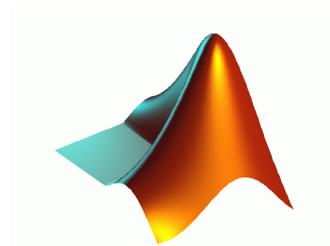




COMS W3101-2

Programming Languages: MATLAB



Simulink

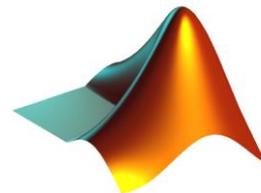
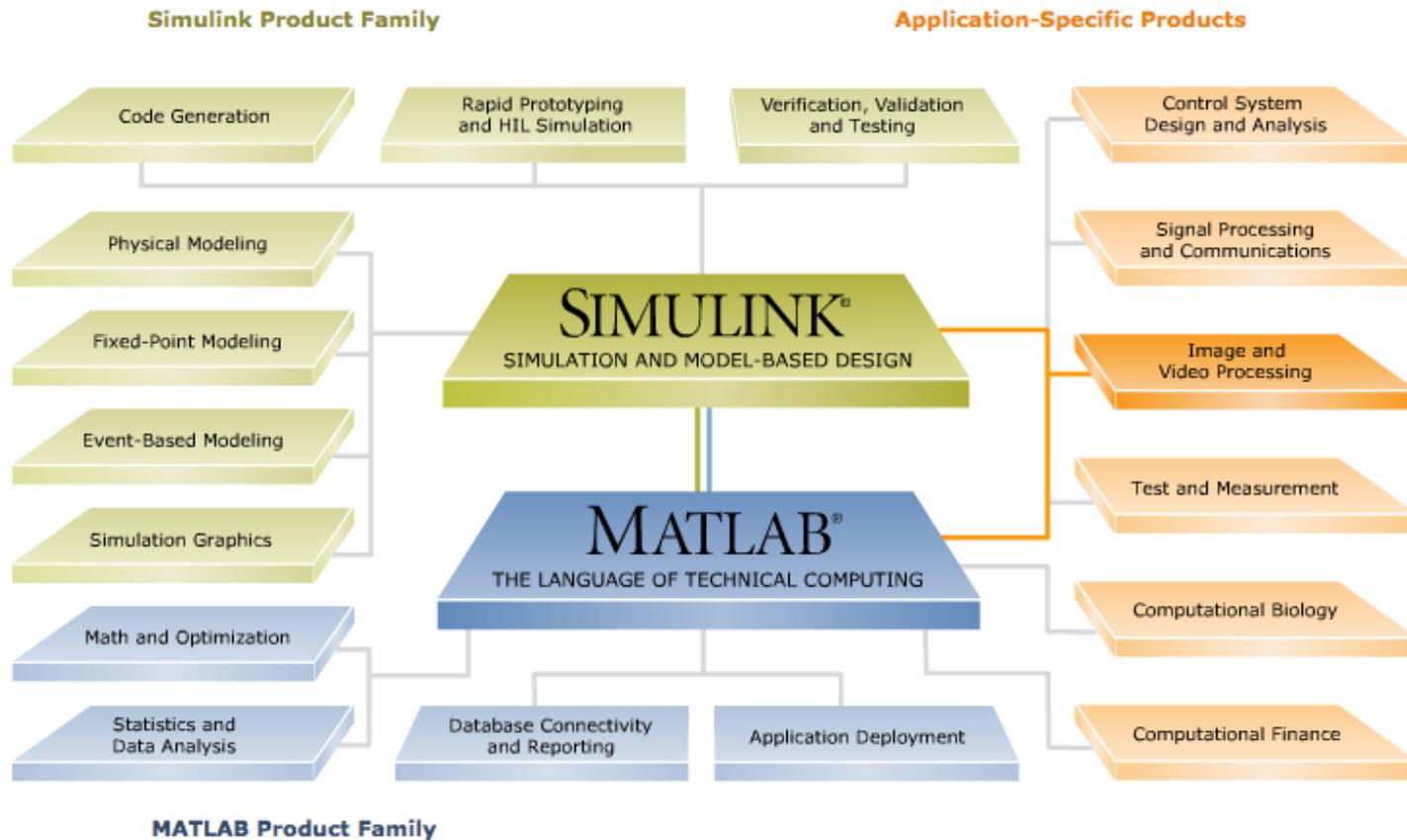
Spring 2010

Daniel Miao

MathWorks Product Overview

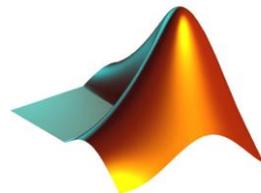
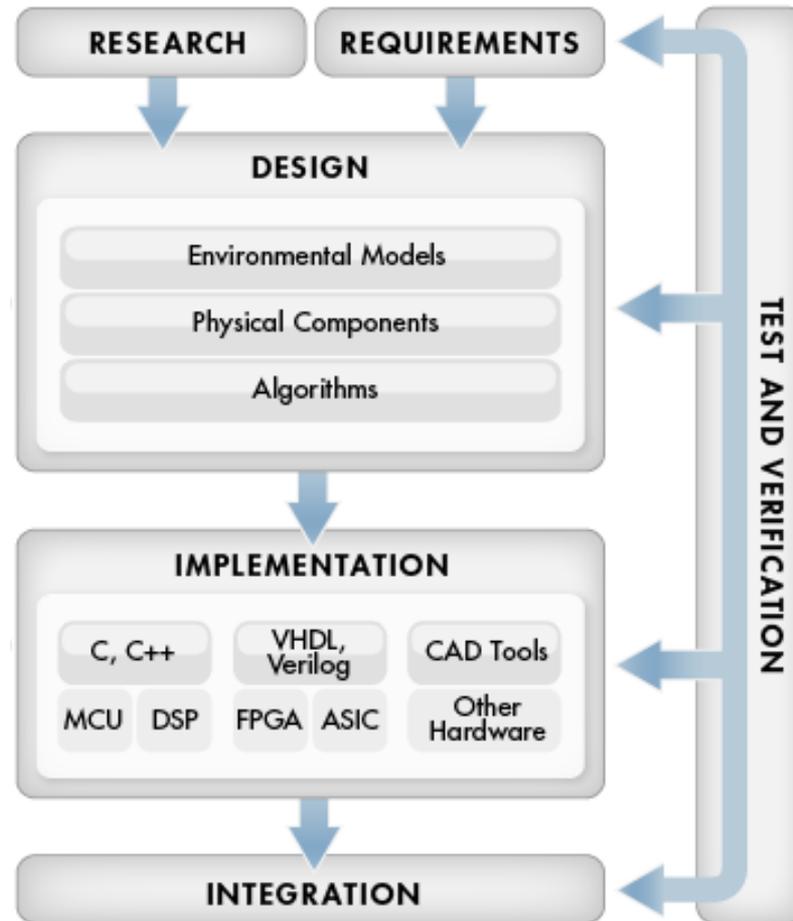
MathWorks Product Overview

[» View full product list](#)



