Fachhochschule Aargau
Nordwestschweiz

PJT (PROJEKTE UND TOOLS)
MATLAB

Zusammenfassung und Kurzbeschreibung aller MATLAB VERSION 5.3-Befehle (und wichtiger Toolboxen)

Inhalt:

Filename:	Version:	Author:
Befehlssatz MATLAB Version 53_1_1.doc	1.1 zu MATLAB Ver. 5.3	Stefan Wicki
Created:	Last modified:	Page:
22-Jan-02	22.10.2003 21:56	**1** / 46

Inhaltsverzeichnis:

1. MATLAB

1.1 Data analysis and Fourier transforms

```
Basic operations.
  max         - Largest component.
  min         - Smallest component.
  mean        - Average or mean value.
  median      - Median value.
  std         - Standard deviation.
  var         - Variance.
  sort        - Sort in ascending order.
  sortrows    - Sort rows in ascending order.
  sum         - Sum of elements.
  prod        - Product of elements.
  hist        - Histogram.
  histc       - Histogram count.
  trapz       - Trapezoidal numerical integration.
  cumsum      - Cumulative sum of elements.
  cumprod     - Cumulative product of elements.
  cumtrapz    - Cumulative trapezoidal numerical integration.

Finite differences.
  diff        - Difference and approximate derivative.
  gradient    - Approximate gradient.
  del2        - Discrete Laplacian.

Correlation.
  corrcoef    - Correlation coefficients.
  cov         - Covariance matrix.
  subspace    - Angle between subspaces.

Filtering and convolution.
  filter      - One-dimensional digital filter.
  filter2     - Two-dimensional digital filter.
  conv        - Convolution and polynomial multiplication.
  conv2       - Two-dimensional convolution.
  convn       - N-dimensional convolution.
  deconv      - Deconvolution and polynomial division.
  detrend     - Linear trend removal.

Fourier transforms.
  fft         - Discrete Fourier transform.
  fft2        - Two-dimensional discrete Fourier transform.
  fftn        - N-dimensional discrete Fourier Transform.
  ifft        - Inverse discrete Fourier transform.
  ifft2       - Two-dimensional inverse discrete Fourier transform.
  ifftn       - N-dimensional inverse discrete Fourier Transform.
  fftshift    - Shift DC component to center of spectrum.
  ifftshift   - Inverse FFTSHIFT.
```



```
Sound and audio.
  sound       - Play vector as sound.
  soundsc     - Autoscale and play vector as sound.
  speak       - Convert input string to speech (Macintosh only).
  recordsound - Record sound (Macintosh only).
  soundcap    - Sound capabilities (Macintosh only).
  mu2lin      - Convert mu-law encoding to linear signal.
  lin2mu      - Convert linear signal to mu-law encoding.

Audio file inport/export.
  auwrite     - Write NeXT/SUN (".au") sound file.
  auread      - Read NeXT/SUN (".au") sound file.
  wavwrite    - Write Microsoft WAVE (".wav") sound file.
  wavread     - Read Microsoft WAVE (".wav") sound file.
  readsnd     - Read SND resources and files (Macintosh only).
  writesnd    - Write SND resources and files (Macintosh only).
```

1.2 Data types and structures

```
Data types (classes)
  double      - Convert to double precision.
  sparse      - Create sparse matrix.
  char        - Create character array (string).
  cell        - Create cell array.
  struct      - Create or convert to structure array.
  single      - Convert to single precision.
  uint8       - Convert to unsigned 8-bit integer.
  uint16      - Convert to unsigned 16-bit integer.
  uint32      - Convert to unsigned 32-bit integer.
  int8        - Convert to signed 8-bit integer.
  int16       - Convert to signed 16-bit integer.
  int32       - Convert to signed 32-bit integer.
  inline      - Construct INLINE object.

Multi-dimensional array functions.
  cat         - Concatenate arrays.
  ndims       - Number of dimensions.
  ndgrid      - Generate arrays for N-D functions and interpolation.
  permute     - Permute array dimensions.
  ipermute    - Inverse permute array dimensions.
  shiftdim    - Shift dimensions.
  squeeze     - Remove singleton dimensions.

Cell array functions.
  cell        - Create cell array.
  cellfun     - Functions on cell array contents.
  celldisp    - Display cell array contents.
  cellplot    - Display graphical depiction of cell array.
  num2cell    - Convert numeric array into cell array.
```

```
    deal        - Deal inputs to outputs.
    cell2struct - Convert cell array into structure array.
    struct2cell - Convert structure array into cell array.
    iscell      - True for cell array.

  Structure functions.
    struct      - Create or convert to structure array.
    fieldnames  - Get structure field names.
    getfield    - Get structure field contents.
    setfield    - Set structure field contents.
    rmfield     - Remove structure field.
    isfield     - True if field is in structure array.
    isstruct    - True for structures.

  Object oriented programming functions.
    class       - Create object or return object class.
    struct      - Convert object to structure array.
    methods     - Display class method names.
    isa         - True if object is a given class.
    isobject    - True for objects.
    inferiorto  - Inferior class relationship.
    superiorto  - Superior class relationship.
    substruct   - Create structure argument for SUBSREF/SUBSASGN

  Overloadable operators.
    minus       - Overloadable method for a-b.
    plus        - Overloadable method for a+b.
    times       - Overloadable method for a.*b.
    mtimes      - Overloadable method for a*b.
    mldivide    - Overloadable method for a\b.
    mrdivide    - Overloadable method for a/b.
    rdivide     - Overloadable method for a./b.
    ldivide     - Overloadable method for a.\b.
    power       - Overloadable method for a.^b.
    mpower      - Overloadable method for a^b.
    uminus      - Overloadable method for -a.
    uplus       - Overloadable method for +a.
    horzcat     - Overloadable method for [a b].
    vertcat     - Overloadable method for [a;b].
    le          - Overloadable method for a<=b.
    lt          - Overloadable method for a<b.
    gt          - Overloadable method for a>b.
    ge          - Overloadable method for a>=b.
    eq          - Overloadable method for a==b.
    ne          - Overloadable method for a~=b.
    not         - Overloadable method for ~a.
    and         - Overloadable method for a&b.
    or          - Overloadable method for a|b.
    subsasgn    - Overloadable method for a(i)=b, a{i}=b, and a.field=b.
    subsref     - Overloadable method for a(i), a{i}, and a.field.
    colon       - Overloadable method for a:b.
    end         - Overloadable method for a(end
    transpose   - Overloadable method for a.'
    ctranspose  - Overloadable method for a'
```



```
    subsindex   - Overloadable method for x(a).
    loadobj     - Called when loading an object from a .MAT file.
    saveobj     - Called with saving an object to a .MAT file.
```

1.3 Examples and demonstrations

```
  Type 'demo' at the command line to browse more demos of
  MATLAB, the Toolboxes, and SIMULINK.


MATLAB/Introduction.
  demo        - Browse demos for MATLAB, Toolboxes, and SIMULINK

MATLAB/Matrices.
  intro       - Introduction to basic matrix operations in MATLAB.
  inverter    - Demonstrate the inversion of a matrix.
  buckydem    - Connectivity graph of the Buckminster Fuller geodesic dome.
  sparsity    - Demonstrate effect of sparsity orderings.
  matmanip    - Introduction to matrix manipulation.
  eigmovie    - Symmetric eigenvalue movie.
  rrefmovie   - Computation of Reduced Row Echelon Form.
  delsqdemo   - Finite difference Laplacian on various domains.
  sepdemo     - Separators for a finite element mesh.
  airfoil     - Display sparse matrix from NASA airfoil.
  eigshow     - Graphical demonstration of matrix eigenvalues.
  svdshow     - Graphical demonstration of matrix singular values.

MATLAB/Numerics.
  funfuns     - Demonstrate functions that operate on other functions.
  fitdemo     - Nonlinear curve fit with simplex algorithm.
  sunspots    - FFT: the answer is 11.08, what is the question?
  e2pi        - 2D visual solutions: Which is greater, e^pi or pi^e?
  bench       - MATLAB Benchmark.
  fftdemo     - Use of the fast finite Fourier transform.
  census      - Try to predict the US population in the year 2000.
  spline2d    - Demonstrate GINPUT and SPLINE in two dimensions.
  lotkademo   - An example of ordinary differential equation solution.
  quaddemo    - Adaptive quadrature.
  zerodemo    - Zerofinding with fzero.
  fplotdemo   - Plot a function.
  quake       - Loma Prieta Earthquake.

MATLAB/Visualization.
  graf2d      - 2D Plots: Demonstrate XY plots in MATLAB.
  graf2d2     - 3D Plots: Demonstrate XYZ plots in MATLAB.
  grafcplx    - Demonstrate complex function plots in MATLAB.
  lorenz      - Plot the orbit around the Lorenz chaotic attractor.
  imageext    - Image colormaps: changing and rotating colormaps.
  xpklein     - Klein bottle demo.
  vibes       - Vibration movie: Vibrating L-shaped membrane.
```

```
  xpsound     - Visualizing sound: Demonstrate MATLAB's sound capability.
  imagedemo   - Demonstrate MATLAB's image capability.
  penny       - Several views of the penny data.
  earthmap    - View Earth's topography.
  xfourier    - Graphic demo of Fourier series expansion.
  colormenu   - Select color map.
  cplxdemo    - Maps of functions of a complex variable.

MATLAB/Language.
  xplang      - Introduction to the MATLAB language.
  hndlgraf    - Demonstrate Handle Graphics for line plots.
  graf3d      - Demonstrate Handle Graphics for surface plots.
  hndlaxis    - Demonstrate Handle Graphics for axes.

MATLAB/ODE Suite.
  odedemo     - Demo for the ODE suite integrators.
  a2ode       - Stiff problem, linear with real eigenvalues (A2 of EHL).
  a3ode       - Stiff problem, linear with real eigenvalues (A3 of EHL).
  b5ode       - Stiff problem, linear with complex eigenvalues (B5 of EHL).
  ballode     - Equations of motion for a bouncing ball used by BALLDEMO.
  besslode    - Bessel's equation of order 0 used by BESSLDEMO.
  brussode    - Stiff problem modelling a chemical reaction (Brusselator).
  buiode      - Stiff problem with analytical solution due to Bui.
  chm6ode     - Stiff problem CHM6 from Enright and Hull.
  chm7ode     - Stiff problem CHM7 from Enright and Hull.
  chm9ode     - Stiff problem CHM9 from Enright and Hull.
  d1ode       - Stiff problem, nonlinear with real eigenvalues (D1 of EHL).
  fem1ode     - Stiff problem with a time-dependent mass matrix.
  fem2ode     - Stiff problem with a time-independent mass matrix.
  gearode     - Stiff problem due to Gear as quoted by van der Houwen.
  hb1ode      - Stiff problem 1 of Hindmarsh and Byrne.
  hb2ode      - Stiff problem 2 of Hindmarsh and Byrne.
  hb3ode      - Stiff problem 3 of Hindmarsh and Byrne.
  orbitode    - Restricted 3 body problem used by ORBITDEMO.
  orbt2ode    - Non-stiff problem D5 of Hull et al.
  rigidode    - Euler equations of a rigid body without external forces.
  sticode     - A spring-driven mass stuck to surface, used by STICDEMO.
  vdpode      - Parameterizable van der Pol equation (stiff for large mu).

Extras/Gallery.
  knot        - Tube surrounding a three-dimensional knot.
  quivdemo    - Demonstrate the quiver function.
  klein1      - Construct a Klein bottle.
  cruller     - Construct cruller.
  tori4       - Hoops: Construct four linked tori.
  spharm2     - Construct spherical surface harmonic.
  modes       - Plot 12 modes of the L-shaped membrane.
  logo        - Display the MATLAB L-shaped membrane logo.

Extras/Games.
  fifteen     - Sliding puzzle.
  xpbombs     - Minesweeper game.
  life        - Conway's Game of Life.
  soma        - Soma cube.
```



```
Extras/Miscellaneous.
  truss       - Animation of a bending bridge truss.
  travel      - Traveling salesman problem.
  spinner     - Colorful lines spinning through space.
  xpquad      - Superquadrics plotting demonstration.
  codec       - Alphabet transposition coder/decoder.
  xphide      - Visual perception of objects in motion.
  makevase    - Generate and plot a surface of revolution.
  wrldtrv     - Great circle flight routes around the globe.
  logospin    - Movie of The MathWorks' logo spinning.
  crulspin    - Spinning cruller movie.
  quatdemo    - Quaternion rotation.

General Demo/Helper functions.
  cmdlnwin    - An Demo gateway routine for playing command line demos.
  cmdlnbgn    - Set up for command line demos.
  cmdlnend    - clean up after command line demos.
  finddemo    - Finds demos available for individual toolboxes.
  helpfun     - Utility function for displaying help text conveniently.
  pltmat      - Display a matrix in a figure window.

MATLAB/Helper functions.
  bucky       - The graph of the Buckminster Fuller geodesic dome.
  peaks       - A sample function of two variables.
  membrane    - Generate MathWorks' logo.


See also SIMDEMOS
```

