ZUSAMMENFASSUNG UND KURZBESCHREIBUNG ALLER MATLAB-BEFEHLE VERSION 6.5

(und wichtiger Toolboxen)

Versionen:

MATLAB	Version 6.5
Signal Processing Toolbox	Version 6.0
Simulink	Version 5.0
Optimization Toolbox	Version 2.2

Inhaltsverzeichnis:

1. MATLAB

1.1 General purpose commands

```
General information
  helpbrowser - Bring up the help browser.
  doc         - Complete on-line help, displayed in the help browser.
  help        - M-file help, displayed at the command line.
  helpwin     - M-file help, displayed in the help browser.
  lookfor     - Search all M-files for keyword.
  syntax      - Help on MATLAB command syntax.
  support     - Open MathWorks Technical Support Web Page.
  demo        - Run demonstrations.
  ver         - MATLAB, SIMULINK, and toolbox version information.
  version     - MATLAB version information.
  whatsnew    - Access Release Notes.

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.
  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.
  rehash      - Refresh function and file system caches.
  import      - Import Java packages into the current scope.

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.
  beep        - Produce beep sound.
```

```
Operating system commands
  cd          - Change current working directory.
  copyfile    - Copy a file or directory.
  movefile    - Move a file or directory.
  delete      - Delete file.
  pwd         - Show (print) current working directory.
  dir         - List directory.
  fileattrib  - Get or set attributes of files and directories.
  isdir       - True if argument is a directory.
  mkdir       - Make directory.
  rmdir       - Remove directory.
  getenv      - Get environment variable.
  !           - Execute operating system command (see PUNCT).
  dos         - Execute DOS command and return result.
  unix        - Execute UNIX command and return result.
  system      - Execute system command and return result.
  perl        - Execute Perl command and return result.
  web         - Open Web browser on site or files.
  computer    - Computer type.
  isunix      - True for the UNIX version of MATLAB.
  ispc        - True for the PC (Windows) version of MATLAB.

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.
  profreport  - Generate profile report.

Tools to locate dependent functions of an M-file.
  depfun      - Locate dependent functions of an m-file.
  depdir      - Locate dependent directories of an m-file.
  inmem       - List functions in memory.

See also PUNCT.
```

1.2 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.
               Short-circuit logical AND        &&
               Short-circuit logical OR         ||
  and        - Element-wise logical AND          &
  or         - Element-wise 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      - Function handle creation          @
  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, FUNCTION_HANDLE.
```

1.3 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.
    continue      - Pass control to the next iteration of FOR or WHILE 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.
    error         - Display error message and abort function.
    rethrow       - Reissue error and abort 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.
  isvarname     - Check for a valid variable name.
  iskeyword     - Check if input is a keyword.
  namelengthmax - Maximum length of a MATLAB name.

Argument handling.
  nargchk       - Validate number of input arguments.
  nargoutchk    - Validate number of output 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.
  warning       - Display warning message.
  lasterr       - Last error message.
  lasterror     - Last error message and related information.
  lastwarn      - Last warning message.
  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.
```

1.4 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.
  freqspace   - Frequency spacing for frequency response.
  meshgrid    - X and Y arrays for 3-D plots.
  :           - Regularly spaced vector and index into matrix.

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

Matrix manipulation.
  cat         - Concatenate arrays.
  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.

Multi-dimensional array functions.
  ndgrid      - Generate arrays for N-D functions and interpolation.
  permute     - Permute array dimensions.
  ipermute    - Inverse permute array dimensions.
  shiftdim    - Shift dimensions.
  circshift   - Shift array circularly.
  squeeze     - Remove singleton dimensions.
```

```
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.
  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.
```

1.5 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.
  realpow     - Power that will error out on complex result.
  reallog     - Natural logarithm of real number.
  realsqrt    - Square root of number greater than or equal to zero.
  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.
```