Model-Based Design

- ▶ Why Simulink?
- ▶ Answer:
- ▶ Model-Based Design

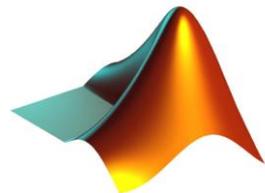
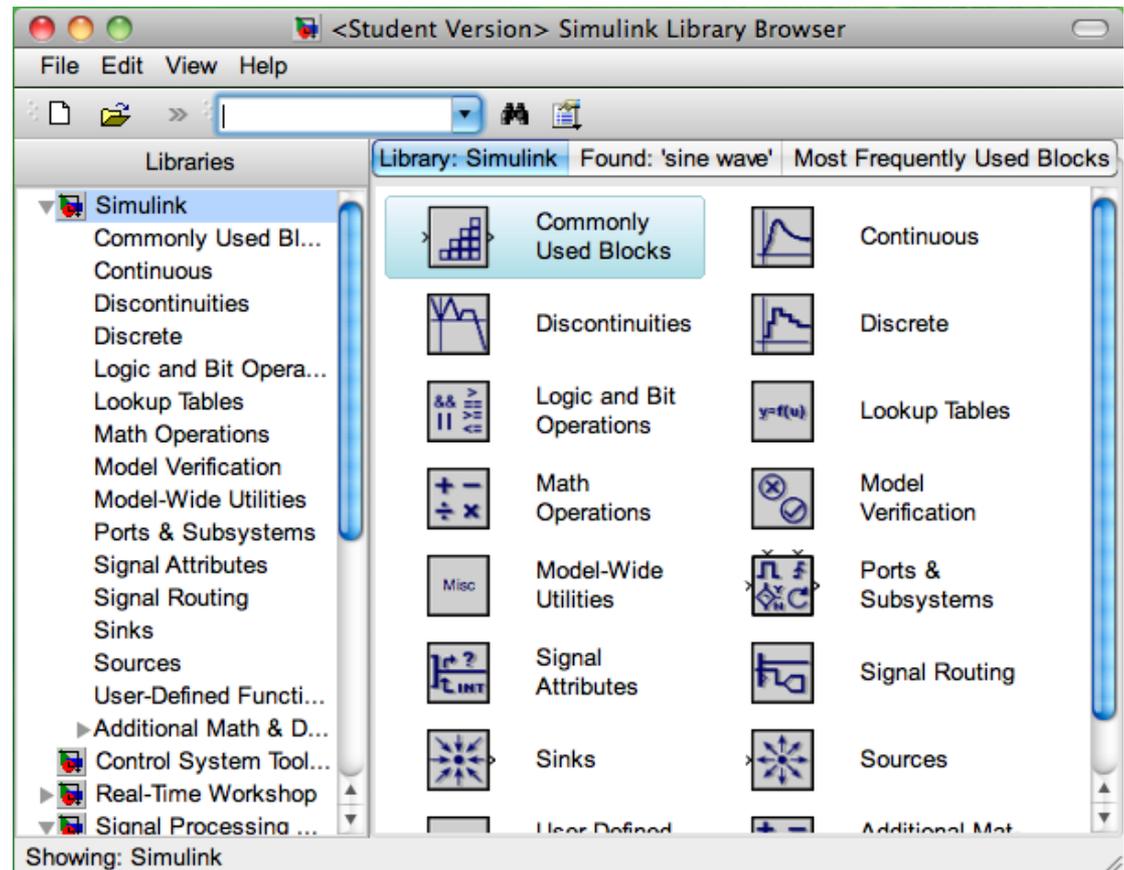
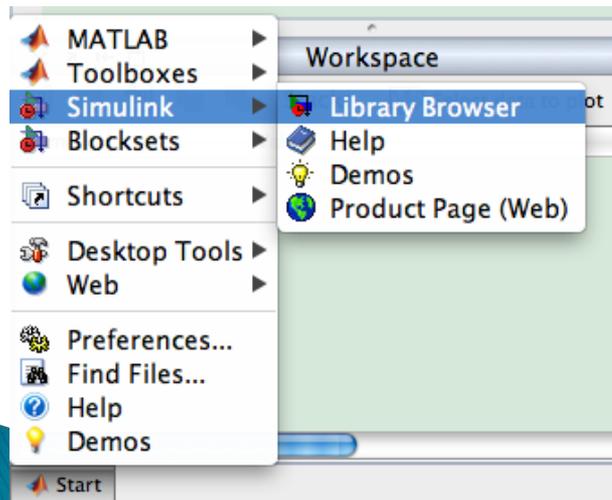


Simulink Library Browser

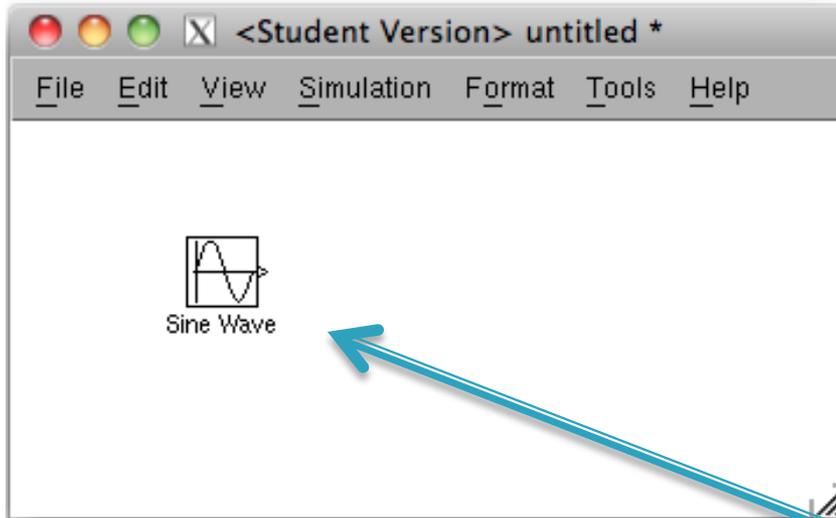
Issue Simulink at the MATLAB command prompt

```
>> Simulink
```

Or



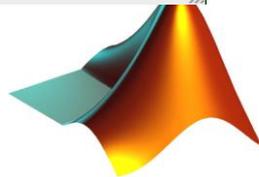
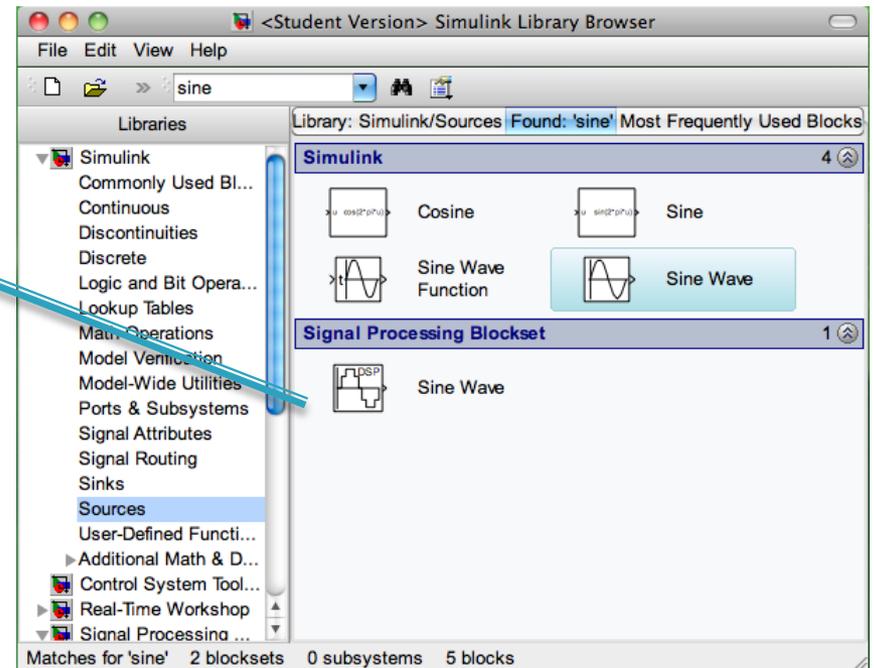
Simulink Model Construction