1.4 Elementary math functions

```
Trigonometric.
  sin         - Sine.
  sinh        - Hyperbolic sine.
  asin        - Inverse sine.
  asinh       - Inverse hyperbolic sine.
  cos         - Cosine.
  cosh        - Hyperbolic cosine.
  acos        - Inverse cosine.
  acosh       - Inverse hyperbolic cosine.
  tan         - Tangent.
  tanh        - Hyperbolic tangent.
  atan        - Inverse tangent.
  atan2       - Four quadrant inverse tangent.
  atanh       - Inverse hyperbolic tangent.
  sec         - Secant.
  sech        - Hyperbolic secant.
  asec        - Inverse secant.
  asech       - Inverse hyperbolic secant.
```

```
  csc         - Cosecant.
  csch        - Hyperbolic cosecant.
  acsc        - Inverse cosecant.
  acsch       - Inverse hyperbolic cosecant.
  cot         - Cotangent.
  coth        - Hyperbolic cotangent.
  acot        - Inverse cotangent.
  acoth       - Inverse hyperbolic cotangent.

Exponential.
  exp         - Exponential.
  log         - Natural logarithm.
  log10       - Common (base 10) logarithm.
  log2        - Base 2 logarithm and dissect floating point number.
  pow2        - Base 2 power and scale floating point number.
  sqrt        - Square root.
  nextpow2    - Next higher power of 2.

Complex.
  abs         - Absolute value.
  angle       - Phase angle.
  complex     - Construct complex data from real and imaginary parts.
  conj        - Complex conjugate.
  imag        - Complex imaginary part.
  real        - Complex real part.
  unwrap      - Unwrap phase angle.
  isreal      - True for real array.
  cplxpair    - Sort numbers into complex conjugate pairs.

Rounding and remainder.
  fix         - Round towards zero.
  floor       - Round towards minus infinity.
  ceil        - Round towards plus infinity.
  round       - Round towards nearest integer.
  mod         - Modulus (signed remainder after division).
  rem         - Remainder after division.
  sign        - Signum.
```


1.5 Elementary matrices and matrix manipulation

```
Elementary matrices.
  zeros       - Zeros array.
  ones        - Ones array.
  eye         - Identity matrix.
  repmat      - Replicate and tile array.
  rand        - Uniformly distributed random numbers.
  randn       - Normally distributed random numbers.
  linspace    - Linearly spaced vector.
  logspace    - Logarithmically spaced vector.
  meshgrid    - X and Y arrays for 3-D plots.
  :           - Regularly spaced vector and index into matrix.

Basic array information.
  size        - Size of matrix.
  length      - Length of vector.
  ndims       - Number of dimensions.
  disp        - Display matrix or text.
  isempty     - True for empty matrix.
  isequal     - True if arrays are identical.
  isnumeric   - True for numeric arrays.
  islogical   - True for logical array.
  logical     - Convert numeric values to logical.

Matrix manipulation.
  reshape     - Change size.
  diag        - Diagonal matrices and diagonals of matrix.
  blkdiag     - Block diagonal concatenation.
  tril        - Extract lower triangular part.
  triu        - Extract upper triangular part.
  fliplr      - Flip matrix in left/right direction.
  flipud      - Flip matrix in up/down direction.
  flipdim     - Flip matrix along specified dimension.
  rot90       - Rotate matrix 90 degrees.
  :           - Regularly spaced vector and index into matrix.
  find        - Find indices of nonzero elements.
  end         - Last index.
  sub2ind     - Linear index from multiple subscripts.
  ind2sub     - Multiple subscripts from linear index.

Special variables and constants.
  ans         - Most recent answer.
  eps         - Floating point relative accuracy.
  realmax     - Largest positive floating point number.
  realmin     - Smallest positive floating point number.
  pi          - 3.1415926535897....
  i, j        - Imaginary unit.
  inf         - Infinity.
  NaN         - Not-a-Number.
  isnan       - True for Not-a-Number.
  isinf       - True for infinite elements.
```

```
  isfinite    - True for finite elements.
  flops       - Floating point operation count.
  why         - Succinct answer.

Specialized matrices.
  compan      - Companion matrix.
  gallery     - Higham test matrices.
  hadamard    - Hadamard matrix.
  hankel      - Hankel matrix.
  hilb        - Hilbert matrix.
  invhilb     - Inverse Hilbert matrix.
  magic       - Magic square.
  pascal      - Pascal matrix.
  rosser      - Classic symmetric eigenvalue test problem.
  toeplitz    - Toeplitz matrix.
  vander      - Vandermonde matrix.
  wilkinson   - Wilkinson's eigenvalue test matrix.
```

1.6 Function functions and ODE solvers

```
Optimization and root finding.
  fminbnd     - Scalar bounded nonlinear function minimization.
  fminsearch  - Multidimensional unconstrained nonlinear minimization,
                by Nelder-Mead direct search method.
  fzero       - Scalar nonlinear zero finding.

Optimization Option handling
  optimset    - Create or alter optimization OPTIONS structure.
  optimget    - Get optimization parameters from OPTIONS structure.

Numerical integration (quadrature).
  quad        - Numerically evaluate integral, low order method.
  quad8       - Numerically evaluate integral, higher order method.
  dblquad     - Numerically evaluate double integral.

Plotting.
  ezplot      - Easy to use function plotter.
  fplot       - Plot function.

Inline function object.
  inline      - Construct INLINE function object.
  argnames    - Argument names.
  formula     - Function formula.
  char        - Convert INLINE object to character array.

Utilities.
  vectorize   - Vectorize string expression or INLINE function object.

Ordinary differential equation solvers.
(If unsure about stiffness, try ODE45 first, then ODE15S.)
```



```
  ode45       - Solve non-stiff differential equations, medium order method.
  ode23       - Solve non-stiff differential equations, low order method.
  ode113      - Solve non-stiff differential equations, variable order method.
  ode23t      - Solve moderately stiff differential equations, trapezoidal rule.
  ode15s      - Solve stiff differential equations, variable order method.
  ode23s      - Solve stiff differential equations, low order method.
  ode23tb     - Solve stiff differential equations, low order method.
  odefile     - ODE file syntax.

ODE Option handling.
  odeset      - Create/alter ODE OPTIONS structure.
  odeget      - Get ODE OPTIONS parameters.

ODE output functions.
  odeplot     - Time series ODE output function.
  odephas2    - 2-D phase plane ODE output function.
  odephas3    - 3-D phase plane ODE output function.
  odeprint    - Command window printing ODE output function.
```