1.6 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.
  psi         - Psi (polygamma) function.
  legendre    - Associated Legendre function.
  cross       - Vector cross product.
  dot         - Vector dot 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.
```

1.7 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.
```

```
  rcond       - LAPACK reciprocal condition estimator
  cond        - Condition number with respect to inversion.
  condest     - 1-norm condition number estimate.
  normest1    - 1-norm 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 singular 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 a column or row from QR factorization.
  qrinsert    - Insert a column or row into 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    - Givens plane rotation.
  cholupdate  - rank 1 update to Cholesky factorization.
  qrupdate    - rank 1 update to QR factorization.
```

1.8 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 zero-frequency component to center of spectrum.
  ifftshift   - Inverse FFTSHIFT.
```

1.9 Audio support

```
Audio input/output objects.
  audioplayer   - Windows audio player object.
  audiorecorder - Windows audio recorder object.

Audio hardware drivers.
  sound         - Play vector as sound.
  soundsc       - Autoscale and play vector as sound.
  wavplay       - Play sound using Windows audio output device.
  wavrecord     - Record sound using Windows audio input device.

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

Utilities.
  lin2mu        - Convert linear signal to mu-law encoding.
  mu2lin        - Convert mu-law encoding to linear signal.

Example audio data (MAT files).
  chirp         - Frequency sweeps          (1.6 sec, 8192 Hz)
  gong          - Gong                      (5.1 sec, 8192 Hz)
  handel        - Hallelujah chorus         (8.9 sec, 8192 Hz)
  laughter      - Laughter from a crowd     (6.4 sec, 8192 Hz)
  splat         - Chirp followed by a splat (1.2 sec, 8192 Hz)
  train         - Train whistle             (1.5 sec, 8192 Hz)
```

1.10 Interpolation and polynomials

```
Data interpolation.
  pchip       - Piecewise cubic Hermite interpolating polynomial.
  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.
  griddata3     - Data gridding and hyper-surface fitting for 3-dimensional
data.
  griddatan   - Data gridding and hyper-surface fitting (dimension >= 2).

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

Geometric analysis.
  delaunay    - Delaunay triangulation.
```

```
  delaunay3   - 3-D Delaunay tessellation.
  delaunayn   - N-D Delaunay tessellation.
  dsearch     - Search Delaunay triangulation for nearest point.
  dsearchn    - Search N-D Delaunay tessellation for nearest point.
  tsearch     - Closest triangle search.
  tsearchn    - N-D closest triangle search.
  convhull    - Convex hull.
  convhulln   - N-D convex hull.
  voronoi     - Voronoi diagram.
  voronoin    - N-D 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.
  polyint     - Integrate polynomial analytically.
  conv        - Multiply polynomials.
  deconv      - Divide polynomials.
```

1.11 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.
  quadl      - Numerically evaluate integral, higher order method.
  dblquad    - Numerically evaluate double integral.
  triplequad - Numerically evaluate triple integral.

Plotting.
  ezplot     - Easy to use function plotter.
  ezplot3    - Easy to use 3-D parametric curve plotter.
  ezpolar    - Easy to use polar coordinate plotter.
  ezcontour  - Easy to use contour plotter.
  ezcontourf - Easy to use filled contour plotter.
  ezmesh     - Easy to use 3-D mesh plotter.
```

```
    ezmeshc    - Easy to use combination mesh/contour plotter.
    ezsurf     - Easy to use 3-D colored surface plotter.
    ezsurfc    - Easy to use combination surf/contour 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.

  Differential equation solvers.
  Initial value problem solvers for ODEs. (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 ODEs and DAEs Index 1, trapezoidal rule.
    ode15s     - Solve stiff ODEs and DAEs Index 1, variable order method.
    ode23s     - Solve stiff differential equations, low order method.
    ode23tb    - Solve stiff differential equations, low order method.

  Initial value problem solvers for delay differential equations (DDEs).
    dde23      - Solve delay differential equations (DDEs) with constant delays.

  Boundary value problem solver for ODEs.
    bvp4c      - Solve two-point boundary value problems for ODEs by collocation.

  1D Partial differential equation solver.
    pdepe      - Solve initial-boundary value problems for parabolic-elliptic
PDEs.

  Option handling.
    odeset     - Create/alter ODE OPTIONS structure.
    odeget     - Get ODE OPTIONS parameters.
    ddeset     - Create/alter DDE OPTIONS structure.
    ddeget     - Get DDE OPTIONS parameters.
    bvpset     - Create/alter BVP OPTIONS structure.
    bvpget     - Get BVP OPTIONS parameters.

  Input and Output functions.
    deval      - Evaluates the solution of a differential equation problem.
    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.
    bvpinit    - Forms the initial guess for BVP4C.
    pdeval     - Evaluates by interpolation the solution computed by PDEPE.
    odefile    - MATLAB v5 ODE file syntax (obsolete).
```