drag-n-drop to add
blocks to a new model

“File -> Save” to save a model

“File -> Open” to load a model

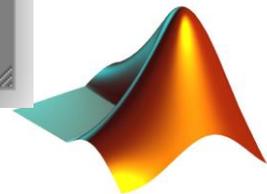
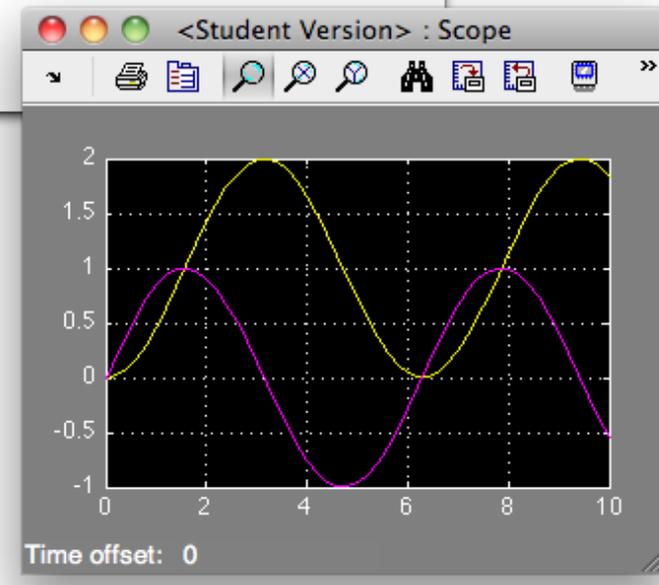
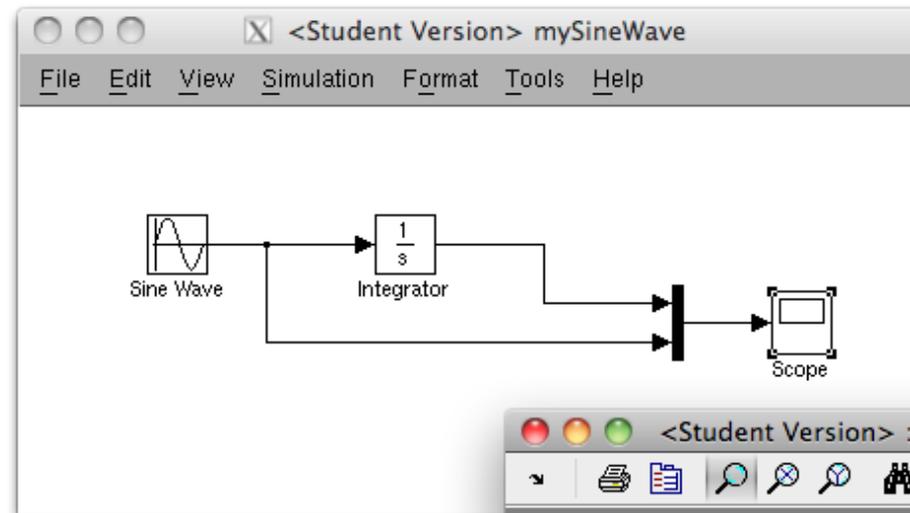


Model Simulation

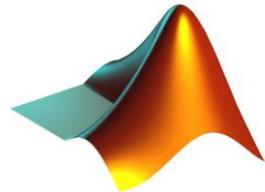
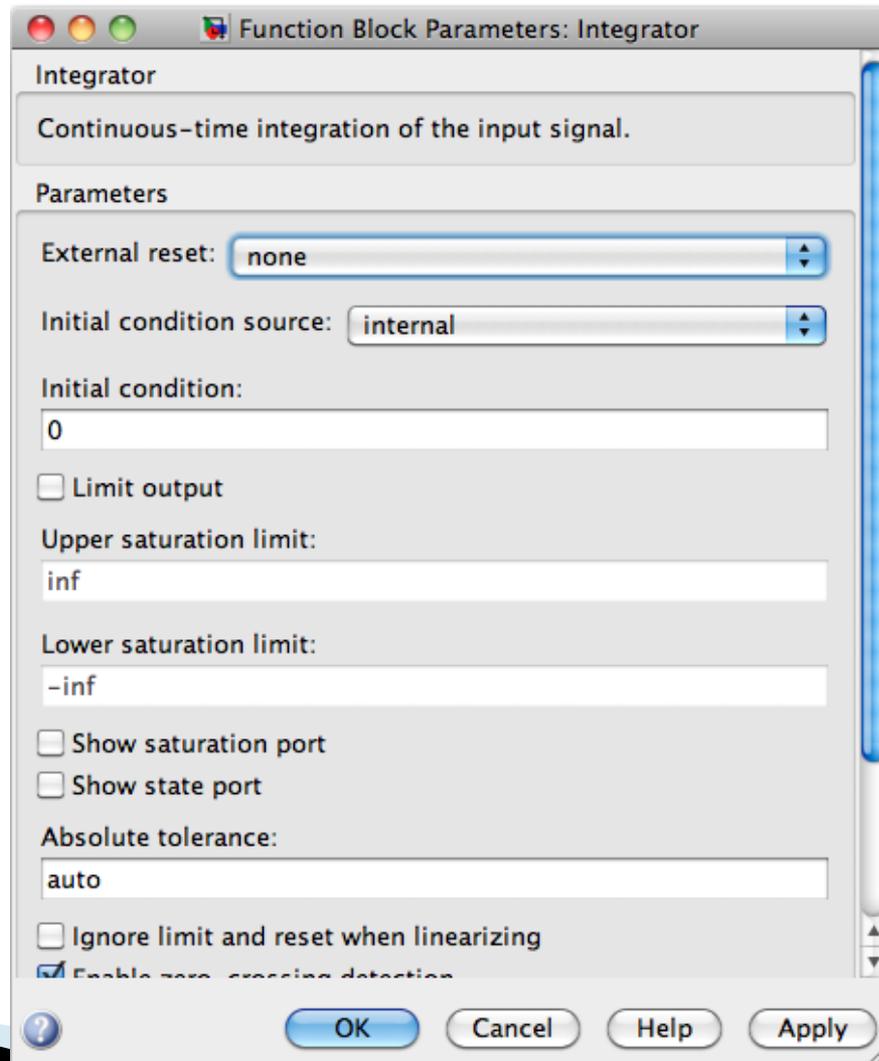
ctrl+t