1.7 General purpose commands

```
MATLAB Toolbox   Version 5.3 (R11)  15-Jan-1999

General information
  help        - On-line help, display text at command line.
  helpwin     - On-line help, separate window for navigation.
  helpdesk    - Comprehensive hypertext documentation and troubleshooting.
  demo        - Run demonstrations.
  ver         - MATLAB, SIMULINK, and toolbox version information.
  whatsnew    - Display Readme files.
  Readme      - What's new in MATLAB

Managing the workspace.
  who         - List current variables.
  whos        - List current variables, long form.
  workspace   - Display Workspace Browser, a GUI for managing the workspace.
  clear       - Clear variables and functions from memory.
  pack        - Consolidate workspace memory.
  load        - Load workspace variables from disk.
  save        - Save workspace variables to disk.
  quit        - Quit MATLAB session.

Managing commands and functions.
  what        - List MATLAB-specific files in directory.
  type        - List M-file.
  edit        - Edit M-file.
  open        - Open files by extension.
  lookfor     - Search all M-files for keyword.
  which       - Locate functions and files.
  pcode       - Create pre-parsed pseudo-code file (P-file).
  inmem       - List functions in memory.
```

```
   mex         - Compile MEX-function.

Managing the search path
   path        - Get/set search path.
   addpath     - Add directory to search path.
   rmpath      - Remove directory from search path.
   pathtool    - Modify search path.

Controlling the command window.
   echo        - Echo commands in M-files.
   more        - Control paged output in command window.
   diary       - Save text of MATLAB session.
   format      - Set output format.

Operating system commands
   cd          - Change current working directory.
   copyfile    - Copy a file.
   pwd         - Show (print) current working directory.
   dir         - List directory.
   delete      - Delete file.
   getenv      - Get environment variable.
   mkdir       - Make directory.
   !           - Execute operating system command (see PUNCT).
   dos         - Execute DOS command and return result.
   unix        - Execute UNIX command and return result.
   vms         - Execute VMS DCL command and return result.
   web         - Open Web browser on site or files.
   computer    - Computer type.

Debugging M-files.
   debug       - List debugging commands.
   dbstop      - Set breakpoint.
   dbclear     - Remove breakpoint.
   dbcont      - Continue execution.
   dbdown      - Change local workspace context.
   dbstack     - Display function call stack.
   dbstatus    - List all breakpoints.
   dbstep      - Execute one or more lines.
   dbtype      - List M-file with line numbers.
   dbup        - Change local workspace context.
   dbquit      - Quit debug mode.
   dbmex       - Debug MEX-files (UNIX only).

Profiling M-files.
   profile     - Profile function execution time.

See also PUNCT.
```


1.8 Two dimensional graphs

```
Elementary X-Y graphs.
   plot        - Linear plot.
   loglog      - Log-log scale plot.
   semilogx    - Semi-log scale plot.
   semilogy    - Semi-log scale plot.
   polar       - Polar coordinate plot.
   plotyy      - Graphs with y tick labels on the left and right.

Axis control.
   axis        - Control axis scaling and appearance.
   zoom        - Zoom in and out on a 2-D plot.
   grid        - Grid lines.
   box         - Axis box.
   hold        - Hold current graph.
   axes        - Create axes in arbitrary positions.
   subplot     - Create axes in tiled positions.

Graph annotation.
   plotedit    - Tools for editing and annotating plots.
   legend      - Graph legend.
   title       - Graph title.
   xlabel      - X-axis label.
   ylabel      - Y-axis label.
   texlabel    - Produces TeX format from a character string
   text        - Text annotation.
   gtext       - Place text with mouse.

Hardcopy and printing.
   print       - Print graph or SIMULINK system; or save graph to M-file.
   printopt    - Printer defaults.
   orient      - Set paper orientation.

See also GRAPH3D, SPECGRAPH.
```

1.9 Three dimensional graphs

```
Elementary 3-D plots.
   plot3       - Plot lines and points in 3-D space.
   mesh        - 3-D mesh surface.
   surf        - 3-D colored surface.
   fill3       - Filled 3-D polygons.

Color control.
   colormap    - Color look-up table.
   caxis       - Pseudocolor axis scaling.
   shading     - Color shading mode.
```

```
  hidden      - Mesh hidden line removal mode.
  brighten    - Brighten or darken color map.
  colordef    - Set color defaults.
  graymon     - Set graphics defaults for gray-scale monitors.

Lighting.
  surfl       - 3-D shaded surface with lighting.
  lighting    - Lighting mode.
  material    - Material reflectance mode.
  specular    - Specular reflectance.
  diffuse     - Diffuse reflectance.
  surfnorm    - Surface normals.

Color maps.
  hsv         - Hue-saturation-value color map.
  hot         - Black-red-yellow-white color map.
  gray        - Linear gray-scale color map.
  bone        - Gray-scale with tinge of blue color map.
  copper      - Linear copper-tone color map.
  pink        - Pastel shades of pink color map.
  white       - All white color map.
  flag        - Alternating red, white, blue, and black color map.
  lines       - Color map with the line colors.
  colorcube   - Enhanced color-cube color map.
  vga         - Windows colormap for 16 colors.
  jet         - Variant of HSV.
  prism       - Prism color map.
  cool        - Shades of cyan and magenta color map.
  autumn      - Shades of red and yellow color map.
  spring      - Shades of magenta and yellow color map.
  winter      - Shades of blue and green color map.
  summer      - Shades of green and yellow color map.

Axis control.
  axis        - Control axis scaling and appearance.
  zoom        - Zoom in and out on a 2-D plot.
  grid        - Grid lines.
  box         - Axis box.
  hold        - Hold current graph.
  axes        - Create axes in arbitrary positions.
  subplot     - Create axes in tiled positions.
  daspect     - Data aspect ratio.
  pbaspect    - Plot box aspect ratio.
  xlim        - X limits.
  ylim        - Y limits.
  zlim        - Z limits.

Viewpoint control.
  view        - 3-D graph viewpoint specification.
  viewmtx     - View transformation matrix.
  rotate3d    - Interactively rotate view of 3-D plot.

Camera control.
  campos      - Camera position.
```



```
  camtarget   - Camera target.
  camva       - Camera view angle.
  camup       - Camera up vector.
  camproj     - Camera projection.

High level camera control.
  camorbit    - Orbit camera.
  campan      - Pan camera.
  camdolly    - Dolly camera.
  camzoom     - Zoom camera.
  camroll     - Roll camera.
  camlookat   - Move camera and target to view specified objects.
  Cameramenu  - Interactively manipulate camera.

High level light control.
  camlight    - Creates or sets position of a light.
  lightangle  - Spherical position of a light.

Graph annotation.
  title       - Graph title.
  xlabel      - X-axis label.
  ylabel      - Y-axis label.
  zlabel      - Z-axis label.
  colorbar    - Display color bar (color scale).
  text        - Text annotation.
  gtext       - Mouse placement of text.
  plotedit    - Experimental graph editing and annotation tools.

Hardcopy and printing.
  print       - Print graph or SIMULINK system; or save graph to M-file.
  printopt    - Printer defaults.
  orient      - Set paper orientation.
  vrml        - Save graphics to VRML 2.0 file.

See also GRAPH2D, SPECGRAPH.
```

1.10 Handle Graphics

```
Figure window creation and control.
  figure      - Create figure window.
  gcf         - Get handle to current figure.
  clf         - Clear current figure.
  shg         - Show graph window.
  close       - Close figure.
  refresh     - Refresh figure.

Axis creation and control.
  subplot     - Create axes in tiled positions.
  axes        - Create axes in arbitrary positions.
  gca         - Get handle to current axes.
```

```
  cla         - Clear current axes.
  axis        - Control axis scaling and appearance.
  box         - Axis box.
  caxis       - Control pseudocolor axis scaling.
  hold        - Hold current graph.
  ishold      - Return hold state.

Handle Graphics objects.
  figure      - Create figure window.
  axes        - Create axes.
  line        - Create line.
  text        - Create text.
  patch       - Create patch.
  rectangle   - Create rectangle, rounded-rectangle, or ellipse.
  surface     - Create surface.
  image       - Create image.
  light       - Create light.
  uicontrol   - Create user interface control.
  uimenu      - Create user interface menu.
  uicontextmenu - Create user interface context menu.

Handle Graphics operations.
  set         - Set object properties.
  get         - Get object properties.
  reset       - Reset object properties.
  delete      - Delete object.
  gco         - Get handle to current object.
  gcbo        - Get handle to current callback object.
  gcbf        - Get handle to current callback figure.
  drawnow     - Flush pending graphics events.
  findobj     - Find objects with specified property values.
  copyobj     - Make copy of graphics object and its children.
  isappdata   - Check if application-defined data exists.
  getappdata  - Get value of application-defined data.
  setappdata  - Set application-defined data.
  rmappdata   - Remove application-defined data.

Hardcopy and printing.
  print       - Print graph or SIMULINK system; or save graph to M-file.
  printopt    - Printer defaults.
  orient      - Set paper orientation.

Utilities.
  closereq    - Figure close request function.
  newplot     - M-file preamble for NextPlot property.
  ishandle    - True for graphics handles.

ActiveX Client Functions (PC Only).
  actxcontrol - Create an ActiveX control.
  actxserver  - Create an ActiveX server.

See also GRAPH2D, GRAPH3D, SPECGRAPH, WINFUN.
```


1.11 File input/output

```
File opening and closing.
  fopen       - Open file.
  fclose      - Close file.

Binary file I/O.
  fread       - Read binary data from file.
  fwrite      - Write binary data to file.

Formatted file I/O.
  textread    - Read formatted data from text file.
  fscanf      - Read formatted data from file.
  fprintf     - Write formatted data to file.
  fgetl       - Read line from file, discard newline character.
  fgets       - Read line from file, keep newline character.
  input       - Prompt for user input.

String conversion.
  sprintf     - Write formatted data to string.
  sscanf      - Read string under format control.

File positioning.
  ferror      - Inquire file error status.
  feof        - Test for end-of-file.
  fseek       - Set file position indicator.
  ftell       - Get file position indicator.
  frewind     - Rewind file.

File name handling
  matlabroot  - Root directory of MATLAB installation.
  filesep     - Directory separator for this platform.
  pathsep     - Path separator for this platform.
  mexext      - MEX filename extension for this platform.
  fullfile    - Build full filename from parts.
  fileparts   - Filename parts.
  partialpath - Partial pathnames.
  tempdir     - Get temporary directory.
  tempname    - Get temporary file.
  prefdir     - Preference directory name.

File import/export functions.
  load        - Load workspace from MAT-file.
  dlmread     - Read ASCII delimited file.
  dlmwrite    - Write ASCII delimited file.
  wk1read     - Read spreadsheet (WK1) file.
  wk1write    - Write spreadsheet (WK1) file.

HDF library interface help.
  hdf         - MEX-file interface to the HDF library.
  hdfan       - MATLAB Gateway to HDF multifile annotation interface.
  hdfdf24     - MATLAB Gateway to HDF raster image interface.
```

```
  hdfdfr8     - MATLAB Gateway to HDF 8-bit raster image interface.
  hdfh        - MATLAB Gateway to HDF H interface.
  hdfhd       - MATLAB Gateway to HDF HD interface.
  hdfhe       - MATLAB Gateway to HDF HE interface.
  hdfml       - MATLAB-HDF gateway utilities.
  hdfsd       - MATLAB Gateway to HDF multifile scientific dataset interface.
  hdfv        - MATLAB Gateway to HDF V (Vgroup) interface.
  hdfvf       - MATLAB Gateway to HDF VF (Vdata) interface.
  hdfvh       - MATLAB Gateway to HDF VH (Vdata) interface.
  hdfvs       - MATLAB Gateway to HDF VS (Vdata) interface.

HDF-EOS library interface help.
  hdfgd       - MATLAB Gateway to HDF-EOS grid interface.
  hdfpt       - MATLAB Gateway to HDF-EOS point interface.
  hdfsw       - MATLAB Gateway to HDF-EOS swath interface.

Image file import/export.
  imread      - Read image from graphics file.
  imwrite     - Write image to graphics file.
  imfinfo     - Return information about graphics file.

Audio file import/export.
  auwrite     - Write NeXT/SUN (".au") sound file.
  auread      - Read NeXT/SUN (".au") sound file.
  wavwrite    - Write Microsoft WAVE (".wav") sound file.
  wavread     - Read Microsoft WAVE (".wav") sound file.

Command window I/O
  clc         - Clear command window.
  home        - Send cursor home.
  disp        - Display array.
  input       - Prompt for user input.
  pause       - Wait for user response.

FIG file support for plotedit and printframes.
  hgload      - Loads a Handle Graphics object from a file.
  hgsave      - Saves an HG object heirarchy to a file.

Utilites.
  str2rng     - Convert spreadsheet range string to numeric array.
  wklconst    - WK1 record type definitions.
  wklwrec     - Write a WK1 record header.

Obsolete functions.
  csvread     - Read a comma separated value file.
  csvwrite    - Write a comma separated value file.
```


