Simulation Software for Control Engineering

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Available Software

MATLAB	SCILAB	GNU OCTAVE	FREEMAT
Licensed	Free / GPL	Free / GPL	Free / GPL
https://www.mathworks.com/products/matlab.html	https://www.scilab.org/	https://www.gnu.org/software/octave/index	http://freemat.sourceforge.net/
Packages for Control Engineering & Analysis:			
★★★	★★★	★★☆	★☆☆
Simulink	**Xcos**	**Sci cosim**	
• https://www.mathworks.com/products/simulink.html?s_tid=hp_ff_p_simulink	• https://www.scilab.org/software/xcos	• Toolbox relies on Scilab Xcos by enabling variable exchange between Octave and Scilab workspaces	
• https://www.mathworks.com/solutions/control-systems.html	• https://www.scilab.org/software/xcos/control-systems	• https://wiki.octave.org/Sci_cosim	

Software

Scilab 6.1.0 + Xcos

Windows:

Download the file from https://www.scilab.org/ and click through the link "Download Scilab 6.1.0" > "Scilab 6.1.0 - Windows 64 bits (exe)"

MacOS:

To start the installation, you may need to follow the following sequence:

(1) AdoptOpenJDK (https://github.com/AdoptOpenJDK/openjdk8-binaries/releases/download/jdk8u242-b08/OpenJDK8U-jdk_x64_mac_hotspot_8u242b08.pkg),

(2) Scilab, and

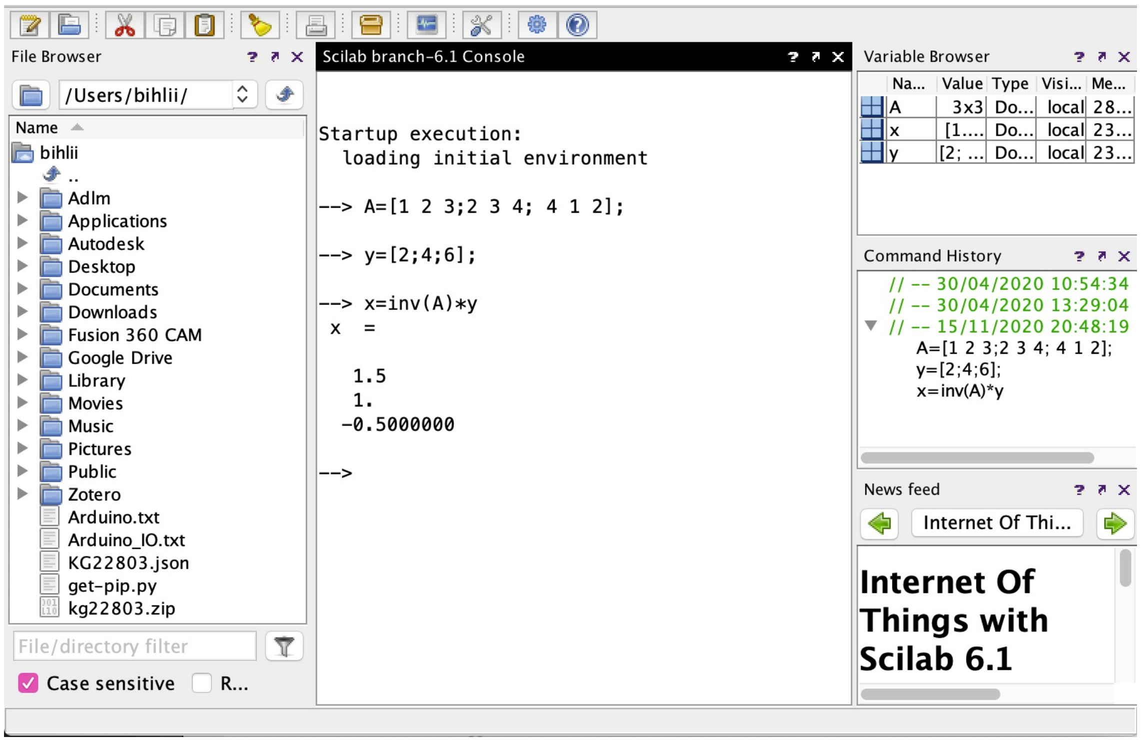
(3) allow command interpreter SH to access your folders (check the video in https://www.utc.fr/~mottelet/scilab/scilab_catalina_enable_sh_720.mov on how to do so). You can refer to https://www.utc.fr/~mottelet/scilab_for_macOS.html for installation guide.

