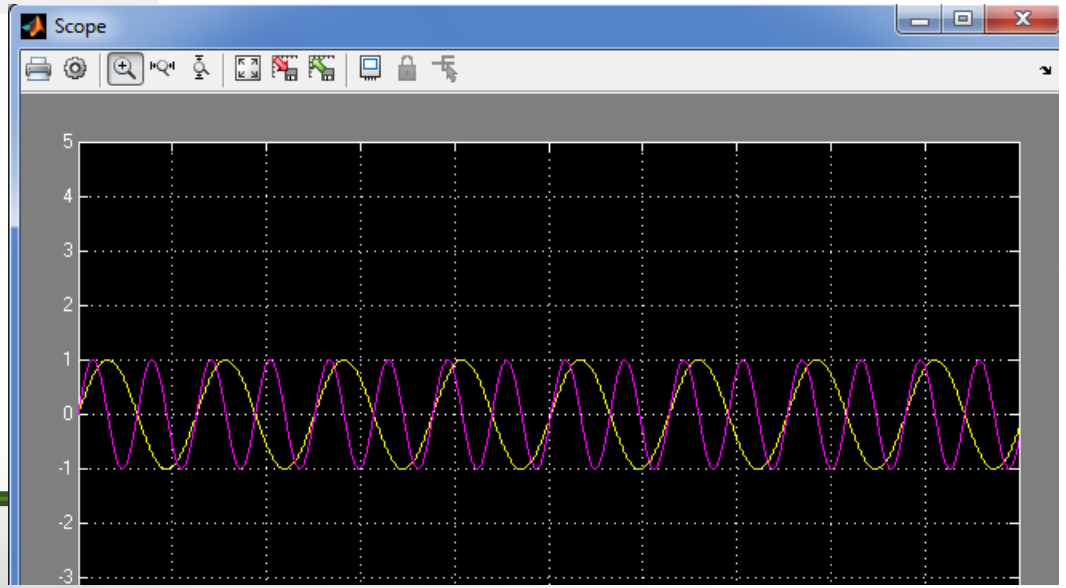
⚠ Unable to determine a fixed step size based on the sample times in the model 'untitled', because the model does not have any discrete sample times. Picking a fixed step size of (0.2) based on simulation start and stop times. You can disable this diagnostic by explicitly specifying a fixed step size in the Solver pane of the Configuration Parameters dialog box, or setting the 'Automatic solver parameter selection' diagnostic to 'none' in the Solver group on the Diagnostics pane of the Configuration Parameters dialog box.

➢ Solver Warning Example (1)

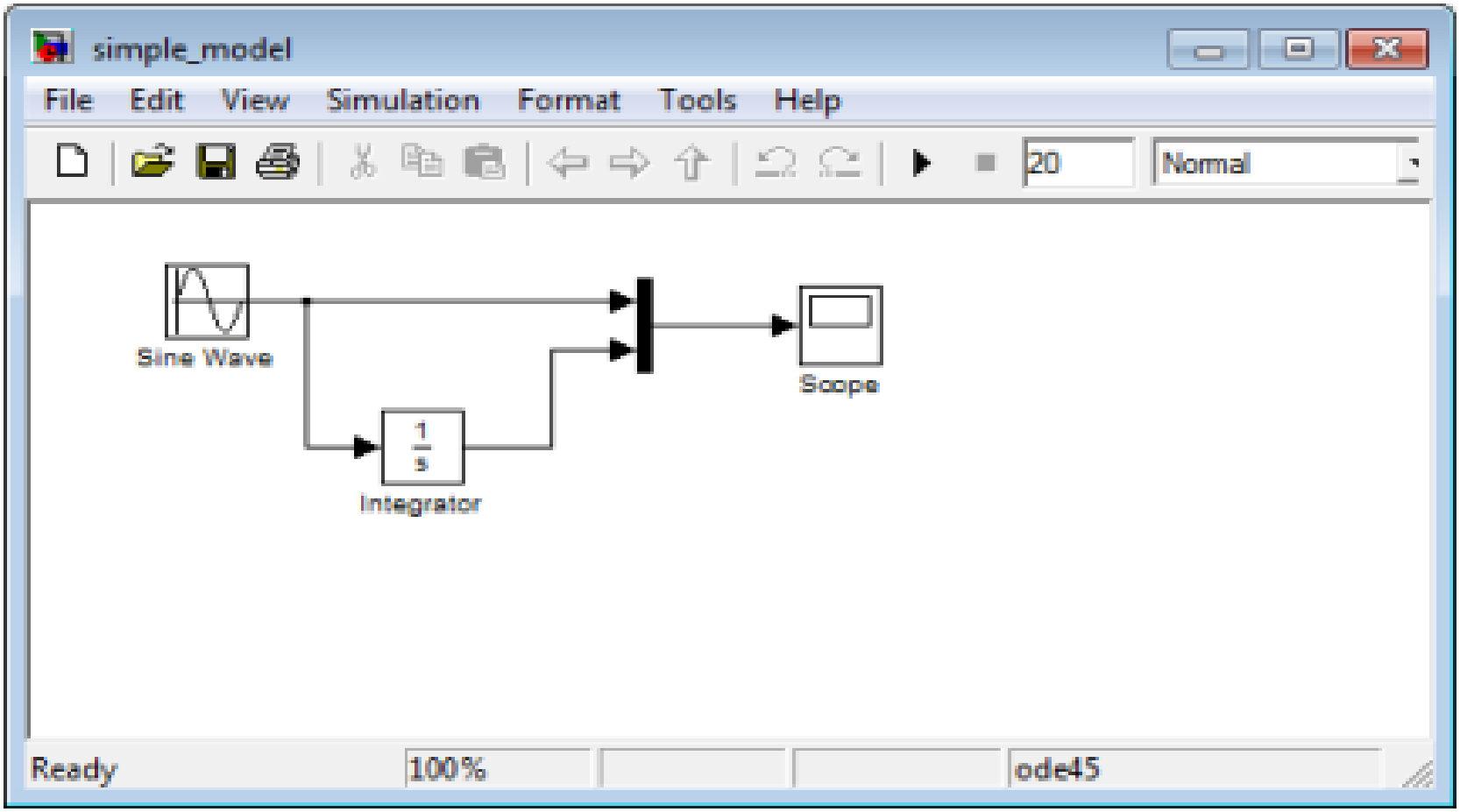
- Bad resolution can be solved by changing the step size to improve the resolution