1.12 Sparse matrices

```
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.
  colamd      - Column approximate minimum degree permutation.
  symamd      - Symmetric approximate minimum degree permutation.
  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, using ARPACK.
  svds        - A few singular values, using eigs.
  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.
  lsqr        - Conjugate Gradients on the Normal Equations.
  minres      - Minimum Residual Method.
```

```
  qmr         - Quasi-Minimal Residual Method.
  symmlq      - Symmetric LQ 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.
```

1.13 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.
```

1.14 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.

Transparency.
  alpha      - Transparency (alpha) mode.
  alphamap   - Transparency (alpha) look-up table.
  alim       - Transparency (alpha) scaling

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.
  cameratoolbar - 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.
```

1.15 Specialized graphs

```
Specialized 2-D graphs.
  area         - Filled area plot.
  bar          - Bar graph.
  barh         - Horizontal bar graph.
  comet        - Comet-like trajectory.
  compass      - Compass plot.
  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.
  plotmatrix   - Scatter plot matrix.
  rose         - Angle histogram plot.
  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.
  bar3         - 3-D bar graph.
  bar3h        - Horizontal 3-D bar graph.
  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.
  pie3         - 3-D pie chart.
  ribbon       - Draw 2-D lines as ribbons in 3-D.
  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.
  isocolors    - Isosurface and patch colors.
  contourslice - Contours in slice planes.
  slice        - Volumetric slice plot.
  streamline   - Streamlines from 2D or 3D vector data.
  stream3      - 3D streamlines.
  stream2      - 2D streamlines.
  quiver3      - 3D quiver plot.
  quiver       - 2D quiver plot.
  divergence   - Divergence of a vector field.
  curl         - Curl and angular velocity of a vector field.
  coneplot     - 3D cone plot.
  streamtube   - 3D stream tube.
  streamribbon - 3D stream ribbon.
  streamslice  - Streamlines in slice planes.
  streamparticles   - Display stream particles.
  interpstreamspeed - Interpolate streamline vertices from speed.
  subvolume    - Extract subset of volume dataset.
  reducevolume - Reduce volume dataset.
  volumebounds - Returns x,y,z and color limits for volume data.
  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.
  im2java      - Convert image to Java image.

Movies and animation.
  capture      - Screen capture of current figure.
  moviein      - Initialize movie frame memory.
  getframe     - Get movie frame.
  movie        - Play recorded movie frames.
```

```
  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.
  ellipsoid    - Generate ellipsoid.
  patch        - Create patch.
  surf2patch   - Convert surface data to patch data.

See also GRAPH2D, GRAPH3D.
```

1.16 Handle Graphics

```
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.
```

1.17 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.
  inspect     - Inspect object properties.
  align       - Align uicontrols and axes.
  propedit    - Edit property.