1.12 Programming language constructs

```
Control flow.
  if          - Conditionally execute statements.
  else        - IF statement condition.
  elseif      - IF statement condition.
  end         - Terminate scope of FOR, WHILE, SWITCH, TRY and IF statements.
  for         - Repeat statements a specific number of times.
  while       - Repeat statements an indefinite number of times.
  break       - Terminate execution of WHILE or FOR loop.
  switch      - Switch among several cases based on expression.
  case        - SWITCH statement case.
  otherwise   - Default SWITCH statement case.
  try         - Begin TRY block.
  catch       - Begin CATCH block.
  return      - Return to invoking function.

Evaluation and execution.
  eval        - Execute string with MATLAB expression.
  evalc       - Evaluate MATLAB expression with capture.
  feval       - Execute function specified by string.
  evalin      - Evaluate expression in workspace.
  builtin     - Execute built-in function from overloaded method.
  assignin    - Assign variable in workspace.
  run         - Run script.

Scripts, functions, and variables.
  script      - About MATLAB scripts and M-files.
  function    - Add new function.
  global      - Define global variable.
  persistent  - Define persistent variable.
  mfilename   - Name of currently executing M-file.
  lists       - Comma separated lists.
  exist       - Check if variables or functions are defined.
  isglobal    - True for global variables.
  mlock       - Prevent M-file from being cleared.
  munlock     - Allow M-file to be cleared.
  mislocked   - True if M-file cannot be cleared.
  precedence  - Operator Precedence in MATLAB.

Argument handling.
  nargchk     - Validate number of input arguments.
  nargin      - Number of function input arguments.
  nargout     - Number of function output arguments.
  varargin    - Variable length input argument list.
  varargout   - Variable length output argument list.
  inputname   - Input argument name.

Message display.
  error       - Display error message and abort function.
  warning     - Display warning message.
  lasterr     - Last error message.
```

```
  lastwarn    - Last warning message.
  errortrap   - Skip error during testing.
  disp        - Display an array.
  display     - Overloaded function to display an array.
  fprintf     - Display formatted message.
  sprintf     - Write formatted data to a string.

Interactive input.
  input       - Prompt for user input.
  keyboard    - Invoke keyboard from M-file.
  pause       - Wait for user response.
  uimenu      - Create user interface menu.
  uicontrol   - Create user interface control.
```

1.13 Matrix functions - numerical linear algebra

```
Matrix analysis.
  norm        - Matrix or vector norm.
  normest     - Estimate the matrix 2-norm.
  rank        - Matrix rank.
  det         - Determinant.
  trace       - Sum of diagonal elements.
  null        - Null space.
  orth        - Orthogonalization.
  rref        - Reduced row echelon form.
  subspace    - Angle between two subspaces.

Linear equations.
  \ and /     - Linear equation solution; use "help slash".
  inv         - Matrix inverse.
  cond        - Condition number with respect to inversion.
  condest     - 1-norm condition number estimate.
  chol        - Cholesky factorization.
  cholinc     - Incomplete Cholesky factorization.
  lu          - LU factorization.
  luinc       - Incomplete LU factorization.
  qr          - Orthogonal-triangular decomposition.
  lsqnonneg   - Linear least squares with nonnegativity constraints.
  pinv        - Pseudoinverse.
  lscov       - Least squares with known covariance.

Eigenvalues and singular values.
  eig         - Eigenvalues and eigenvectors.
  svd         - Singular value decomposition.
  gsvd        - Generalized ingular value decomposition.
  eigs        - A few eigenvalues.
  svds        - A few singular values.
  poly        - Characteristic polynomial.
  polyeig     - Polynomial eigenvalue problem.
  condeig     - Condition number with respect to eigenvalues.
```



```
  hess        - Hessenberg form.
  qz          - QZ factorization for generalized eigenvalues.
  schur       - Schur decomposition.

Matrix functions.
  expm        - Matrix exponential.
  logm        - Matrix logarithm.
  sqrtm       - Matrix square root.
  funm        - Evaluate general matrix function.

Factorization utilities
  qrdelete    - Delete column from QR factorization.
  qrinsert    - Insert column in QR factorization.
  rsf2csf     - Real block diagonal form to complex diagonal form.
  cdf2rdf     - Complex diagonal form to real block diagonal form.
  balance     - Diagonal scaling to improve eigenvalue accuracy.
  planerot    - Given's plane rotation.
  cholupdate  - rank 1 update to Cholesky factorization.
  qrupdate    - rank 1 update to QR factorization.
```

1.14 Operators and special characters

```
Arithmetic operators.
  plus        - Plus                              +
  uplus       - Unary plus                        +
  minus       - Minus                             -
  uminus      - Unary minus                       -
  mtimes      - Matrix multiply                   *
  times       - Array multiply                   .*
  mpower      - Matrix power                      ^
  power       - Array power                      .^
  mldivide    - Backslash or left matrix divide   \
  mrdivide    - Slash or right matrix divide      /
  ldivide     - Left array divide                .\
  rdivide     - Right array divide               ./
  kron        - Kronecker tensor product         kron

Relational operators.
  eq          - Equal                            ==
  ne          - Not equal                        ~=
  lt          - Less than                         <
  gt          - Greater than                      >
  le          - Less than or equal               <=
  ge          - Greater than or equal            >=

Logical operators.
  and         - Logical AND                       &
  or          - Logical OR                        |
  not         - Logical NOT                       ~
  xor         - Logical EXCLUSIVE OR
```

```
   any         - True if any element of vector is nonzero
   all         - True if all elements of vector are nonzero

Special characters.
   colon       - Colon                              :
   paren       - Parentheses and subscripting       ( )
   paren       - Brackets                           [ ]
   paren       - Braces and subscripting            { }
   punct       - Decimal point                      .
   punct       - Structure field access             .
   punct       - Parent directory                   ..
   punct       - Continuation                       ...
   punct       - Separator                          ,
   punct       - Semicolon                          ;
   punct       - Comment                            %
   punct       - Invoke operating system command    !
   punct       - Assignment                         =
   punct       - Quote                              '
   transpose   - Transpose                          .'
   ctranspose  - Complex conjugate transpose        '
   horzcat     - Horizontal concatenation           [,]
   vertcat     - Vertical concatenation             [;]
   subsasgn    - Subscripted assignment          ( ),{ },.
   subsref     - Subscripted reference           ( ),{ },.
   subsindex   - Subscript index

Bitwise operators.
   bitand      - Bit-wise AND.
   bitcmp      - Complement bits.
   bitor       - Bit-wise OR.
   bitmax      - Maximum floating point integer.
   bitxor      - Bit-wise XOR.
   bitset      - Set bit.
   bitget      - Get bit.
   bitshift    - Bit-wise shift.

Set operators.
   union       - Set union.
   unique      - Set unique.
   intersect   - Set intersection.
   setdiff     - Set difference.
   setxor      - Set exclusive-or.
   ismember    - True for set member.

See also ARITH, RELOP, SLASH.
```


1.15 Interpolation and polynomials

```
Data interpolation.
   interp1     - 1-D interpolation (table lookup).
   interp1q    - Quick 1-D linear interpolation.
   interpft    - 1-D interpolation using FFT method.
   interp2     - 2-D interpolation (table lookup).
   interp3     - 3-D interpolation (table lookup).
   interpn     - N-D interpolation (table lookup).
   griddata    - Data gridding and surface fitting.

Spline interpolation.
   spline      - Cubic spline interpolation.
   ppval       - Evaluate piecewise polynomial.

Geometric analysis.
   delaunay    - Delaunay triangulation.
   dsearch     - Search Delaunay triagulation for nearest point.
   tsearch     - Closest triangle search.
   convhull    - Convex hull.
   voronoi     - Voronoi diagram.
   inpolygon   - True for points inside polygonal region.
   rectint     - Rectangle intersection area.
   polyarea    - Area of polygon.

Polynomials.
   roots       - Find polynomial roots.
   poly        - Convert roots to polynomial.
   polyval     - Evaluate polynomial.
   polyvalm    - Evaluate polynomial with matrix argument.
   residue     - Partial-fraction expansion (residues).
   polyfit     - Fit polynomial to data.
   polyder     - Differentiate polynomial.
   conv        - Multiply polynomials.
   deconv      - Divide polynomials.
```