Or

Simulation ->
Start



Simulink Block Parameter



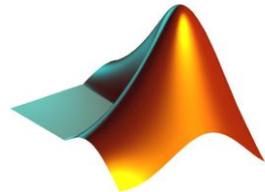
Using workspace variables

>> myAmplitude = 5



The image shows two overlapping windows from a MATLAB/Simulink environment. The background window is the "Source Block Parameters: Sine Wave" dialog. It contains the following text:
Sine Wave
Output a sine wave:
$$O(t) = \text{Amp} \cdot \sin(\text{Freq} \cdot t + \text{Phase}) + \text{Bias}$$

Sine type determines the computational technique used. The two types are related through:
Samples per period = $2 \cdot \pi / (\text{Frequency} \cdot \text{Sample time})$
Number of offset samples = $\text{Phase} \cdot \text{Samples per period} / (2 \cdot \pi)$
Use the sample-based sine type if numerical problems due to large times (e.g. overflow in absolute time) occur.
Parameters
Sine type: Time based
Time (t): Use simulation time
Amplitude: myAmplitude
Bias: 0
Frequency (rad/sec): 1
Buttons: OK, Cancel, Help
The foreground window is titled "<Student Version> mySineWave" and shows a Simulink block diagram. It consists of a "Sine Wave" block connected to an "Integrator" block (represented by a box with $\frac{1}{s}$). The output of the integrator is connected to a "Scope" block. The diagram is overlaid on the Sine Wave parameter dialog.

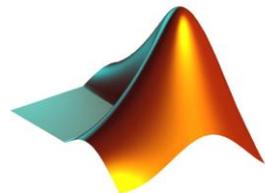
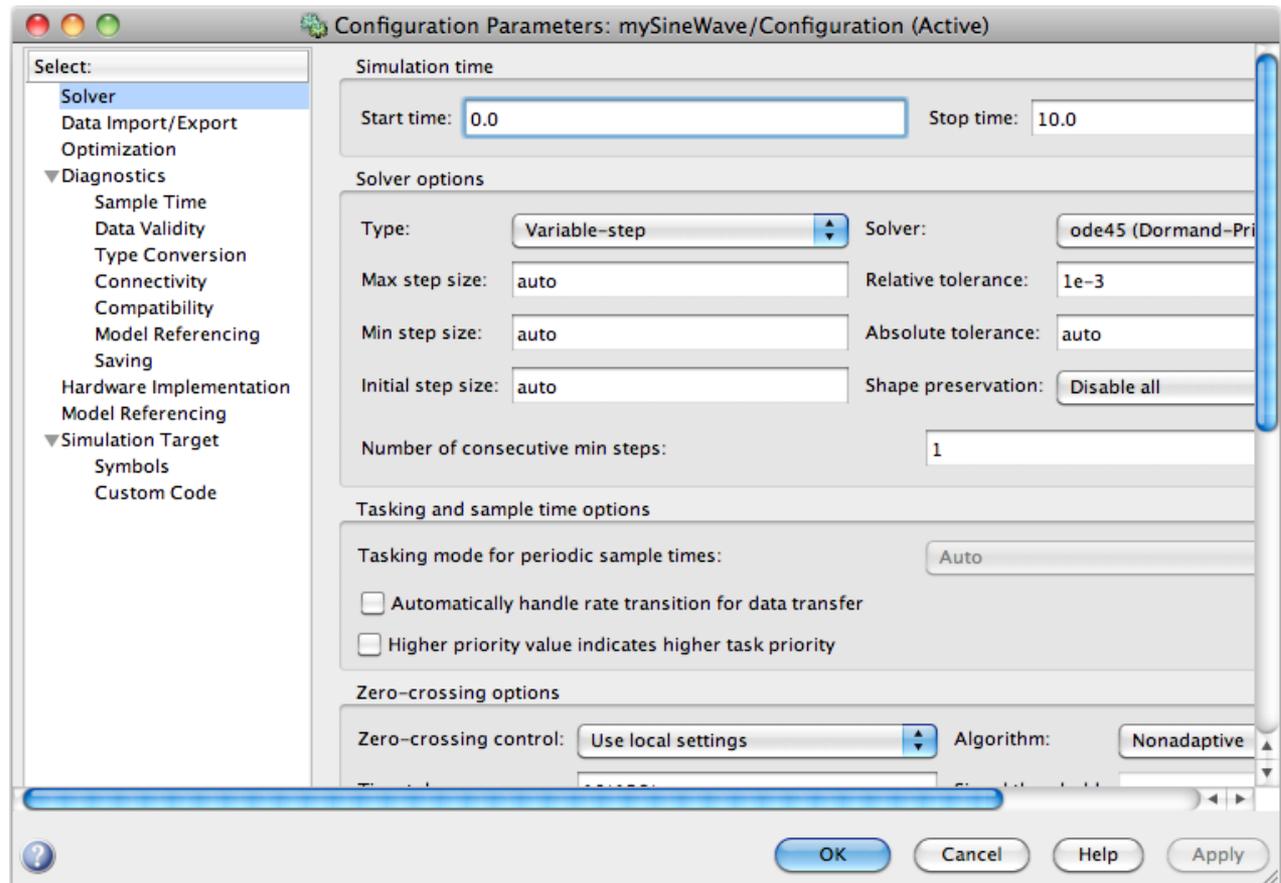


Configuration Parameters – Solver

Shortcut:
Ctrl + e

Or

Simulation ->
Configuration
Parameters



Configuration Parameter-Data I/O

Configuration Parameters: mySineWave/Configuration (Active)

Select:

- Solver
- Data Import/Export
- Optimization
- ▼ Diagnostics
 - Sample Time
 - Data Validity
 - Type Conversion
 - Connectivity
 - Compatibility
 - Model Referencing
 - Saving
- Hardware Implementation
- Model Referencing
- ▼ Simulation Target
 - Symbols
 - Custom Code

Load from workspace

Input: [t, u]

Initial state: xInitial

Save to workspace

Time: tout

States: xout

Output: yout

Final states: xFinal Save complete SimState in final state

Signal logging: log sout Inspect signal logs when simulation is paused/stopped

Data stores: dsmout

Save options

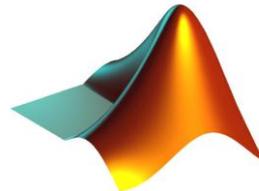
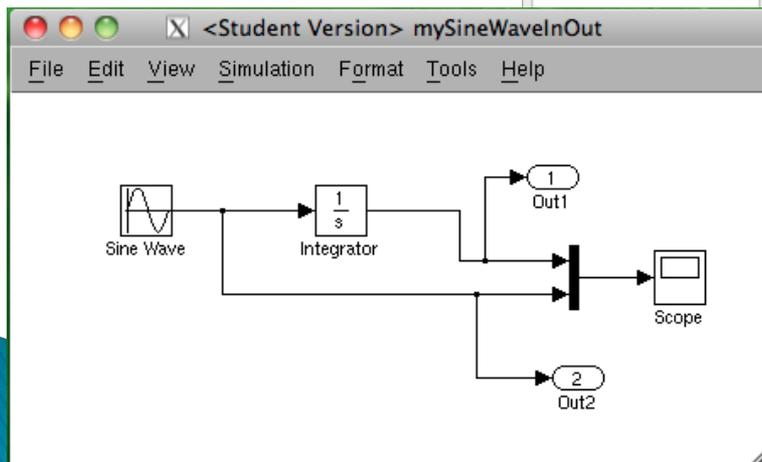
Limit data points to last: 1000 Decimation: 1