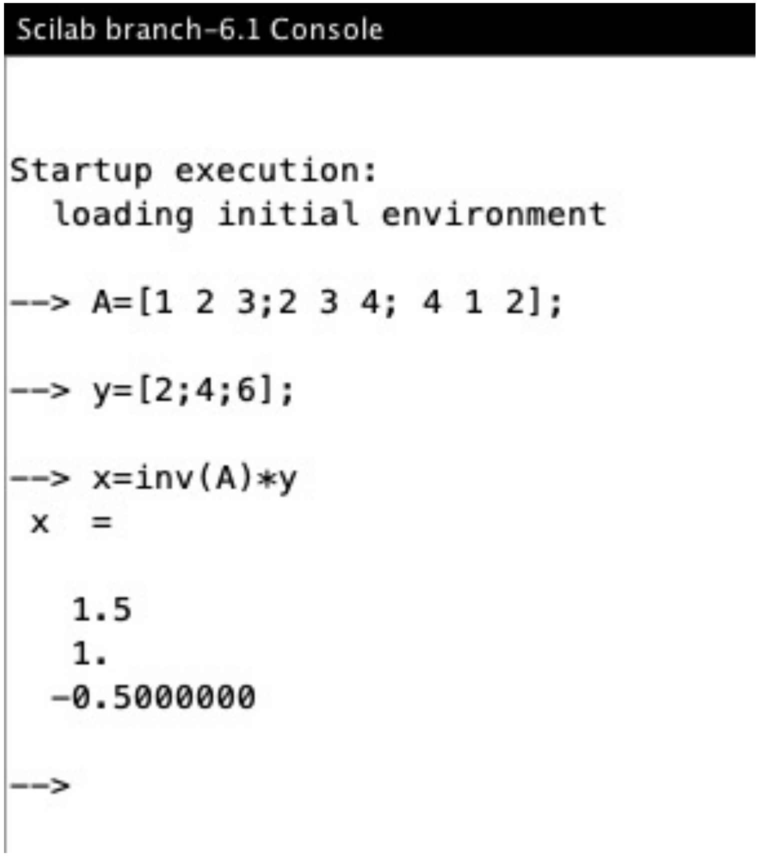
Matlab + Simulink

Basic of Scilab

[Scilab] – solving simultaneous eq.

```
A*x=y

x= inv(A)*y
```





Basic of Scilab

[Scilab] – Matrix Operations

Generate row vector:

```
A=1:5
```

```
--> A=1:5
 A  =

   1.   2.   3.   4.   5.
```

Generate row vector with step:

```
B=1.1:0.1:1.5
```

```
--> B=1.1:0.1:1.5
 B  =

   1.1   1.2   1.3   1.4   1.5
```

Combine into matrix:

```
C=[A;B]
```

```
--> C=[A;B]
 C  =

   1.     2.     3.     4.     5.
   1.1    1.2    1.3    1.4    1.5
```

To extract member (indices):

```
A(3)
A(3:5)
C(:,1)
C(1,:)
```

```
--> A(3)
 ans  =

   3.
```

```
--> A(3:5)
 ans  =

   3.   4.   5.
```

```
--> C(:,1)
 ans  =

   1.
   1.1
```

```
--> C(1,:)
 ans  =

   1.   2.   3.   4.   5.
```

Basic of Scilab

[Scilab] – Polynomial & Rational Functions

Polynomial:

```
x=poly(0,'x')
D=x^2+2*x+2
coeff(D)
roots(D)
```

```
--> x=poly(0,'x')
 x  =

  x
```

```
--> D=x^2+2*x-2
 D  =

  -2 +2x +x²
```