1.16 Elementary sparse matrices

```
   speye       - Sparse identity matrix.
   sprand      - Sparse uniformly distributed random matrix.
   sprandn     - Sparse normally distributed random matrix.
   sprandsym   - Sparse random symmetric matrix.
   spdiags     - Sparse matrix formed from diagonals.

Full to sparse conversion.
   sparse      - Create sparse matrix.
   full        - Convert sparse matrix to full matrix.
   find        - Find indices of nonzero elements.
   spconvert   - Import from sparse matrix external format.
```

```
Working with sparse matrices.
  nnz         - Number of nonzero matrix elements.
  nonzeros    - Nonzero matrix elements.
  nzmax       - Amount of storage allocated for nonzero matrix elements.
  spones      - Replace nonzero sparse matrix elements with ones.
  spalloc     - Allocate space for sparse matrix.
  issparse    - True for sparse matrix.
  spfun       - Apply function to nonzero matrix elements.
  spy         - Visualize sparsity pattern.

Reordering algorithms.
  colmmd      - Column minimum degree permutation.
  symmmd      - Symmetric minimum degree permutation.
  symrcm      - Symmetric reverse Cuthill-McKee permutation.
  colperm     - Column permutation.
  randperm    - Random permutation.
  dmperm      - Dulmage-Mendelsohn permutation.

Linear algebra.
  eigs        - A few eigenvalues.
  svds        - A few singular values.
  luinc       - Incomplete LU factorization.
  cholinc     - Incomplete Cholesky factorization.
  normest     - Estimate the matrix 2-norm.
  condest     - 1-norm condition number estimate.
  sprank      - Structural rank.

Linear Equations (iterative methods).
  pcg         - Preconditioned Conjugate Gradients Method.
  bicg        - BiConjugate Gradients Method.
  bicgstab    - BiConjugate Gradients Stabilized Method.
  cgs         - Conjugate Gradients Squared Method.
  gmres       - Generalized Minimum Residual Method.
  qmr         - Quasi-Minimal Residual Method.

Operations on graphs (trees).
  treelayout  - Lay out tree or forest.
  treeplot    - Plot picture of tree.
  etree       - Elimination tree.
  etreeplot   - Plot elimination tree.
  gplot       - Plot graph, as in "graph theory".

Miscellaneous.
  symbfact    - Symbolic factorization analysis.
  spparms     - Set parameters for sparse matrix routines.
  spaugment   - Form least squares augmented system.
```


1.17 Specialized math functions

```
Specialized math functions.
  airy        - Airy functions.
  besselj     - Bessel function of the first kind.
  bessely     - Bessel function of the second kind.
  besselh     - Bessel functions of the third kind (Hankel function).
  besseli     - Modified Bessel function of the first kind.
  besselk     - Modified Bessel function of the second kind.
  beta        - Beta function.
  betainc     - Incomplete beta function.
  betaln      - Logarithm of beta function.
  ellipj      - Jacobi elliptic functions.
  ellipke     - Complete elliptic integral.
  erf         - Error function.
  erfc        - Complementary error function.
  erfcx       - Scaled complementary error function.
  erfinv      - Inverse error function.
  expint      - Exponential integral function.
  gamma       - Gamma function.
  gammainc    - Incomplete gamma function.
  gammaln     - Logarithm of gamma function.
  legendre    - Associated Legendre function.
  cross       - Vector cross product.

Number theoretic functions.
  factor      - Prime factors.
  isprime     - True for prime numbers.
  primes      - Generate list of prime numbers.
  gcd         - Greatest common divisor.
  lcm         - Least common multiple.
  rat         - Rational approximation.
  rats        - Rational output.
  perms       - All possible permutations.
  nchoosek    - All combinations of N elements taken K at a time.
  factorial   - Factorial function.

Coordinate transforms.
  cart2sph    - Transform Cartesian to spherical coordinates.
  cart2pol    - Transform Cartesian to polar coordinates.
  pol2cart    - Transform polar to Cartesian coordinates.
  sph2cart    - Transform spherical to Cartesian coordinates.
  hsv2rgb     - Convert hue-saturation-value colors to red-green-blue.
  rgb2hsv     - Convert red-green-blue colors to hue-saturation-value.
```

1.18 Specialized graphs

```
Specialized 2-D graphs.
  area        - Filled area plot.
  bar         - Bar graph.
  barh        - Horizontal bar graph.
  bar3        - 3-D bar graph.
  bar3h       - Horizontal 3-D bar graph.
  comet       - Comet-like trajectory.
  errorbar    - Error bar plot.
  ezplot      - Easy to use function plotter.
  ezpolar     - Easy to use polar coordinate plotter.
  feather     - Feather plot.
  fill        - Filled 2-D polygons.
  fplot       - Plot function.
  hist        - Histogram.
  pareto      - Pareto chart.
  pie         - Pie chart.
  pie3        - 3-D pie chart.
  plotmatrix  - Scatter plot matrix.
  ribbon      - Draw 2-D lines as ribbons in 3-D.
  scatter     - Scatter plot.
  stem        - Discrete sequence or "stem" plot.
  stairs      - Stairstep plot.

Contour and 2-1/2 D graphs.
  contour     - Contour plot.
  contourf    - Filled contour plot.
  contour3    - 3-D Contour plot.
  clabel      - Contour plot elevation labels.
  ezcontour   - Easy to use contour plotter.
  ezcontourf  - Easy to use filled contour plotter.
  pcolor      - Pseudocolor (checkerboard) plot.
  voronoi     - Voronoi diagram.

Specialized 3-D graphs.
  comet3      - 3-D comet-like trajectories.
  ezgraph3    - General purpose surface plotter.
  ezmesh      - Easy to use 3-D mesh plotter.
  ezmeshc     - Easy to use combination mesh/contour plotter.
  ezplot3     - Easy to use 3-D parametric curve plotter.
  ezsurf      - Easy to use 3-D colored surface plotter.
  ezsurfc     - Easy to use combination surf/contour plotter.
  meshc       - Combination mesh/contour plot.
  meshz       - 3-D mesh with curtain.
  scatter3    - 3-D scatter plot.
  stem3       - 3-D stem plot.
  surfc       - Combination surf/contour plot.
  trisurf     - Triangular surface plot.
  trimesh     - Triangular mesh plot.
  waterfall   - Waterfall plot.
```



```
Volume and vector visualization.
  vissuite    - Visualization suite.
  isosurface  - Isosurface extractor.
  isonormals  - Isosurface normals.
  isocaps     - Isosurface end caps.
  contourslice- Contours in slice planes.
  slice       - Volumetric slice plot.
  streamline  - Stream lines from 2D or 3D vector data.
  stream3     - 3D stream lines.
  stream2     - 2D stream lines.
  quiver3     - 3D quiver plot.
  quiver      - 2D quiver plot.
  coneplot    - 3D cone plot.
  subvolume   - Extract subset of volume dataset.
  reducevolume- Reduce volume dataset.
  smooth3     - Smooth 3D data.
  reducepatch - Reduce number of patch faces.
  shrinkfaces - Reduce size of patch faces.

Images display and file I/O.
  image       - Display image.
  imagesc     - Scale data and display as image.
  colormap    - Color look-up table.
  gray        - Linear gray-scale color map.
  contrast    - Gray scale color map to enhance image contrast.
  brighten    - Brighten or darken color map.
  colorbar    - Display color bar (color scale).
  imread      - Read image from graphics file.
  imwrite     - Write image to graphics file.
  imfinfo     - Information about graphics file.

Movies and animation.
  capture     - Screen capture of current figure.
  moviein     - Initialize movie frame memory.
  getframe    - Get movie frame.
  movie       - Play recorded movie frames.
  qtwrite     - Translate movie into QuickTime format (Macintosh only).
  rotate      - Rotate object about specified orgin and direction.
  frame2im    - Convert movie frame to indexed image.
  im2frame     - Convert index image into movie format.

Color related functions.
  spinmap     - Spin color map.
  rgbplot     - Plot color map.
  colstyle    - Parse color and style from string.
  ind2rgb     - Convert indexed image to RGB image.

Solid modeling.
  cylinder    - Generate cylinder.
  sphere      - Generate sphere.
  patch       - Create patch.
  surf2patch  - Convert surface data to patch data.

See also GRAPH2D, GRAPH3D.
```

1.19 Character strings

```
General.
  char        - Create character array (string).
  double      - Convert string to numeric character codes.
  cellstr     - Create cell array of strings from character array.
  blanks      - String of blanks.
  deblank     - Remove trailing blanks.
  eval        - Execute string with MATLAB expression.

String tests.
  ischar      - True for character array (string).
  iscellstr   - True for cell array of strings.
  isletter    - True for letters of the alphabet.
  isspace     - True for white space characters.

String operations.
  strcat      - Concatenate strings.
  strvcat     - Vertically concatenate strings.
  strcmp      - Compare strings.
  strncmp     - Compare first N characters of strings.
  strcmpi     - Compare strings ignoring case.
  strncmpi    - Compare first N characters of strings ignoring case.
  findstr     - Find one string within another.
  strjust     - Justify character array.
  strmatch    - Find possible matches for string.
  strrep      - Replace string with another.
  strtok      - Find token in string.
  upper       - Convert string to uppercase.
  lower       - Convert string to lowercase.

String to number conversion.
  num2str     - Convert number to string.
  int2str     - Convert integer to string.
  mat2str     - Convert matrix to eval'able string.
  str2double  - Convert string to double precision value.
  str2num     - Convert string matrix to numeric array.
  sprintf     - Write formatted data to string.
  sscanf      - Read string under format control.

Base number conversion.
  hex2num     - Convert IEEE hexadecimal to double precision number.
  hex2dec     - Convert hexadecimal string to decimal integer.
  dec2hex     - Convert decimal integer to hexadecimal string.
  bin2dec     - Convert binary string to decimal integer.
  dec2bin     - Convert decimal integer to binary string.
  base2dec    - Convert base B string to decimal integer.
  dec2base    - Convert decimal integer to base B string.

  See also STRINGS.
```


1.20 Time and dates

```
Current date and time.
  now         - Current date and time as date number.
  date        - Current date as date string.
  clock       - Current date and time as date vector.

Basic functions.
  datenum     - Serial date number.
  datestr     - String representation of date.
  datevec     - Date components.

Date functions.
  calendar    - Calendar.
  weekday     - Day of week.
  eomday      - End of month.
  datetick    - Date formatted tick labels.

Timing functions.
  cputime     - CPU time in seconds.
  tic         - Start stopwatch timer.
  toc         - Stop stopwatch timer.
  etime       - Elapsed time.
  pause       - Wait in seconds.
```