Format: Structure

Output options: Refine output Refine factor: 1

Return as single object: out

OK Cancel Help Apply

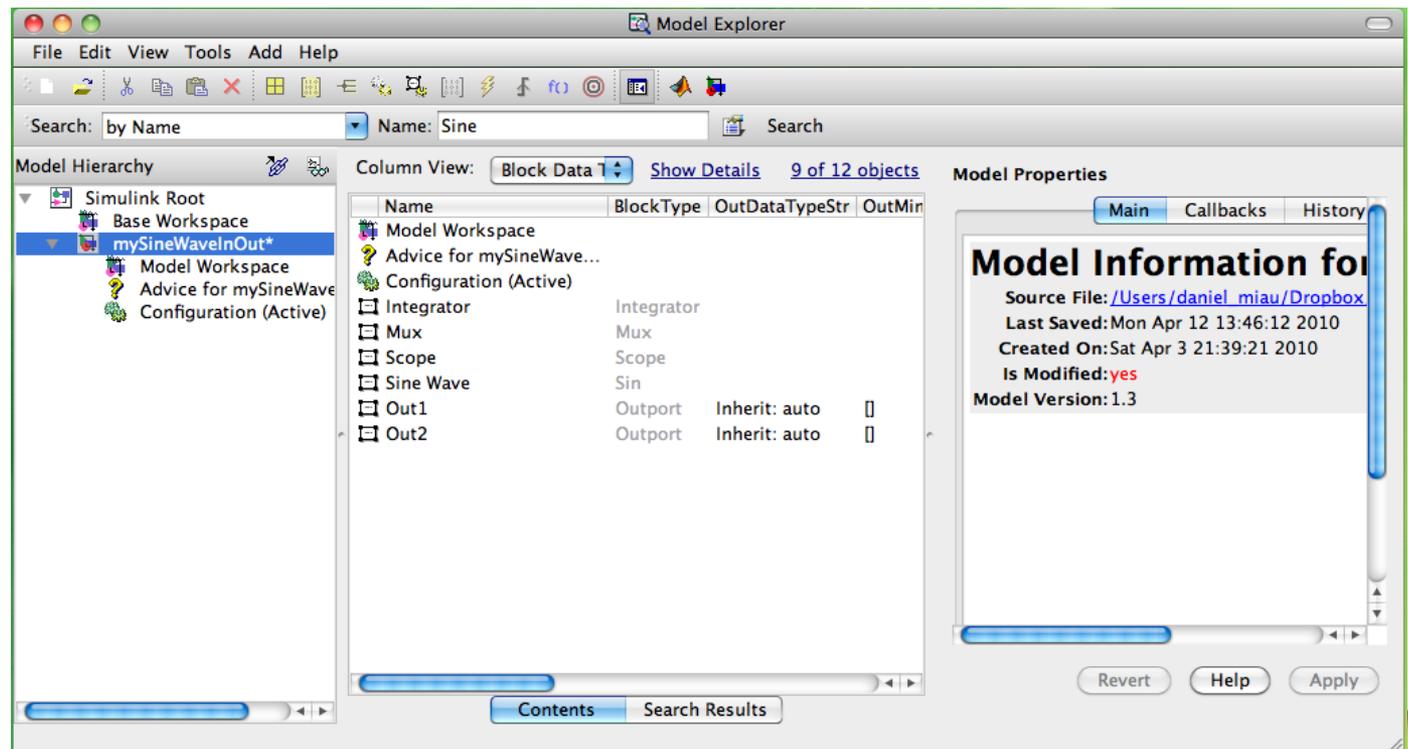


Simulink Model Explorer

To launch Model Explorer:

-View - Model Explorer

-Ctrl + H



Column View: Block Data T Show Details 9 of 12 objects

Name	BlockType	OutDataTypeStr	OutMin
Model Workspace			
Advice for mySineWave...			
Configuration (Active)			
Integrator	Integrator		
Mux	Mux		
Scope	Scope		
Sine Wave	Sin		
Out1	Output	Inherit: auto	[]
Out2	Output	Inherit: auto	[]

Model Properties

Main Callbacks History

Model Information for

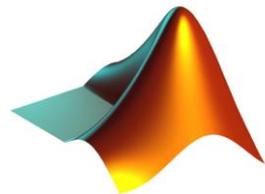
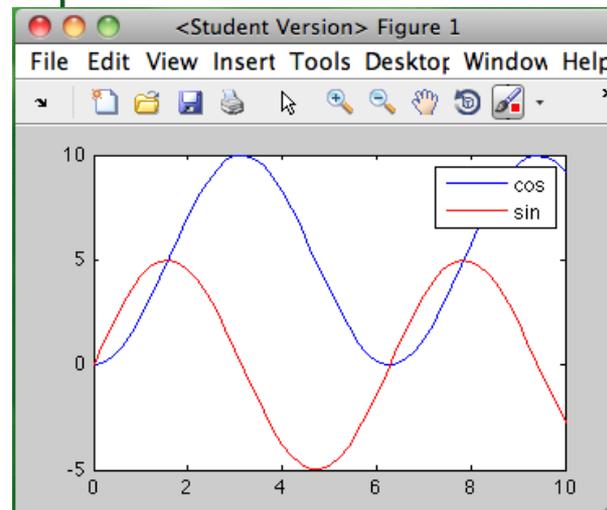
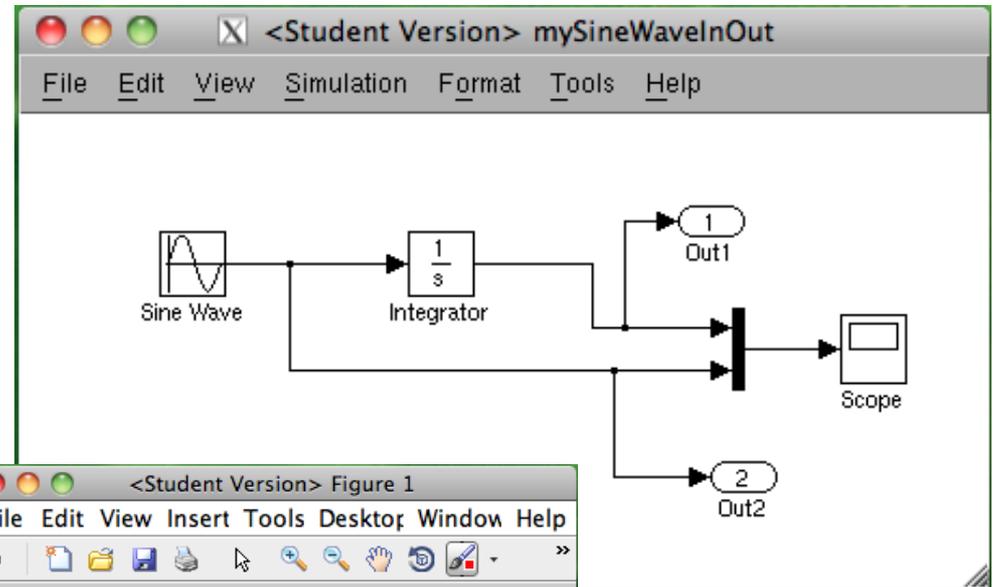
Source File: [/Users/daniel_miau/Dropbox](#)
Last Saved: Mon Apr 12 13:46:12 2010
Created On: Sat Apr 3 21:39:21 2010
Is Modified: **yes**
Model Version: 1.3