Examples
(1) Integration and Signals Multiplexing

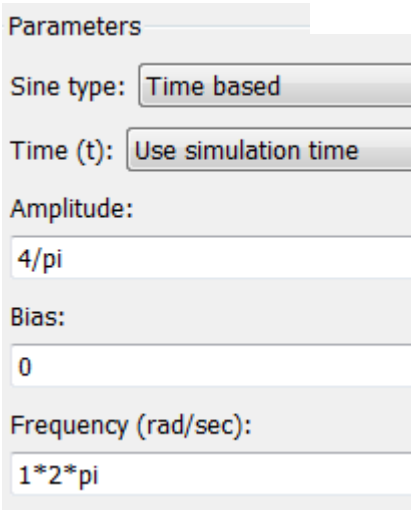


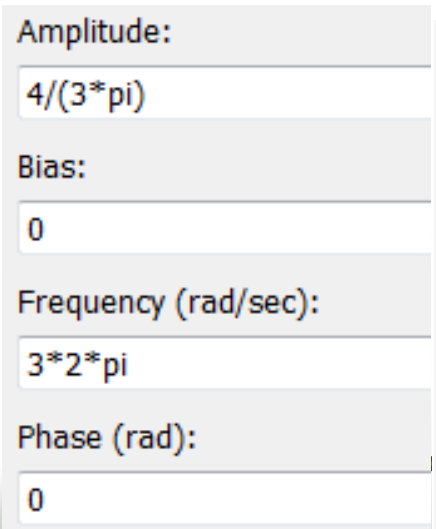
- Integrator: Simulink- Continuous
- Integrator: Simulink – Commonly used Blocks