1.21 Graphical user interface tools

```
GUI functions.
  uicontrol   - Create user interface control.
  uimenu      - Create user interface menu.
  ginput      - Graphical input from mouse.
  dragrect    - Drag XOR rectangles with mouse.
  rbbox       - Rubberband box.
  selectmoveresize   - Interactively select, move, resize, or copy objects.
  waitforbuttonpress - Wait for key/buttonpress over figure.
  waitfor     - Block execution and wait for event.
  uiwait      - Block execution and wait for resume.
  uiresume    - Resume execution of blocked M-file.
  uistack     - Control stacking order of objects.
  uisuspend   - Suspend the interactive state of a figure.
  uirestore   - Restore the interactive state of a figure.

GUI design tools.
  guide       - Design GUI.
  align       - Align uicontrols and axes.
  cbedit      - Edit callback.
  menuedit    - Edit menu.
  propedit    - Edit property.
```

```
Dialog boxes.
  dialog      - Create dialog figure.
  axlimdlg    - Axes limits dialog box.
  errordlg    - Error dialog box.
  helpdlg     - Help dialog box.
  inputdlg    - Input dialog box.
  listdlg     - List selection dialog box.
  menu        - Generate menu of choices for user input.
  msgbox      - Message box.
  questdlg    - Question dialog box.
  warndlg     - Warning dialog box.
  uigetfile   - Standard open file dialog box.
  uiputfile   - Standard save file dialog box.
  uisetcolor  - Color selection dialog box.
  uisetfont   - Font selection dialog box.
  pagedlg      - Page position dialog box.
  pagesetupdlg- Page setup dialog.
  printdlg    - Print dialog box.
  waitbar     - Display wait bar.
  printpreview- Display preview of figure to be printed.

Menu utilities.
  makemenu    - Create menu structure.
  menubar     - Computer dependent default setting for MenuBar property.
  umtoggle    - Toggle "checked" status of uimenu object.
  winmenu     - Create submenu for "Window" menu item.

Toolbar button group utilities.
  btngroup    - Create toolbar button group.
  btnstate    - Query state of toolbar button group.
  btnpress    - Button press manager for toolbar button group.
  btndown     - Depress button in toolbar button group.
  btnup       - Raise button in toolbar button group.

Preferences.
  addpref     - Add preference.
  getpref     - Get preference.
  rmpref      - Remove preference.
  setpref     - Set preference.

Miscellaneous utilities.
  allchild    - Get all object children.
  findall     - Find all objects.
  hidegui     - Hide/unhide GUI.
  edtext      - Interactive editing of axes text objects.
  findfigs    - Find figures positioned off screen.
  getstatus   - Get status text string in figure.
  setstatus   - Set status text string in figure.
  popupstr    - Get popup menu selection string.
  remapfig    - Transform figure objects' positions.
  setptr      - Set figure pointer.
  getptr      - Get figure pointer.
  overobj     - Get handle of object the pointer is over.
```



```
  uiclearmode - Clears the currently active interactive mode.
```

1.22 Windows Operating System Interface Files (DDE/ActiveX)

```
ActiveX Client Functions.
  actxcontrol    - Create an ActiveX control.
  actxserver     - Create an ActiveX server.
  winfun\activex - ActiveX class.

ActiveX Demos.
  mwsamp      - Sample activex control creation.
  sampev      - Sample event handler for ActiveX server.

DDE Client Functions.
  ddeadv      - Set up advisory link.
  ddeexec     - Send string for execution.
  ddeinit     - Initiate DDE conversation.
  ddepoke     - Send data to application.
  ddereq      - Request data from application.
  ddeterm     - Terminate DDE conversation.
  ddeunadv    - Release advisory link.
```

2. CONTROL SYSTEM TOOLBOX

```
Version 4.2 (R11)  15-Jul-1998

What's new.
  Readme      - New features and enhancements in this version.

Creation of LTI models.
  tf          - Create a transfer function model.
  zpk         - Create a zero/pole/gain model.
  ss          - Create a state-space model.
  dss         - Create a descriptor state-space model.
  frd         - Create a frequency response data model.
  filt        - Specify a digital filter.
  set         - Set/modify properties of LTI models.
  ltimodels   - Detailed help on various types of LTI models.
  ltiprops    - Detailed help on available LTI properties.

Data extraction.
  tfdata      - Extract numerator(s) and denominator(s).
  zpkdata     - Extract zero/pole/gain data.
  ssdata      - Extract state-space matrices.
  dssdata     - Descriptor version of SSDATA.
  frdata      - Extract frequency response data.
  get         - Access values of LTI model properties.

Model dimensions and characteristics.
  class       - Model type ('tf', 'zpk', 'ss', or 'frd').
  isa         - Test if LTI model is of given type.
  size        - Model sizes and order.
  ndims       - Number of dimensions.
  isempty     - True for empty LTI models.
  isct        - True for continuous-time models.
  isdt        - True for discrete-time models.
  isproper    - True for proper LTI models.
  issiso      - True for single-input/single-output models.
  reshape     - Reshape array of LTI models.

Conversions.
  tf          - Conversion to transfer function.
  zpk         - Conversion to zero/pole/gain.
  ss          - Conversion to state space.
  frd         - Conversion to frequency data.
  chgunits    - Change units of FRD model frequency points.
  c2d         - Continuous to discrete conversion.
  d2c         - Discrete to continuous conversion.
  d2d         - Resample discrete-time model.

Overloaded arithmetic operations.
  + and -     - Add and subtract LTI systems (parallel connection).
  *           - Multiply LTI systems (series connection).
  \           - Left divide -- sys1\sys2 means inv(sys1)*sys2.
```



```
  /           - Right divide -- sys1/sys2 means sys1*inv(sys2).
  ^           - LTI model powers.
  '           - Pertransposition.
  .'          - Transposition of input/output map.
  [..]        - Concatenate LTI models along inputs or outputs.
  stack       - Stack LTI models/arrays along some array dimension.
  inv         - Inverse of an LTI system.

Model dynamics.
  pole, eig   - System poles.
  zero        - System (transmission) zeros.
  pzmap       - Pole-zero map.
  dcgain      - D.C. (low frequency) gain.
  norm        - Norms of LTI systems.
  covar       - Covariance of response to white noise.
  damp        - Natural frequency and damping of system poles.
  esort       - Sort continuous poles by real part.
  dsort       - Sort discrete poles by magnitude.

Time delays.
  hasdelay    - True for models with time delays.
  totaldelay  - Total delay between each input/output pair.
  delay2z     - Replace delays by poles at z=0 or FRD phase shift.
  pade        - Pade approximation of time delays.

State-space models.
  rss,drss    - Random stable state-space models.
  ss2ss       - State coordinate transformation.
  canon       - State-space canonical forms.
  ctrb, obsv  - Controllability and observability matrices.
  gram        - Controllability and observability gramians.
  ssbal       - Diagonal balancing of state-space realizations.
  balreal     - Gramian-based input/output balancing.
  modred      - Model state reduction.
  minreal     - Minimal realization and pole/zero cancellation.
  sminreal    - Structurally minimal realization.

Time response.
  ltiview     - Response analysis GUI (LTI Viewer).
  step        - Step response.
  impulse     - Impulse response.
  initial     - Response of state-space system with given initial state.
  lsim        - Response to arbitrary inputs.
  gensig      - Generate input signal for LSIM.
  stepfun     - Generate unit-step input.

Frequency response.
  ltiview     - Response analysis GUI (LTI Viewer).
  bode        - Bode plot of the frequency response.
  sigma       - Singular value frequency plot.
  nyquist     - Nyquist plot.
  nichols     - Nichols chart.
  margin      - Gain and phase margins.
  freqresp    - Frequency response over a frequency grid.
```

```
   evalfr      - Evaluate frequency response at given frequency.

System interconnections.
   append      - Group LTI systems by appending inputs and outputs.
   parallel    - Generalized parallel connection (see also overloaded +).
   series      - Generalized series connection (see also overloaded *).
   feedback    - Feedback connection of two systems.
   lft         - Generalized feedback interconnection (Redheffer star product).
   connect     - Derive state-space model from block diagram description.

Classical design tools.
   rltool      - Root locus design GUI
   rlocus      - Evans root locus.
   rlocfind    - Interactive root locus gain determination.
   acker       - SISO pole placement.
   place       - MIMO pole placement.
   estim       - Form estimator given estimator gain.
   reg         - Form regulator given state-feedback and estimator gains.

LQG design tools.
   lqr,dlqr    - Linear-quadratic (LQ) state-feedback regulator.
   lqry        - LQ regulator with output weighting.
   lqrd        - Discrete LQ regulator for continuous plant.
   kalman      - Kalman estimator.
   kalmd       - Discrete Kalman estimator for continuous plant.
   lqgreg      - Form LQG regulator given LQ gain and Kalman estimator.
   augstate    - Augment output by appending states.

Matrix equation solvers.
   lyap        - Solve continuous Lyapunov equations.
   dlyap       - Solve discrete Lyapunov equations.
   care        - Solve continuous algebraic Riccati equations.
   dare        - Solve discrete algebraic Riccati equations.

Demonstrations.
   ctrldemo    - Introduction to the Control System Toolbox.
   jetdemo     - Classical design of jet transport yaw damper.
   diskdemo    - Digital design of hard-disk-drive controller.
   milldemo    - SISO and MIMO LQG control of steel rolling mill.
   kalmdemo    - Kalman filter design and simulation.
Version 2.0.1 (R11)  16-Sep-1998

GUI editors
   anfisedit   - ANFIS training and testing UI tool.
   Findcluster - Clustering UI tool.
   fuzzy       - Basic FIS editor.
   mfedit      - Membership function editor.
   ruleedit    - Rule editor and parser.
   ruleview    - Rule viewer and fuzzy inference diagram.
   surfview    - Output surface viewer.

Membership functions.
   dsigmf      - Difference of two sigmoid membership functions.
   gauss2mf    - Two-sided Gaussian curve membership function.
```



```
   gaussmf     - Gaussian curve membership function.
   gbellmf     - Generalized bell curve membership function.
   pimf        - Pi-shaped curve membership function.
   psigmf      - Product of two sigmoid membership functions.
   smf         - S-shaped curve membership function.
   sigmf       - Sigmoid curve membership function.
   trapmf      - Trapezoidal membership function.
   trimf       - Triangular membership function.
   zmf         - Z-shaped curve membership function.

Command line FIS functions
   addmf       - Add membership function to FIS
   addrule     - Add rule to FIS.
   addvar      - Add variable to FIS.
   defuzz      - Defuzzify membership function.
   evalfis     - Perform fuzzy inference calculation.
   evalmf      - Generic membership function evaluation.
   gensurf     - Generate FIS output surface.
   getfis      - Get fuzzy system properties.
   mf2mf       - Translate parameters between functions.
   newfis      - Create new FIS.
   parsrule    - Parse fuzzy rules.
   plotfis     - Display FIS input-output diagram.
   plotmf      - Display all membership functions for one variable.
   readfis     - Load FIS from disk.
   rmmf        - Remove membership function from FIS.
   rmvar       - Remove variable from FIS.
   setfis      - Set fuzzy system properties.
   showfis     - Display annotated FIS.
   showrule    - Display FIS rules.
   writefis    - Save FIS to disk.

Advanced techniques
   anfis       - Training routine for Sugeno-type FIS (MEX only).
   fcm         - Find clusters with fuzzy c-means clustering.
   genfis1     - Generate FIS matrix using generic method.
   genfis2     - Generate FIS matrix using subtractive clustering.
   subclust    - Estimate cluster centers with subtractive clustering.

Miscellaneous functions
   convertfis  - Convert v1.0 fuzzy matrix to v2.0 fuzzy structure.
   discfis     - Discretize a fuzzy inference system.
   evalmmf     - For multiple membership functions evaluation.
   fstrvcat    - Concatenate matrices of varying size.
   fuzarith    - Fuzzy arithmatic function.
   findrow     - Find the rows of a matrix that match the input string.
   genparam    - Generates initial premise parameters for ANFIS learning.
   probor      - Probabilistic OR.
   sugmax      - Maximum output range for a Sugeno system.

GUI helper files
   cmfdlg      - Add customized membership function dialog.
   cmthdlg     - Add customized inference method dialog.
   fisgui      - Generic GUI handling for the Fuzzy Logic Toolbox
```

```
    gfmfdlg     - Generate fis using grid partition method dialog.
    mfdlg       - Add membership function dialog.
    mfdrag      - Drag membership functions using mouse.
    popundo     - Pull the last change off the undo stack.
    pushundo    - Push the current FIS data onto the undo stack.
    savedlg     - Save before closing dialog.
    statmsg     - Display messages in a status field.
    updtfis     - Update Fuzzy Logic Toolbox GUI tools.
    wsdlg       - Open from/save to workspace dialog.


fuzzy is both a directory and a function.

 FUZZY  Basic FIS editor.
    The FIS Editor displays high-level information about a
    Fuzzy Inference System. At the top is a diagram of the
    system with each input and output clearly labeled. By
    double-clicking on the input or output boxes, you can bring
    up the Membership Function Editor. Double-clicking on the
    fuzzy rule box in the center of the diagram will bring up
    the Rule Editor.

    Just below the diagram is a text field that displays the
    name of the current FIS. In the lower left of the window are
    a series of popup menus that allow you to specify the various
    functions used in the fuzzy implication process. In the lower
    right are fields that provide information about the current
    variable. The current variable is determined by clicking once
    on one of the input or output boxes.

    See also MFEDIT, RULEEDIT, RULEVIEW, SURFVIEW, ANFISEDIT.
```


