MATLAB COMMANDS

REPRESENTING POLYNOMIALS: MATLAB represents polynomials as row vectors containing coefficients ordered by descending powers. For example, consider the equation:

$$p(x) = x^3 - 2x - 5$$

To enter this polynomial into MATLAB, use p = [1 0 -2 -5]

TF Creation of transfer functions or conversion to transfer function.
SYS = TF(NUM,DEN) creates a continuous-time transfer function SYS with numerator(s) NUM and denominator(s) DEN. The output SYS is a TF object.

ROOTS Find polynomial roots.
ROOTS(C) computes the roots of the polynomial whose coefficients are the elements of the vector C. If C has N+1 components, the polynomial is C(1)*X^N + ... + C(N)*X + C(N+1).

RESIDUE finds the partial fraction expansion of the ratio of two polynomials. This is particularly useful for applications that represent systems in transfer function form. See help RESIDUE for more information

RLOCUS(SYS) or **RLOCUS(NUM,DEN)** computes and plots the root locus of the single-input, single-output LTI model SYS. The root locus plot is used to analyze the negative feedback loop.

BODE(SYS) or **BODE(NUM,DEN)** draws the Bode plot of the LTI model SYS. The frequency range and number of points are chosen automatically.

NYQUIST(SYS) or **NYQUIST(NUM,DEN)** draws the Nyquist plot of the LTI model SYS. The frequency range and number of points are chosen automatically.

MARGIN Gain and phase margins and crossover frequencies.
[Gm,Pm,Wcg,Wcp] = MARGIN(SYS) computes the gain margin Gm, the phase margin Pm, and the associated frequencies Wcg and Wcp, for the SISO open-loop model SYS (continuous or discrete). The gain margin Gm is defined as 1/G where G is the gain at the -180 phase crossing. The phase margin Pm is in degrees. The gain margin in dB is derived by

Gm_dB = 20*log10(Gm)

The loop gain at Wcg can increase or decrease by this many dBs before losing stability, and Gm_dB<0 (Gm<1) means that stability is most sensitive to loop gain reduction. If there are several crossover points, MARGIN returns the smallest margins (gain margin nearest to 0 dB and phase margin nearest to 0 degrees).

LTIVIEW opens an empty LTI Viewer. The LTI Viewer is an interactive graphical user interface (GUI) for analyzing the time and frequency responses of linear systems and comparing such systems. See LTIMODELS for details on how to model linear systems in the Control System Toolbox.

LTIVIEW(SYS1,SYS2,...,SYSN) opens an LTI Viewer containing the step response of the LTI models SYS1,SYS2,...,SYSN. You can specify a distinctive color, line style, and marker for each system, as in

```
sys1 = rss(3,2,2);
sys2 = rss(4,2,2);
ltiview(sys1,'r-*',sys2,'m--');
```

LTIVIEW(PLOTTYPE,SYS1,SYS2,...,SYSN) further specifies which responses to plot in the LTI Viewer. PLOTTYPE may be any of the following strings (or a combination thereof):

1) 'step' Step response
2) 'impulse' Impulse response
3) 'bode' Bode diagrams
4) 'bodemag' Bode magnitude plot
5) 'nyquist' Nyquist plot
6) 'nichols' Nichols plot
7) 'sigma' Singular value plot
8) 'pzmap' Pole/zero map

For example,

```
ltiview({'step';'bode'},sys1,sys2)
```

opens an LTI Viewer showing the step and Bode responses of the LTI models SYS1 and SYS2.

LTIVIEW(PLOTTYPE,SYS,EXTRAS) allows you to specify the additional input arguments supported by the various response types. See the HELP text for each response type for more details on the format of these extra arguments. You can also use this syntax to plot the output of LSIM or INITIAL in the LTI Viewer, as in

```
ltiview('lsim',sys1,sys2,u,t,x0)
```

Two additional options are available for manipulating previously opened LTI Viewers:

LTIVIEW('clear',VIEWERS) clears the plots and data from the LTI Viewers with handles VIEWERS.

LTIVIEW('current',SYS1,SYS2,...,SYSN,VIEWERS) adds the responses of the systems SYS1,SYS2,... to the LTI Viewers with handles VIEWERS. If these new systems do not have the same I/O dimensions as those currently in the LTI Viewer, the LTI Viewer is first cleared and only the new responses are shown.

See also STEP, IMPULSE, BODE, BODEMAG, NYQUIST, NICHOLS, SIGMA, LSIM, INITIAL.