Dialog boxes.
  axlimdlg     - Axes limits dialog box.
  dialog       - Create dialog figure.
  errordlg     - Error dialog box.
  helpdlg      - Help dialog box.
  imageview    - Show image in figure with zoom.
  inputdlg     - Input dialog box.
  listdlg      - List selection dialog box.
  menu         - Generate menu of choices for user input.
  movieview    - Show movie in figure with replay button.
  msgbox       - Message box.
  pagedlg      - Page position dialog box.
```

```
  pagesetupdlg - Page setup dialog.
  printdlg     - Print dialog box.
  printpreview - Display preview of figure to be printed.
  questdlg     - Question dialog box.
  soundview    - Show sound in figure and play.
  uigetpref    - Question dialog box with preference support.
  uigetfile    - Standard open file dialog box.
  uiputfile    - Standard save file dialog box.
  uigetdir     - Standard open directory dialog box.
  uisetcolor   - Color selection dialog box.
  uisetfont    - Font selection dialog box.
  uiopen       - Show open file dialog and call OPEN on result.
  uisave       - Show open file dialog and call SAVE on result.
  uiload       - Show open file dialog and call LOAD on result.
  uiimport     - Start the GUI for importing data (Import Wizard).
  waitbar      - Display wait bar.
  warndlg      - Warning dialog box.

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.
  btnresize  - Resize 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.
  ispref     - Test for existence of preference.

Miscellaneous utilities.
  allchild   - Get all object children.
  clipboard  - Copy and Paste strings to and from system clipboard.
  edtext     - Interactive editing of axes text objects.
  findall    - Find all objects.
  findfigs   - Find figures positioned off screen.
  getptr     - Get figure pointer.
  getstatus  - Get status text string in figure.
  hidegui    - Hide/unhide GUI.
  listfonts  - Get list of available system fonts in cell array.
  movegui    - Move GUI to specified part of screen.
  guihandles - Return a structure of handles.
  guidata    - Store or retrieve application data.
```

```
  overobj    - Get handle of object the pointer is over.
  popupstr   - Get popup menu selection string.
  remapfig   - Transform figure objects' positions.
  setptr     - Set figure pointer.
  setstatus  - Set status text string in figure.
  uiclearmode - Clears the currently active interactive mode.
```

1.18 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.
  regexp      - Regular expression matching.
  regexpi     - Regular expression matching ignoring case.
  regexprep   - Regular expression replacing.
  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 shorter string pattern within longer string.
  strfind     - Find second string pattern within first string.
  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.
```

1.19 File input/output

```
File import/export functions.
  dlmread     - Read delimited text file.
  dlmwrite    - Write delimited text file.
  load        - Load workspace from MATLAB (MAT) file.
  importdata  - Load workspace variables disk file.
  wk1read     - Read spreadsheet (WK1) file.
  wk1write    - Write spreadsheet (WK1) file.
  xlsread     - Read spreadsheet (XLS) file.

Image file import/export.
  imfinfo     - Return information about graphics file.
  imread      - Read image from graphics file.
  imwrite     - Write image to graphics file.
  im2java     - Convert image to Java image.

Internet resource.
  urlread     - Read the contents of a URL into a string.
  urlwrite    - Write the contents of a URL to a local file.
  sendmail    - Send e-mail.

Zip file access.
  zip         - Compress files into a zip file.
  unzip       - Extract the contents of a zip file.

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

Video file import/export.
  aviread     - Read movie (AVI) file.
  aviinfo     - Return information about AVI file.
  avifile     - Create a new AVI file.
  movie2avi   - Create AVI movie from MATLAB movie.

Formatted file I/O.
  fgetl       - Read line from file, discard newline character.
```

```
  fgets       - Read line from file, keep newline character.
  fprintf     - Write formatted data to file.
  fscanf      - Read formatted data from file.
  input       - Prompt for user input.
  textread    - Read formatted data from text file.

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

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.

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

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

CDF file handling
  cdfread     - Read data from a CDF file.
  cdfinfo     - Get information from a CDF file.
  cdfwrite    - Write data to a CDF file.
  cdfepoch    - Construct cdfepoch object.

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.

XML file handling
  xmlread     - Parse an XML file and return a Document Object Model node.
  xmlwrite    - Serialize an XML Document Object Model node.
  xslt        - Transform an XML document using an XSLT engine.

Serial port support.
  serial      - Construct serial port object.

Timer support.
  timer       - Construct timer object.

Command window I/O
  clc         - Clear command window.
  disp        - Display array.
  home        - Send cursor home.
  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 hierarchy to a file.

Utilities.
  str2rng     - Convert spreadsheet range string to numeric array.
  wk1const    - WK1 record type definitions.
  wk1wrec     - Write a WK1 record header.
```