Revert Help Apply

Running Simulation Programmatically

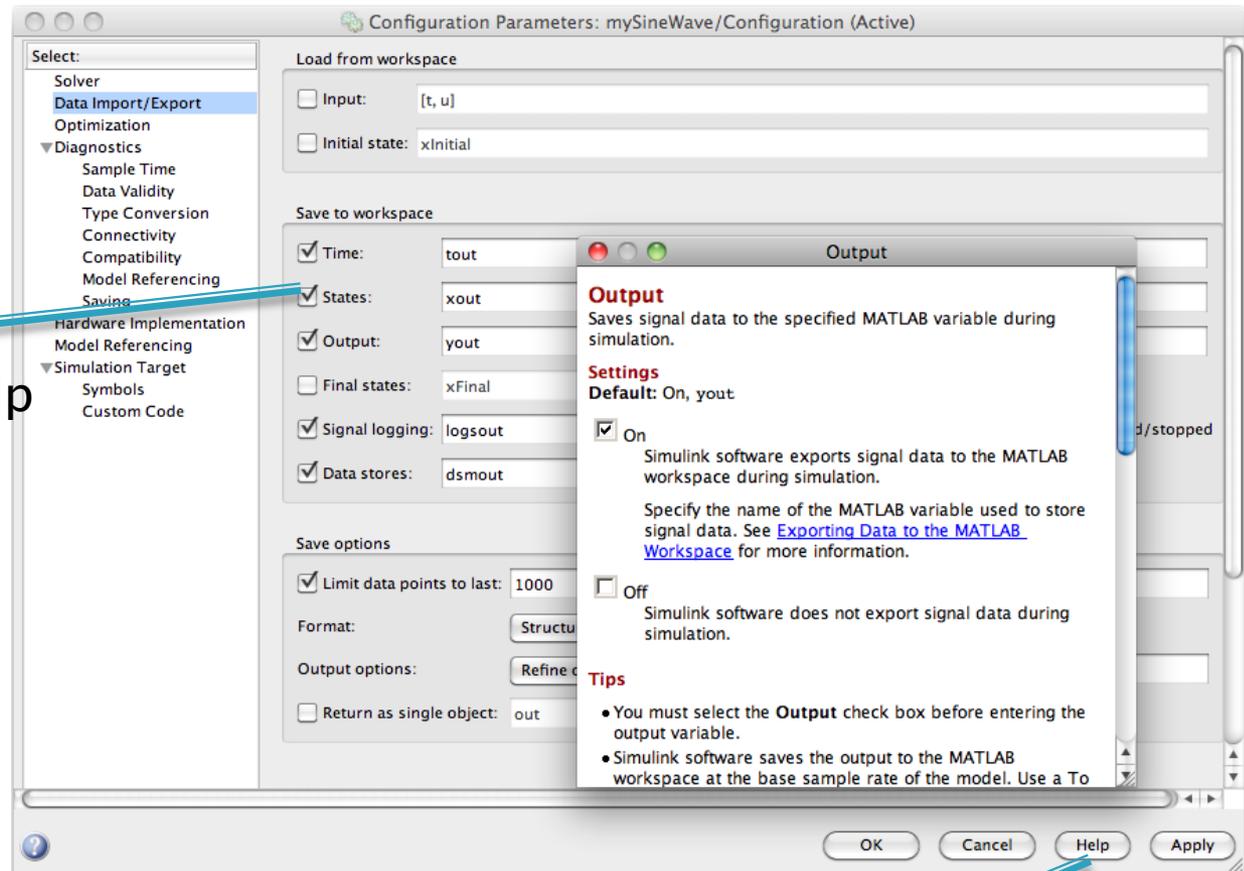
- ▶ `mdl = 'mySineWaveInOut'`
- ▶ `load_system(mdl)`
- ▶ `myAmp = 5`
- ▶ `sim(mdl)`

- ▶ `plot(tout, yout(:, 1), 'b')`
- ▶ Hold on
- ▶ `Plot(tout, yout(:, 2), 'r')`
- ▶ `Legend('cos', 'sin')`

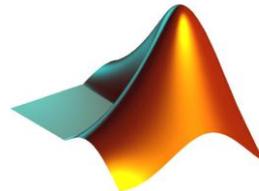


Simulink Help

Right-click to
get context-sensitive help



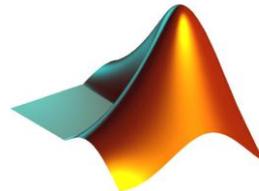
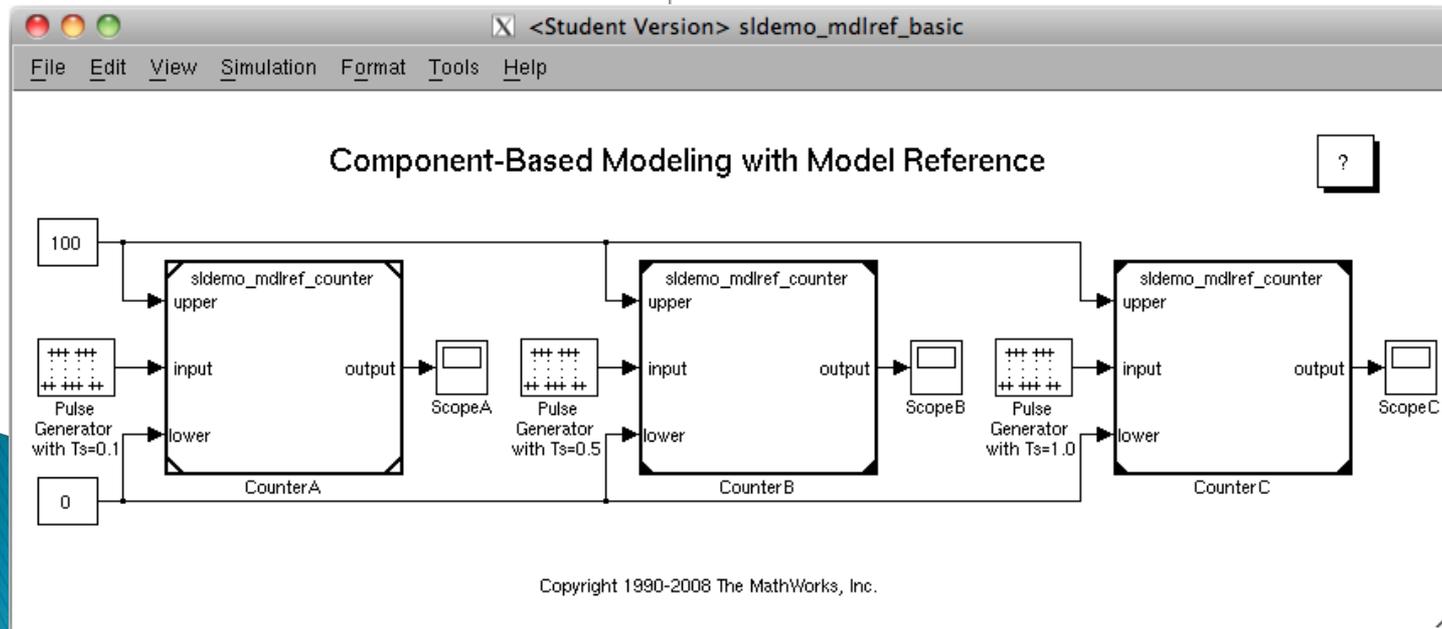
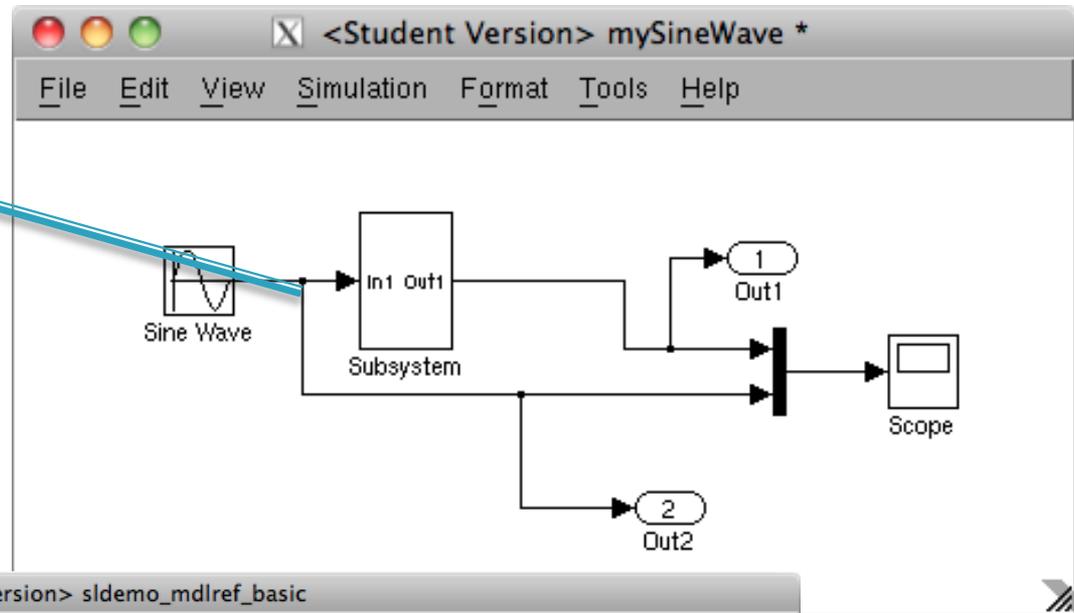
Click help to access
MATLAB/Simulink
help