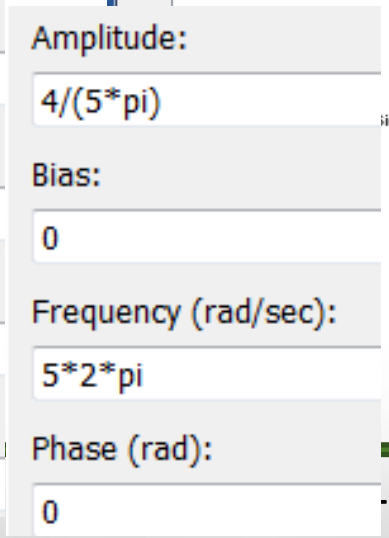
Examples: (2) Fourier Series

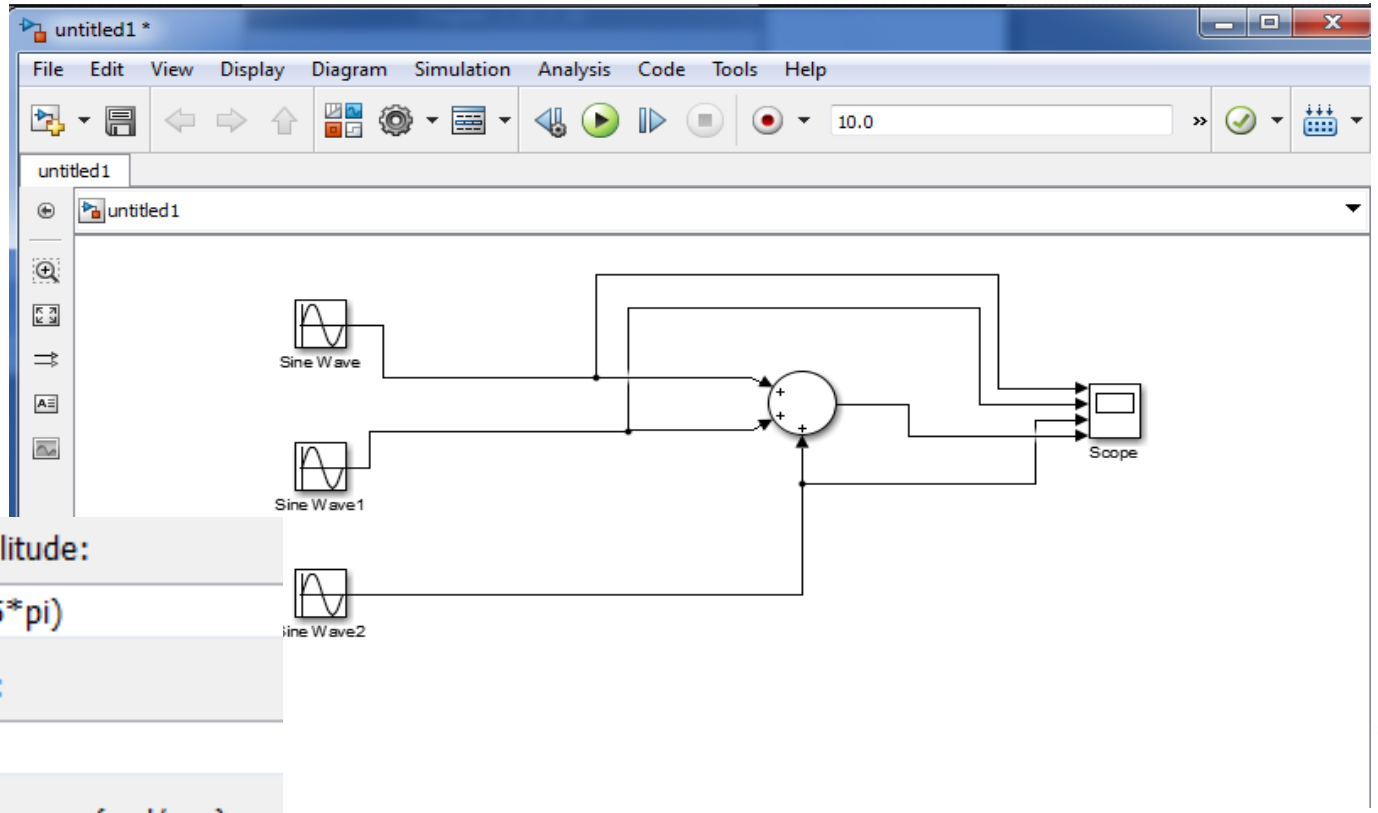
1.2 Let $x(t) = \frac{4}{\pi}\left[\sin(t) + \frac{1}{3}\sin(3t) + \frac{1}{5}\sin(5t)\right]$.

a. Develop a Simulink model for $x(t)$ with an included information block. Assume a 10 s simulation time.