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 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.
  uint64          - Convert to unsigned 64-bit integer.
  int8            - Convert to signed 8-bit integer.
  int16           - Convert to signed 16-bit integer.
  int32           - Convert to signed 32-bit integer.
  int64           - Convert to signed 64-bit integer.
  inline          - Construct INLINE object.
  function_handle - Function handle array.
  javaArray       - Construct a Java array.
  javaMethod      - Invoke a Java method.
  javaObject      - Invoke a Java object constructor.

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.
  cell2mat        - Combine cell array of matrices into one matrix.
```

```
  mat2cell        - Break matrix up into cell array of matrices.
  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.
  orderfields     - Order fields of a structure array.

Function handle functions.
  @               - Create function_handle.
  func2str        - Convert function_handle array into string.
  str2func        - Convert string into function_handle array.
  functions       - List functions associated with a function_handle.

Object oriented programming functions.
  class           - Create object or return object class.
  struct          - Convert object to structure array.
  methods         - List names and properties of class methods.
  methodsview     - View names and properties of class methods.
  isa             - True if object is a given class.
  isjava          - True for Java objects.
  isobject        - True for MATLAB 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.
```

1.22 Version control

```
Version control commands.
  checkin         - checkin files into a version control system.
  checkout        - checkout files from a version control system.
  undocheckout    - undo checkout files from a version control system.

Specific version control.
  rcs             - Version control actions using RCS.
  pvcs            - Version control actions using PVCS.
  clearcase       - Version control actions using ClearCase.
  sourcesafe      - Version control actions using Visual SourceSafe.
  customverctrl   - Custom version control template.
```

1.23 Windows Operating System Interface Files (DDE/COM)

```
COM Automation Client Functions.
  winfun\comcli  - COM class functions.

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.

Other
  winopen     - Open a file using the appropriate Windows command.
  winqueryreg - Get information from the Windows registry.
```

1.24 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.
  qhulldemo   - Tessellation and interpolation of scattered data.
  expm1       - Matrix exponential via Pade approximation.
  expm2       - Matrix exponential via Taylor series.
  expm3       - Matrix exponential via eigenvalues and eigenvectors.

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/Differential equations.
  odedemo     - Demo for the MATLAB Differential Equation solvers.
  odeexamples - Browse the MATLAB ODE/DAE/BVP/PDE examples.
MATLAB/ODEs
  ballode     - Demo of a bouncing ball.
  brussode    - Stiff problem modelling a chemical reaction (Brusselator).
  burgersode  - Burger's equation solved using a moving mesh technique.
  fem1ode     - Stiff problem with a time-dependent mass matrix.
  fem2ode     - Stiff problem with a constant mass matrix.
  hb1ode      - Stiff problem 1 of Hindmarsh and Byrne.
  orbitode    - Restricted three body problem.
  rigidode    - Euler equations of a rigid body without external forces.
  vdpode      - Parameterizable van der Pol equation (stiff for large mu).
MATLAB/DAEs
  hb1dae      - Stiff DAE from a conservation law.
  amp1dae     - Stiff DAE from an electrical circuit.
MATLAB/DDEs
  ddex1       - Example 1 for DDE23
  ddex2       - Example 2 for DDE23
MATLAB/BVPs
  twobvp      - BVP that has exactly two solutions.
  mat4bvp     - Find the fourth eigenvalue of the Mathieu's equation.
  shockbvp    - The solution has a shock layer near x = 0.
  fsbvp       - Falkner-Skan BVP on an infinite interval.
  emdenbvp    - Emden's equation - BVP with a singular term.
MATLAB/PDEs
  pdex1       - Example 1 for PDEPE
  pdex2       - Example 2 for PDEPE
  pdex3       - Example 3 for PDEPE
  pdex4       - Example 4 for PDEPE
  pdex5       - Example 5 for PDEPE

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 MATLAB logo spinning.
  crulspin    - Spinning cruller movie.
  quatdemo    - Quaternion rotation.
  chaingui    - Matrix chain multiplication optimization.

General Demo/Helper functions.
  cmdlnwin    - Demo gateway routine for playing command line demos.
  cmdlnbgn    - Set up for command line demos.
  cmdlnend    - Clean up after command line demos.
  finddemo    - Find demos available for individual toolboxes.
  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    - Generates the MATLAB logo.


See also SIMDEMOS
```