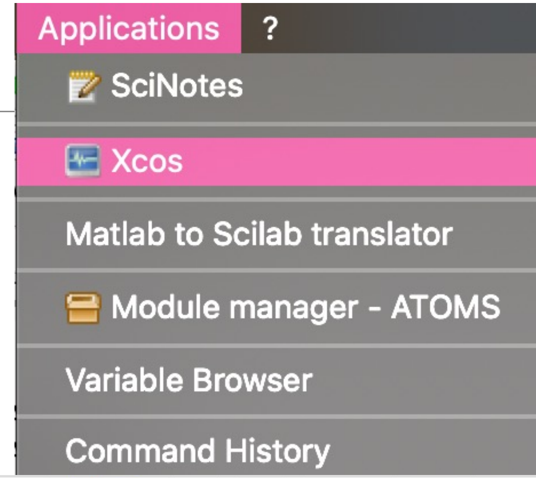
```
--> coeff(D)
 ans  =

  -2.   2.   1.
```

```
--> roots(D)
 ans  =

  -2.7320508 + 0.i
   0.7320508 + 0.i
```

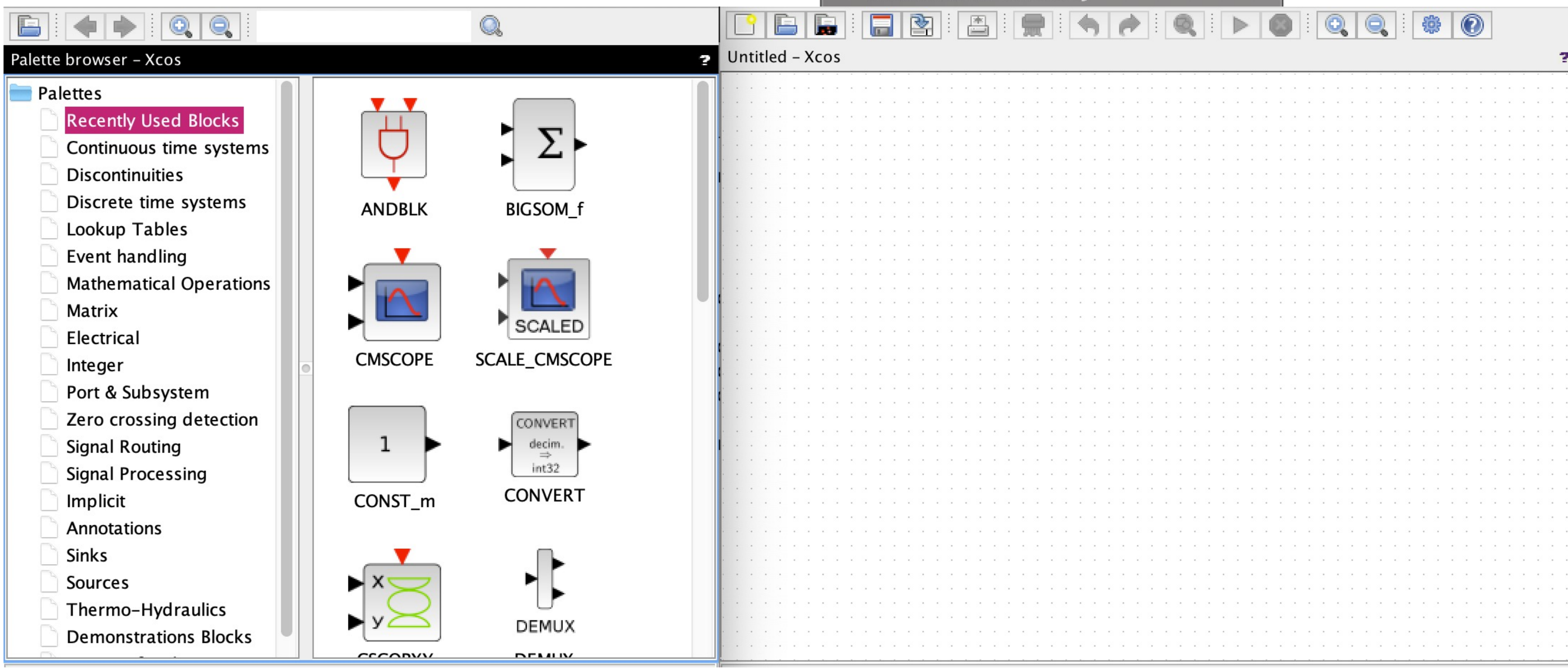
```
x=poly(0,'x');
W=1/(x+1)
```

```
--> W=1/(x+1)
 W  =

    1
   ----
   1 +x
```