3. LOCAL

```
Preferences.

  Saved preferences files.
    startup     - User startup M-file.
    finish      - User finish M-file.
    matlabrc    - Master startup M-file.
    pathdef     - Search path defaults.
    docopt      - Web browser defaults.
    printopt    - Printer defaults.

  Preference commands.
    cedit       - Set command line editor keys.
    terminal    - Set graphics terminal type.

  Configuration information.
    hostid      - MATLAB server host identification number.
    license     - License number.
    version     - MATLAB version number.
  Version 1.1.3 (R11) 10-Aug-1998

  Dialog Box Managers.
    coneddlg    - Manages a dialog box for the NCD Blockset Constraint editor.
    paramdlg    - Manages a dialog box for NCD Blockset Optimization Parameters.
    rangedlg    - Manages a dialog box for Axes Ranges.
    refdlg      - Manages a dialog box for NCD Blockset Reference Signal.
    stepdlg     - Manages a dialog box for NCD Step Response.
    uncerdlg    - Manages a dialog box for NCD Blockset Uncertain Variables.

  Main interface.
    contrncd    - Creates the uicontrols for the NCD Blockset constraint figure.
    menuncd     - Creates the uimenus for the NCD Blockset constraint figure.
    ncdblock    - SIMULINK system containing the NCD block.
    rmsblock    - SIMULINK system with continuous and discrete RMS value blocks.
    slblocks    - Defines the block library for NCD Blockset.
    optblock    - Script which opens an NCD Blockset figure.
    optfig      - Creates an NCD Blockset constraint figure.

  Main optimization.
    initresp    - Plots the initial response of the Simulink Model.
    costfun     - Cost function for NCD Blockset optimization.
    gradfun     - Gradient of the Cost function for NCD Blockset optimization.
    nlinopt     - Runs the optimization algorithm.
    copymdl     - Creates an augmented SL model, used in gradient finding.
    tvarset     - S-function to set the tunable parameters.

  Demonstrations.
    ncddemo     - SIMULINK system containing all NCD Blockset demos.
    ncddemo1    - PID Controller.
    ncddemo2    - LQR with Feedforward Controller.
    ncddemo3    - MIMO PI Controller.
```

```
  ncddemo4    - Inverted Pendulum.
  rmsdemo     - SIMULINK system demo for using the RMS blocks.

Tutorials.
  ncdtut1     - Control Design Example.
  ncdtut2     - System Identification Example.
  ncdtut2old  - Old System Identification Example.

Demonstration and Tutorial Utilities.
  ncd1init    - Setup for optimization of ncddemo1.
  ncd2init    - Setup for optimization of ncddemo2.
  ncd3init    - Setup for optimization of ncddemo3.
  ncd4init    - Setup for optimization of ncddemo4.
  penddata    - Setup for ncdtut2.
  ncdtut2old.mat - Data for ncdtut2old.

Interface Utilities.
  bdncd       - NCD Blockset WindowButtonDownFcn.
  bmncd       - NCD Blockset WindowButtonMotionFcn
  buncd       - NCD Blockset WindowButtonUpFcn.
  curobj      - Provides information about what is under CurrentPoint.
  dividecb    - Divides constraint bounds in two.
  delline     - Deletes all plots from the NCD figure.
  donep       - Callback for the Close pushbutton and menu.
  errorncd    - Manages commonly generated NCD errors.  Calls errordlg.
  fillaxes    - Creates the constraint bounds and does some data checking.
  keyncd      - NCD Blockset KeyPressFcn.
  loado       - Loads and displays NCD Blockset data.
  makesurf    - Creates and constraint bound surface and patch.
  snapncd     - Snaps constraint bar in 22.5 degree increments.
  refresho    - Makes the constraint matrix consistent with figure.
  saveload    - True if file is selected from SELECTFILE.
  texted      - Callback for Port editable text.
  undoncd     - Undoes the last NCD Blockset GUI operation.
  updatdlg    - Updates the NCD dialog boxes.

Optimization Utilities.
  convertm    - Converts constraint matrix into optimization format.
  minipars    - Miniparser for the NCD Blockset.
  montevar    - Initializes Monte Carlo simulations.
  ncdglob     - Defines NCD global variables.
  str2mat2    - Converts one row string into multi-row string.

Help text files (.hlp extension)
  ncdhelp     - Driver to pop up the NCD Blockset Help windows.
  hotkey      - Hot-key help
  mainncd     - General NCD help
  paramdlg    - Help on Optimization Parameters dialog box
  readncd     - Contains same info as Readme.m
  stepdlg     - Help on Step Response dialog box
  uncerdlg    - Help on Uncertain Variables dialog box
```