2. SIGNAL PROCESSING TOOLBOX

```
  Filter analysis.
    abs         - Magnitude.
    angle       - Phase angle.
    filternorm  - Compute the 2-norm or inf-norm of a digital filter.
    freqs       - Laplace transform frequency response.
    freqspace   - Frequency spacing for frequency response.
    freqz       - Z-transform frequency response.
    fvtool      - Filter Visualization Tool.
    grpdelay    - Group delay.
    impz        - Discrete impulse response.
    phasez      - Digital filter phase response.
    phasedelay  - Phase delay of a digital filter.
    unwrap      - Unwrap phase.
    zerophase   - Zero-phase response of a real filter.
    zplane      - Discrete pole-zero plot.

  Filter implementation.
    conv        - Convolution.
    conv2       - 2-D convolution.
    convmtx     - Convolution matrix.
    deconv      - Deconvolution.
    fftfilt     - Overlap-add filter implementation.
    filter      - Filter implementation.
    filter2     - Two-dimensional digital filtering.
    filtfilt    - Zero-phase version of filter.
    filtic      - Determine filter initial conditions.
    latcfilt    - Lattice filter implementation.
    medfilt1    - 1-Dimensional median filtering.
    sgolayfilt  - Savitzky-Golay filter implementation.
    sosfilt     - Second-order sections (biquad) filter implementation.
    upfirdn     - Up sample, FIR filter, down sample.

  Discrete-time filter object.
    dfilt        - Construct a discrete-time, filter object.
                   (Type "doc dfilt" for more information)

  FIR filter design.
    cremez      - Complex and nonlinear phase equiripple FIR filter design.
    fir1        - Window based FIR filter design - low, high, band, stop, multi.
    fir2        - FIR arbitrary shape filter design using the frequency sampling
method.
    fircls      - Constrained Least Squares filter design - arbitrary response.
    fircls1       - Constrained Least Squares FIR filter design - low and
highpass.
    firgauss    - FIR Gaussian digital filter design.
    firls       - Optimal least-squares FIR filter design.
    firrcos     - Raised cosine FIR filter design.
    intfilt     - Interpolation FIR filter design.
    kaiserord   - Kaiser window design based filter order estimation.
    remez       - Optimal Chebyshev-norm FIR filter design.
```

```
  remezord    - Remez design based filter order estimation.
  sgolay      - Savitzky-Golay FIR smoothing filter design.

IIR digital filter design.
  butter      - Butterworth filter design.
  cheby1      - Chebyshev Type I filter design (passband ripple).
  cheby2      - Chebyshev Type II filter design (stopband ripple).
  ellip       - Elliptic filter design.
  maxflat     - Generalized Butterworth lowpass filter design.
  yulewalk    - Yule-Walker filter design.

IIR filter order estimation.
  buttord     - Butterworth filter order estimation.
  cheb1ord    - Chebyshev Type I filter order estimation.
  cheb2ord    - Chebyshev Type II filter order estimation.
  ellipord    - Elliptic filter order estimation.

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.

Analog filter design.
  besself     - Bessel analog filter design.
  butter      - Butterworth filter design.
  cheby1      - Chebyshev Type I filter design.
  cheby2      - Chebyshev Type II filter design.
  ellip       - Elliptic filter design.

Analog filter transformation.
  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.
  polystab    - Polynomial stabilization.
  polyscale   - Scale roots of polynomial.
  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.
  tf2zpk      - Discrete-time 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.
  barthannwin    - Modified Bartlett-Hanning window.