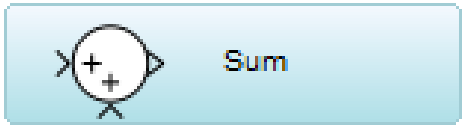


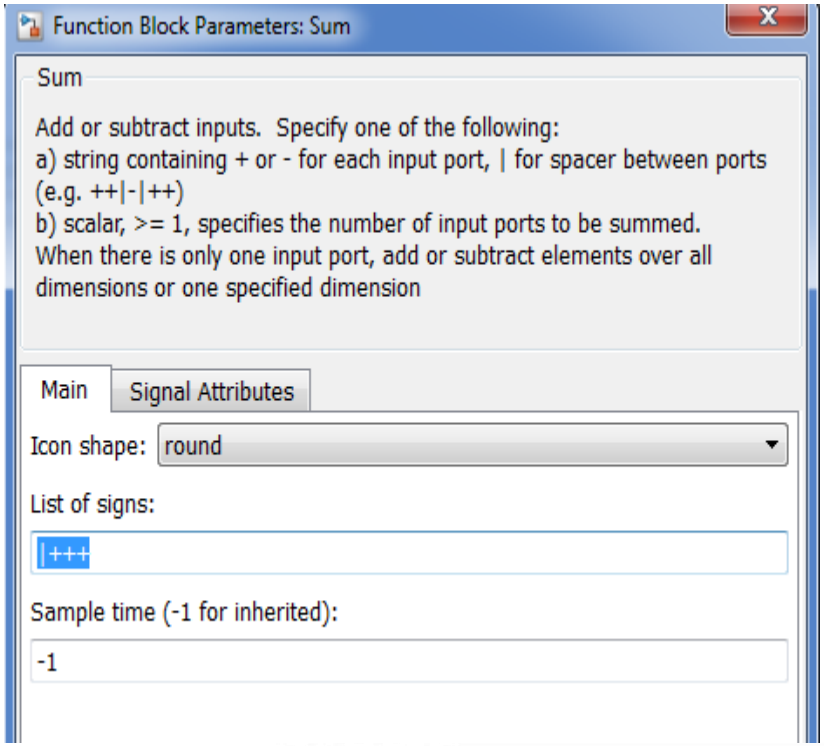


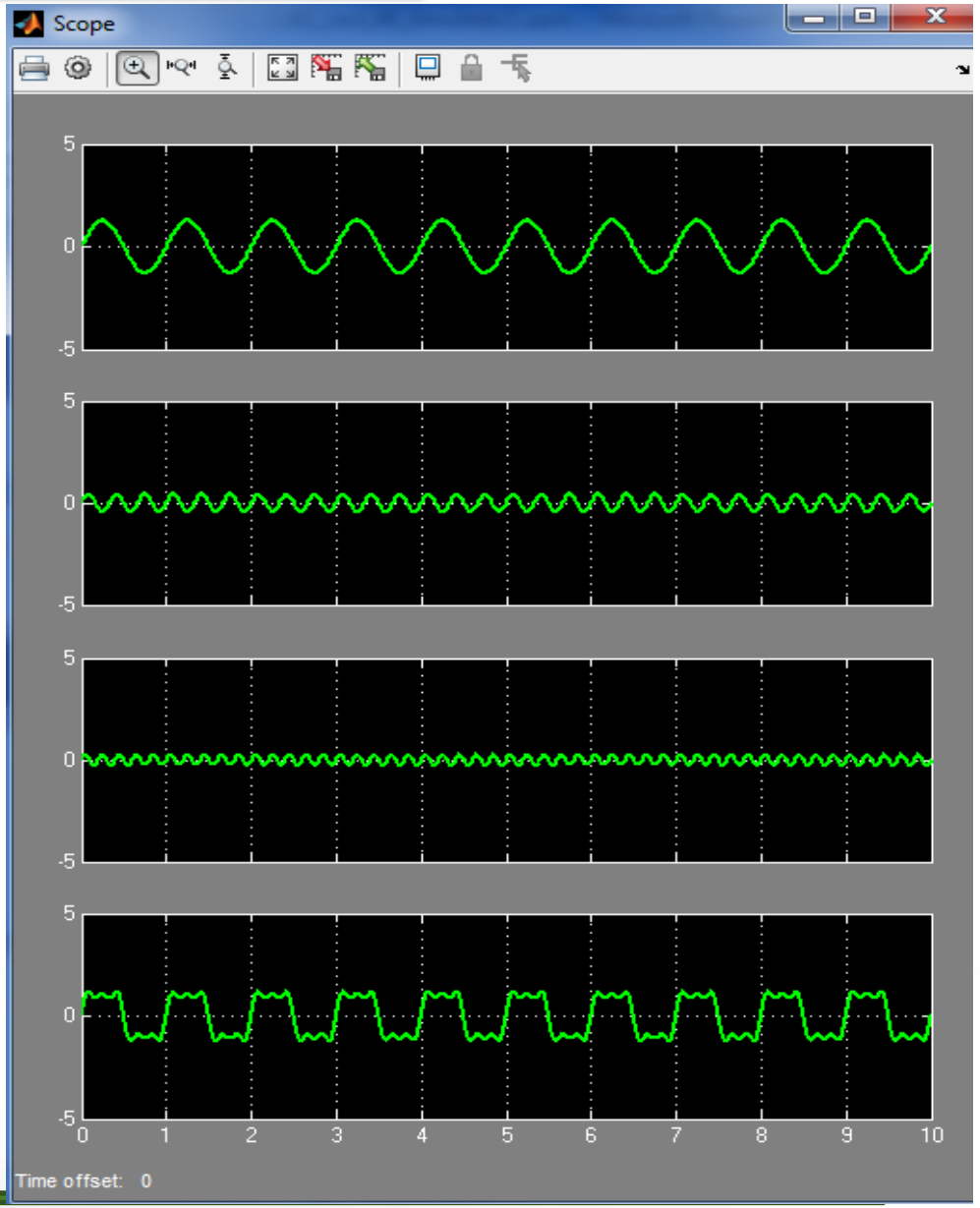




Examples: (2) Fourier Series