4. SIGNAL PROCESSING TOOLBOX

```
Version 4.3   (R11.1) 01-June-1999

What's new.
  Readme      - New features, bug fixes, and changes in this version.

Filter analysis and implementation.
  abs         - Magnitude.
  angle       - Phase angle.
  conv        - Convolution.
  fftfilt     - Overlap -add filter implementation.
  filter      - Filter implementation.
  filtfilt    - Zero -phase version of filter.
  filtic      - Determine filter initial conditions.
  freqs       - Laplace transform frequency response.
  freqspace   - Frequency spacing for frequency response.
  freqz       - Z -transform frequency response.
  freqzplot   - Plot frequency response data.
  grpdelay    - Group delay.
  impz        - Impulse response (discrete).
  latcfilt    - Lattice filter implementation.
  sgolayfilt  - Savitzky -Golay filter implementation.
  sosfilt     - Second -order sections (biquad) filter implementation.
  unwrap      - Unwrap phase.
  upfirdn     - Up sample, FIR filter, down sample.
  zplane      - Discrete pole -zero plot.

FIR filter design.
  convmtx     - Convolution matrix.
  cremez      - Complex and nonlinear phase equiripple FIR filter design.
  fir1        - Window based FIR filter design  - low, high, band, stop, multi.
  fir2        - Window based FIR filter design  - arbitrary response.
  fircls      - Constrained Least Squares filter design  - arbitrary response.
  fircls1     - Constrained Least Squares FIR filter design  - low and highpass.
  firls       - FIR filter design  - arbitrary response with transition bands.
  firrcos     - Raised cosine FIR filter design.
  intfilt     - Interpolation FIR filter design.
  kaiserord   - Window based filter order selection using Kaiser window.
  remez       - Parks -McClellan optimal FIR filter design.
  remezord    - Parks -McClellan filter order selection.
  sgolay      - Savitzky -Golay FIR smoothing filter design.

IIR digital filter design.
  butter      - Butterworth filter design.
  cheby1      - Chebyshev type I filter design.
  cheby2      - Chebyshev type II filter design.
  ellip       - Elliptic filter design.
  maxflat     - Generalized Butterworth lowpass filter design.
  yulewalk    - Yule -Walker filter design.

IIR filter order selection.
```

```
  buttord     - Butterworth filter order selection.
  cheb1ord    - Chebyshev type I filter order selection.
  cheb2ord    - Chebyshev type II filter order selection.
  ellipord    - Elliptic filter order selection.

Analog lowpass filter prototypes.
  besselap    - Bessel filter prototype.
  buttap      - Butterworth filter prototype.
  cheb1ap     - Chebyshev type I filter prototype (passband ripple).
  cheb2ap     - Chebyshev type II filter prototype (stopband ripple).
  ellipap     - Elliptic filter prototype.

Frequency translation.
  lp2bp       - Lowpass to bandpass analog filter transformation.
  lp2bs       - Lowpass to bandstop analog filter transformation.
  lp2hp       - Lowpass to highpass analog filter transformation.
  lp2lp       - Lowpass to lowpass analog filter transformation.

Filter discretization.
  bilinear    - Bilinear transformation with optional prewarping.
  impinvar    - Impulse invariance analog to digital conversion.

Linear system transformations.
  latc2tf     - Lattice or lattice ladder to transfer function conversion.
  residuez    - Z -transform partial fraction expansion.
  sos2ss      - Second -order sections to state -space conversion.
  sos2tf      - Second -order sections to transfer function conversion.
  sos2zp      - Second -order sections to zero -pole conversion.
  ss2sos      - State -space to second -order sections conversion.
  ss2tf       - State -space to transfer function conversion.
  ss2zp       - State -space to zero -pole conversion.
  tf2latc     - Transfer function to lattice or lattice ladder conversion.
  tf2sos      - Transfer Function to second -order sections conversion.
  tf2ss       - Transfer function to state -space conversion.
  tf2zp       - Transfer function to zero -pole conversion.
  zp2sos      - Zero -pole to second -order sections conversion.
  zp2ss       - Zero -pole to state -space conversion.
  zp2tf       - Zero -pole to transfer function conversion.

Windows.
  bartlett    - Bartlett window.
  blackman    - Blackman window.
  boxcar      - Rectangular window.
  chebwin     - Chebyshev window.
  hamming     - Hamming window.
  hann        - Hanning window.
  kaiser      - Kaiser window.
  triang      - Triangular window.

Transforms.
  czt         - Chirp -z transform.
  dct         - Discrete cosine transform.
  dftmtx      - Discrete Fourier transform matrix.
  fft         - Fast Fourier transform.
```



```
  fftshift    - Swap vector halves.
  hilbert     - Hilbert transform.
  idct        - Inverse discrete cosine transform.
  ifft        - Inverse fast Fourier transform.

Statistical signal processing and spectral analysis.
  cohere      - Coherence function estimate.
  corrcoef    - Correlation coefficients.
  corrmtx     - Autocorrelation matrix.
  cov         - Covariance matrix.
  csd         - Cross Spectral Density.
  pcov        - Power Spectral Density estimate via Covariance method.
  peig        - Power Spectral Density estimate via the Eigenvector method.
  pmcov       - Power Spectral Density estimate via the Modified Covariance
                method.
  pburg       - Power Spectral Density estimate via Burg's method.
  periodogram - Power Spectral Density estimate via periodogram method.
  pmtm        - Power Spectral Density estimate via the Thomson multitaper
                method.
  pmusic      - Power Spectral Density estimate via MUSIC method.
  psdplot     - Plot Power Spectral Density   data.
  pyulear     - Power Spectral Density estimate via the Yule -Walker AR Method.
  pwelch      - Power Spectral Density estimate via Welch's method.
  rooteig     - Computes the frequencies and powers of sinusoids via the
                eigenvector algorithm.
  rootmusic   - Computes the frequencies and powers of sinusoids via the
                MUSIC algorithm.
  spectrum    - psd, csd, cohere and tfe combined.
  tfe         - Transfer function estimate.
  xcorr       - Cross -correlation function.
  xcov        - Covariance function.

Parametric modeling.
  arburg      - AR parametric modeling via Burg's method.
  arcov       - AR parametric modeling via covariance method.
  armcov      - AR parametric modeling via modified covariance method.
  aryule      - AR parametric modeling via the Yule -Walker method.
  ident       - See the System Identification Toolbox.
  invfreqs    - Analog filter fit to frequency response.
  invfreqz    - Discrete filter fit to frequency response.
  prony       - Prony's discrete filter fit to time response.
  stmcb       - Steiglitz -McBride iteration for ARMA modeling.

Linear Prediction.
  ac2rc       - Autocorrelation sequence to reflection coefficients conversion.
  ac2poly     - Autocorrelation sequence to prediction polynomial conversion.
  is2rc       - Inverse sine parameters to reflection coefficients conversion.
  lar2rc      - Log area ratios to reflection coefficients conversion.
  levinson    - Levinson -Durbin recursion.
  lpc         - Linear Predictive Coefficients using autocorrelation method.
  lsf2poly    - Line spectral frequencies to prediction polynomial conversion.
  poly2ac     - Prediction polynomial to autocorrelation sequence conversion.
  poly2lsf    - Prediction polynomial to line spectral frequencies conversion.
  poly2rc     - Prediction polynomial to reflection coefficients conversion.
```

```
  rc2ac       - Reflection coefficients to autocorrelation sequence conversion.
  rc2is       - Reflection coefficients to inverse sine parameters conversion.
  rc2lar      - Reflection coefficients to log area ratios conversion.
  rc2poly     - Reflection coefficients to prediction polynomial conversion.
  rlevinson   - Reverse Levinson -Durbin recursion.
  schurrc     - Schur algorithm.

Waveform generation.
  chirp       - Swept -frequency cosine generator.
  diric       - Dirichlet (periodic sinc) function.
  gauspuls    - Gaussian pulse generator.
  pulstran    - Pulse train generator.
  rectpuls    - Sampled aperiodic rectangle generator.
  sawtooth    - Sawtooth function.
  sinc        - Sinc or sin(pi*x)/(pi*x) function
  square      - Square wave function.
  tripuls     - Sampled aperiodic triangle generator.

Audio support.
  auread      - Read NeXT/SUN (".au") sound file.
  auwrite     - Write NeXT/SUN (".au") sound file.
  sound       - Play vector as sound.
  soundsc     - Autoscale and play vector as sound.
  wavplay     - Play sound using Windows audio output device.
  wavread     - Read Microsoft WAVE (".wav") sound file.
  wavrecord   - Record sound using Windows audio input device.
  wavwrite    - Write Microsoft WAVE (".wav") sound file.

Specialized operations.
  cceps       - Complex cepstrum.
  decimate    - Resample data at a lower sample rate.
  deconv      - Deconvolution.
  demod       - Demodulation for communications simulation.
  dpss        - Discrete prolate spheroidal sequences (Slepian sequences).
  dpssclear   - Remove discrete prolate spheroidal sequences from database.
  dpssdir     - Discrete prolate spheroidal sequence database directory.
  dpssload    - Load discrete prolate spheroidal sequences from database.
  dpsssave    - Save discrete prolate spheroidal sequences in database.
  interp      - Resample data at a higher sample rate.
  interp1     - General 1 -D interpolation. (MATLAB Toolbox)
  medfilt1    - 1 -Dimensional median filtering.
  modulate    - Modulation for communications simulation.
  rceps       - Real cepstrum and minimum phase reconstruction.
  resample    - Resample sequence with new sampling rate.
  specgram    - Spectrogram, for speech signals.
  spline      - Cubic spline interpolation.
  udecode     - Uniform decoding of the input.
  uencode     - Uniform quantization and encoding of the input into N -bits
  vco         - Voltage controlled oscillator.

Other.
  besself     - Bessel analog filter design.
  buffer      - Buffer a signal vector into a matrix of data frames.
  conv2       - 2 -D convolution.
```



```
  cplxpair    - Order vector into complex conjugate pairs.
  eqtflength  - Equalize the length of a discrete-time transfer function.
  fft2        - 2 -D fast Fourier transform.
  ifft2       - Inverse 2 -D fast Fourier transform.
  polystab    - Polynomial stabilization.
  seqperiod   - Find minimum -length repeating sequence in a vector.
  stem        - Plot discrete data sequence.
  strips      - Strip plot.
  xcorr2      - 2 -D cross -correlation.

See also SIGGUI, SIGDEMOS.
```

5. SIMULINK

```
Version 3.0 (R11) 01-Sep-1998

Model analysis and construction functions.

Simulation.
  sim           - Simulate a Simulink model.
  sldebug       - Debug a Simulink model.
  simset        - Define options to SIM Options structure.
  simget        - Get SIM Options structure

Linearization and trimming.
  linmod        - Extract linear model from continuous-time system.
  linmod2       - Extract linear model, advanced method.
  dlinmod       - Extract linear model from discrete-time system.
  trim          - Find steady-state operating point.

Model Construction.
  close_system  - Close open model or block.
  new_system    - Create new empty model window.
  open_system   - Open existing model or block.
  load_system   - Load existing model without making model visible.
  save_system   - Save an open model.
  add_block     - Add new block.
  add_line      - Add new line.
  delete_block  - Remove block.
  delete_line   - Remove line.
  find_system   - Search a model.
  replace_block - Replace existing blocks with a new block.
  set_param     - Set parameter values for model or block.
  get_param     - Get simulation parameter values from model.
  bdclose       - Close a Simulink window.
  bdroot        - Root level model name.
  gcb           - Get the name of the current block.
  gcbh          - Get the handle of the current block.
  gcs           - Get the name of the current system.
  getfullname   - get the full path name of a block
  slupdate      - Update older 1.x models to 3.x.
  addterms      - Add terminators to unconnected ports.
  bool          - Convert numeric array to boolean.

Masking.
  hasmask       - Check for mask.
  hasmaskdlg    - Check for mask dialog.
  hasmaskicon   - Check for mask icon.
  iconedit      - Design block icons using ginput function.
  maskpopups    - Return and change masked block's popup menu items.
  movemask      - Restructure masked built-in blocks as masked subsystems.

Library.
  libinfo       - Get library information for a system.
```



```
Hardcopy and printing.
  frameedit     - Edit print frames for annotated model printouts.
  print         - Print graph or Simulink system; or save graph to M-file.
  printopt      - Printer defaults.
  orient        - Set paper orientation.

See also BLOCKS and SIMDEMOS.
```