Model Organization

Subsystem:
Ctrl + g to convert
selected area
to a subsystem

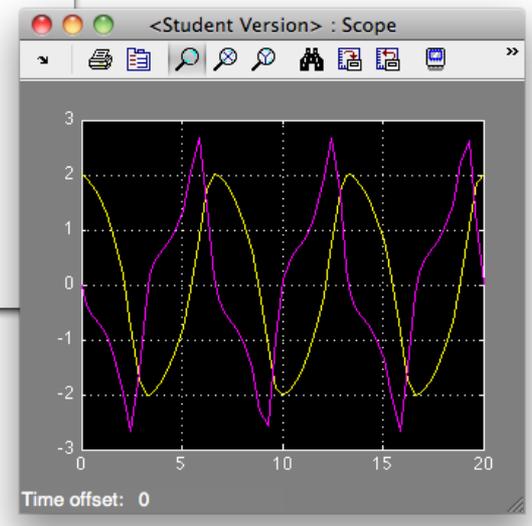
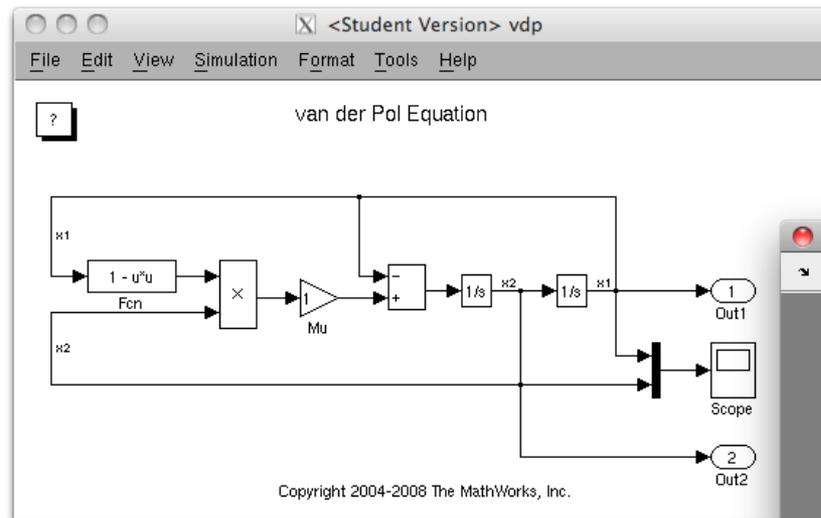
Model Reference:
(Port&Subsystems -> Model)
Demo: sldemo_mdref_basic