Basic of Xcos



[Xcos]

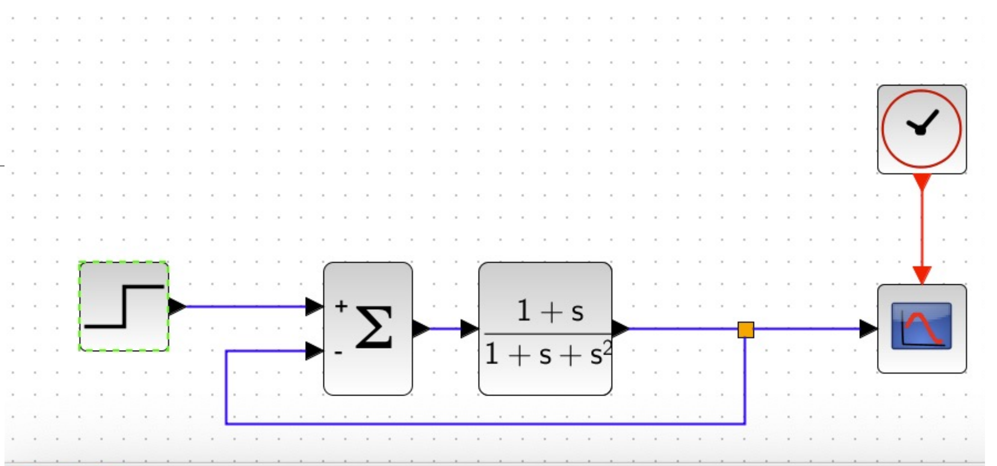


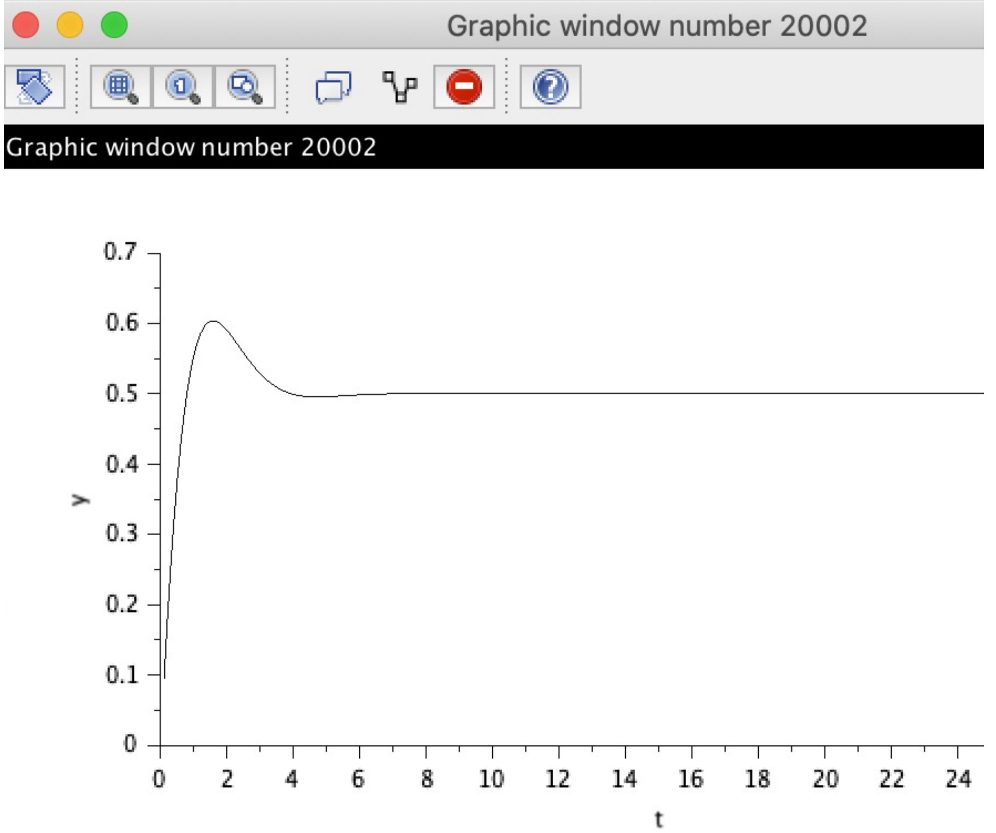
Basic of Xcos

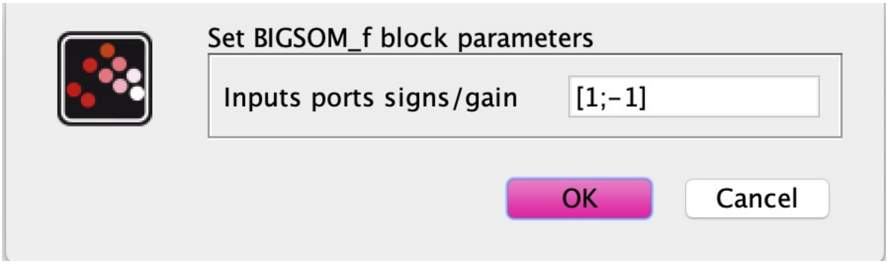
[Xcos]

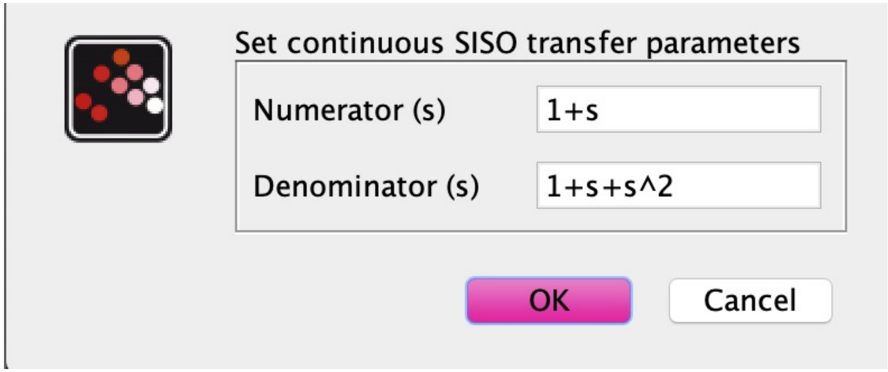
CLOCK_c and STEP_FUNCTION (from Sources palette)

CSCOPE (from Sinks palette), BIGSOM_f (from Mathematical Operations)









Build-in function for linear analysis

```
--> help plzr
```

Frequency Domain

- black — Black-Nichols diagram of a linear dynamical system
- bode — Bode plot
- bode_asymp — Bode plot asymptote
- calfrq — frequency response discretization
- dbphi — frequency response to phase and magnitude representation
- freq — frequency response
- freson — peak frequencies
- gainplot — magnitude plot
- hallchart — Draws a Hall chart
- nicholschart — Nichols chart
- nyquist — nyquist plot
- nyquistfrequencybounds — Computes the frequencies for which the nyquist locus enters and leaves a given rectangle.
- phasemag — phase and magnitude computation
- phaseplot — frequency phase plot
- repfreq — frequency response
- svplot — singular-value sigma-plot
- trzeros — transmission zeros and normal rank

Stability

bstap — hankel approximant
dtsi — Continuous time dynamical systems stable anti-stable decomposition
evans — Evans root locus
g_margin — gain margin and associated crossover frequency
p_margin — phase margin and associated crossover frequency
plzr — pole-zero plot
routh_t — Routh's table
sgrid — draws a s-plane grid
show_margins — display gain and phase margin and associated crossover frequencies
st_ility — stabilizability test
zgrid — zgrid plot

Time Domain

arsimul — armax simulation
csim — simulation (time response) of linear system
damp — Natural frequencies and damping factors.
dsimul — state space discrete time simulation
flts — time response (discrete time, sampled system)
ltitr — discrete time response (state space)
narsimul — armax simulation (using rtitr)
rtitr — discrete time response (transfer matrix)