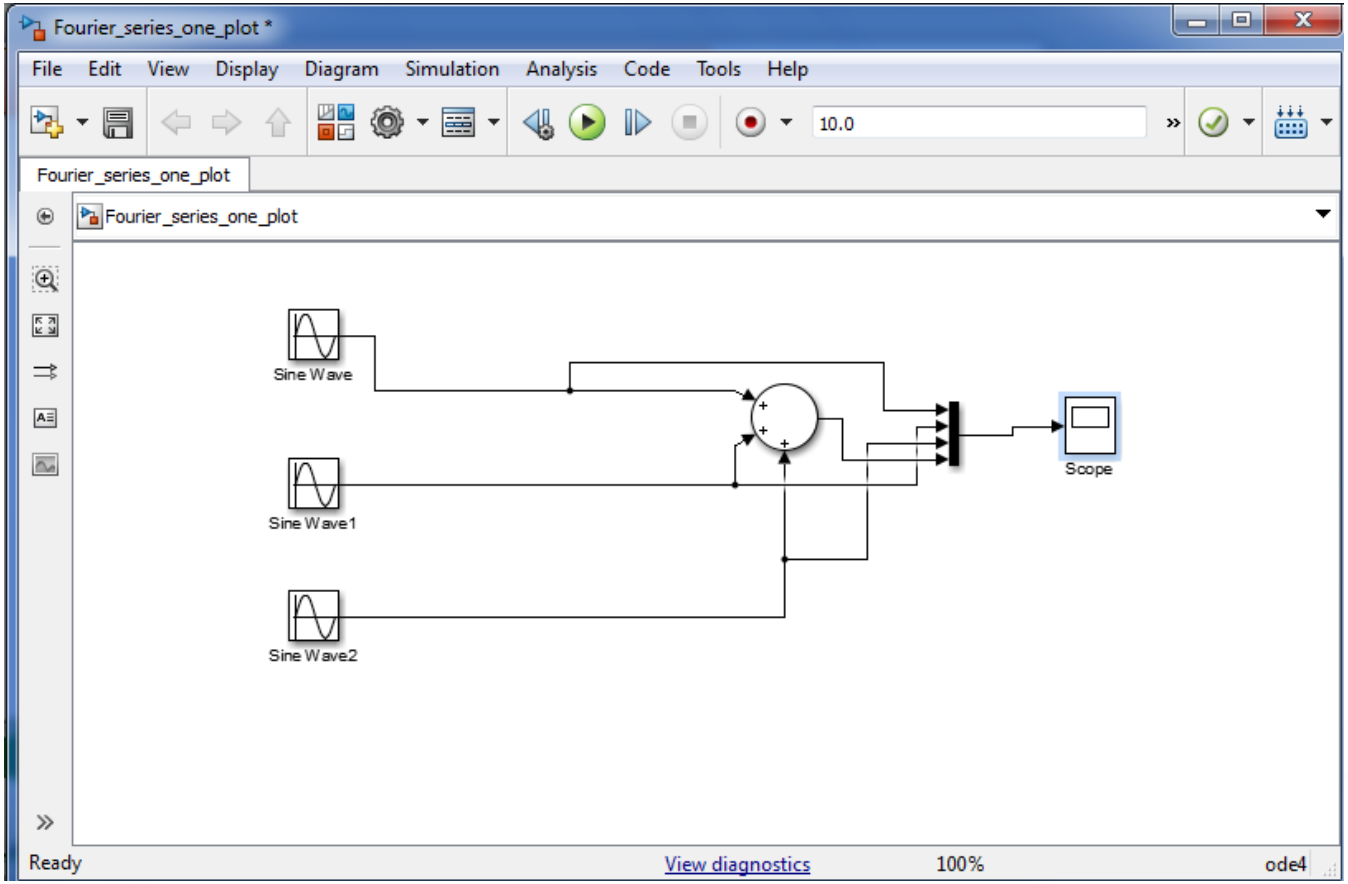






Examples: (2) Fourier Series

- Different Plotting



Examples: (2) Fourier Series

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