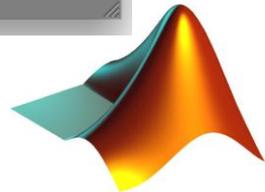
Example: van der Pol Equation

$$y'' - \mu(1 - y^2)y' + y = 0$$

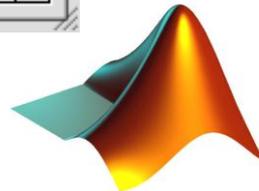
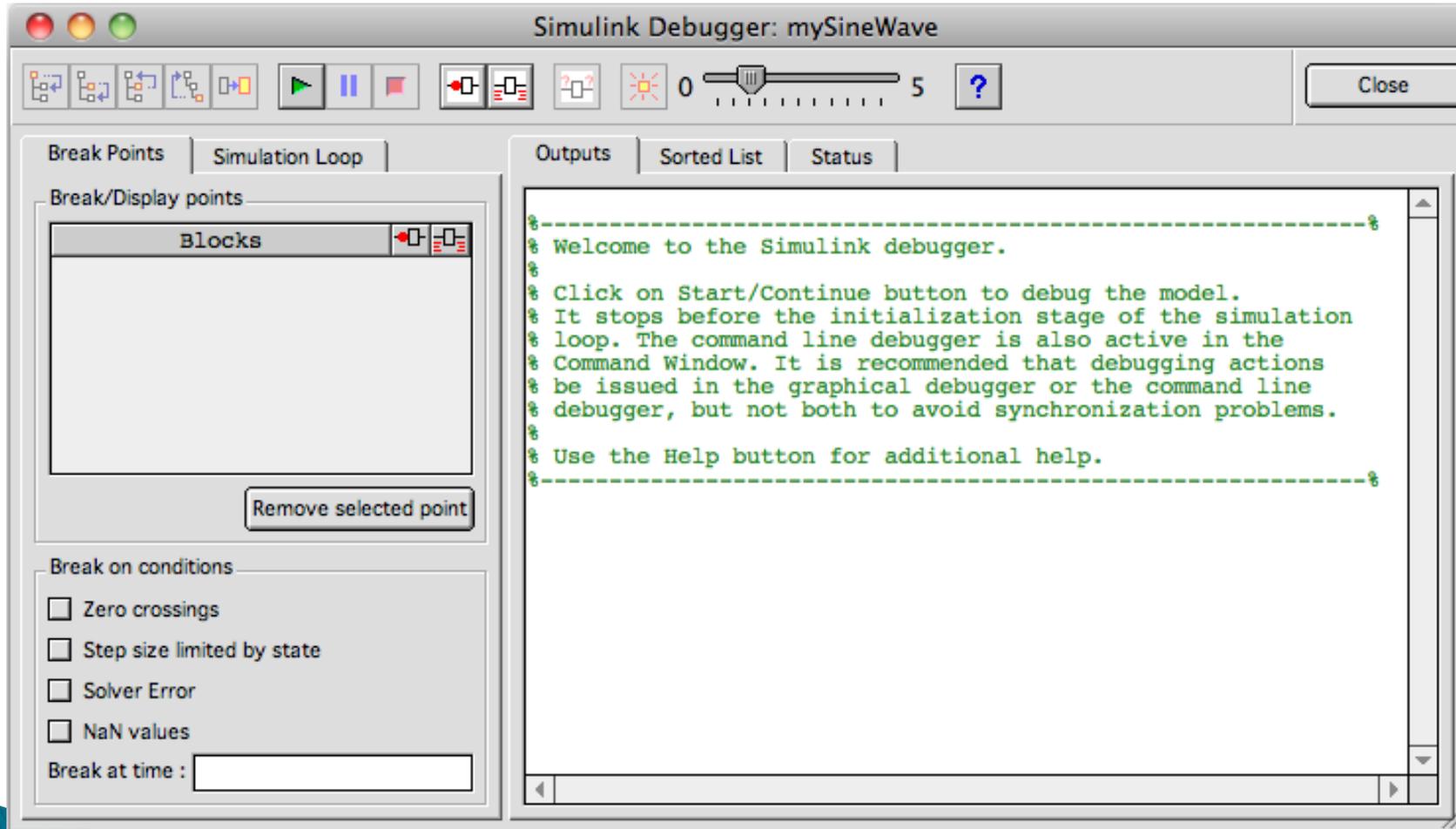
>> vdp



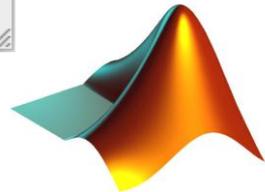
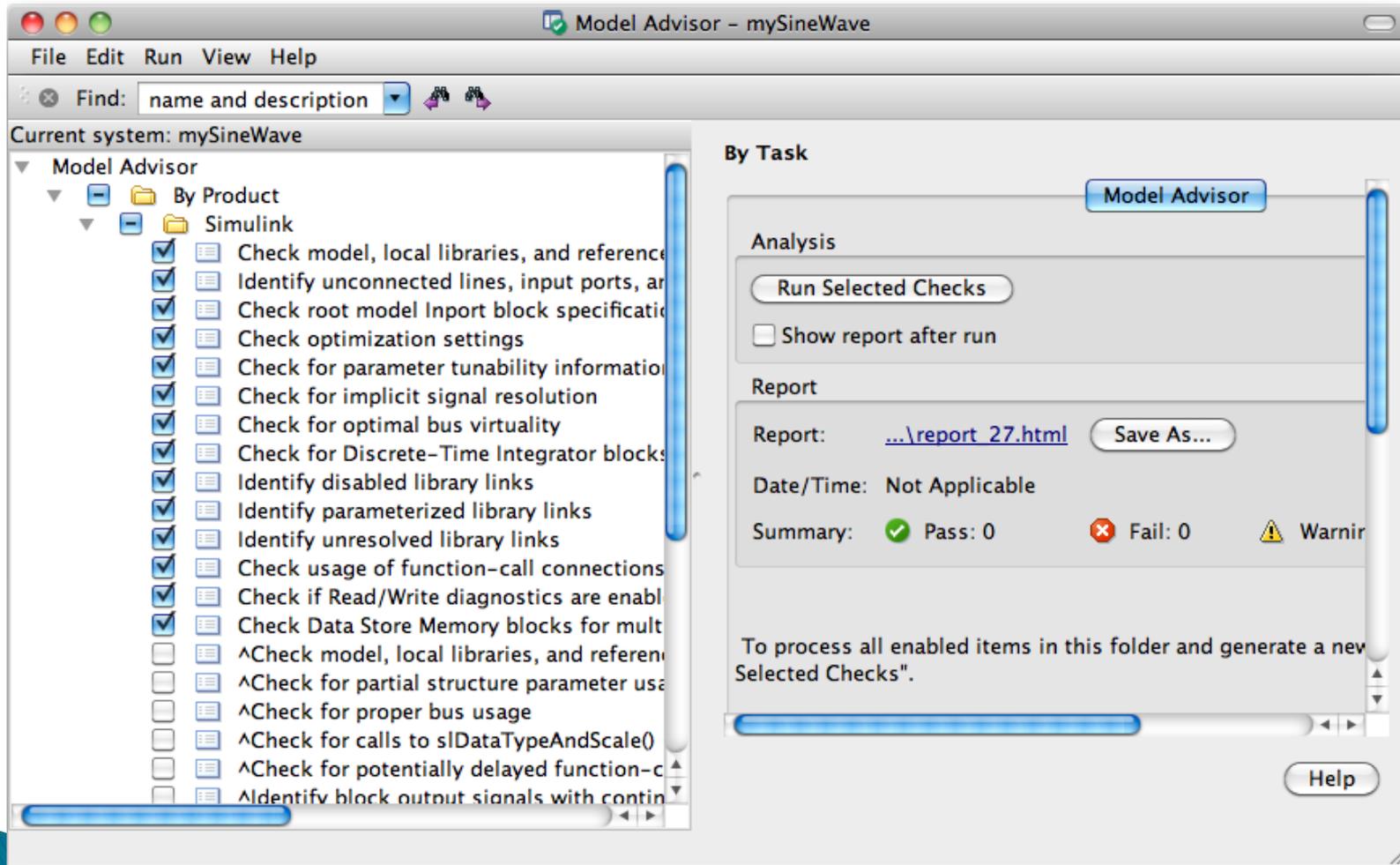
http://en.wikipedia.org/wiki/Van_der_Pol_oscillator



Simulink Debugger

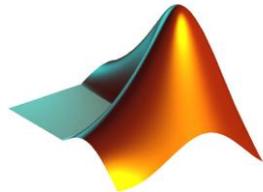


Simulink Model Advisor



Simulink Tips and Tricks

- ▶ Programmatically construct/manipulate Simulink models
 - New_system, load_system, Open_system
 - Bdclose all
 - Find_system
 - Sim
 - gcs
- ▶ Code generation
- ▶ <http://www.mathworks.com/products/rtwembedded/>



References

Blog:

- ▶ Seth on Simulink <http://blogs.mathworks.com/seth/>

Documentation:

- ▶ <http://www.mathworks.com/access/helpdesk/help/toolbox/simulink/>

Model Reference:

- ▶ <http://www.mathworks.com/access/helpdesk/help/toolbox/simulink/ug/f4-141721.html>

Model Based Design

- ▶ <http://www.mathworks.com/model-based-design/>
- ▶ http://en.wikipedia.org/wiki/Model_based_design