  blackman       - Blackman window.
  blackmanharris - Minimum 4-term Blackman-Harris window.
  bohmanwin      - Bohman window.
  chebwin        - Chebyshev window.
  flattopwin     - Flat Top window.
  gausswin       - Gaussian window.
  hamming        - Hamming window.
  hann           - Hann window.
  kaiser         - Kaiser window.
  nuttallwin     - Nuttall defined minimum 4-term Blackman-Harris window.
  parzenwin      - Parzen (de la Valle-Poussin) window.
  rectwin        - Rectangular window.
  triang         - Triangular window.
  tukeywin       - Tukey window.
  wvtool         - Window Visualization Tool.
  window         - Window function gateway.

Window object.
  sigwin         - Construct a window object.
                   (Type "doc sigwin" for more information)

Transforms.
  bitrevorder   - Permute input into bit-reversed order.
  czt           - Chirp-z transform.
  dct           - Discrete cosine transform.
  dftmtx        - Discrete Fourier transform matrix.
  digitrevorder - Permute input into digit-reversed order.
  fft           - Fast Fourier transform.
  fft2          - 2-D fast Fourier transform.
  fftshift      - Swap vector halves.
  goertzel      - Second-order Goertzel algorithm.
  hilbert       - Discrete-time analytic signal via Hilbert transform.
  idct          - Inverse discrete cosine transform.
  ifft          - Inverse fast Fourier transform.
  ifft2         - Inverse 2-D fast Fourier transform.

Cepstral analysis.
  cceps       - Complex cepstrum.
  icceps      - Inverse Complex cepstrum.
  rceps       - Real cepstrum and minimum phase reconstruction.
```

```
  Statistical signal processing and spectral analysis.
    cohere      - Coherence function estimate.
    corrcoef    - Correlation coefficients.
    corrmtx     - Autocorrelation matrix.
    cov         - Covariance matrix.
    csd         - Cross Spectral Density.
    pburg       - Power Spectral Density estimate via Burg's method.
    pcov        - Power Spectral Density estimate via the Covariance method.
    peig        - Power Spectral Density estimate via the Eigenvector method.
    periodogram - Power Spectral Density estimate via the periodogram method.
    pmcov         - Power Spectral Density estimate via the Modified Covariance
method.
    pmtm          - Power Spectral Density estimate via the Thomson multitaper
method.
    pmusic      - Power Spectral Density estimate via the MUSIC method.
    psdplot     - Plot Power Spectral Density data.
    pwelch      - Power Spectral Density estimate via Welch's method.
    pyulear     - Power Spectral Density estimate via the Yule-Walker AR Method.
    rooteig       - Sinusoid frequency and power estimation via the eigenvector
algorithm.
    rootmusic     - Sinusoid frequency and power estimation via the MUSIC
algorithm.
    tfe         - Transfer function estimate.
    xcorr       - Cross-correlation function.
    xcorr2      - 2-D cross-correlation.
    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.

Multirate signal processing.
  decimate    - Resample data at a lower sample rate.
  downsample  - Downsample input signal.
  interp      - Resample data at a higher sample rate.
  interp1     - General 1-D interpolation. (MATLAB Toolbox)
  resample    - Resample sequence with new sampling rate.
  spline      - Cubic spline interpolation.
  upfirdn     - Up sample, FIR filter, down sample.
  upsample    - Upsample input signal.

Waveform generation.
  chirp       - Swept-frequency cosine generator.
  diric       - Dirichlet (periodic sinc) function.
  gauspuls    - Gaussian RF pulse generator.
  gmonopuls   - Gaussian monopulse 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.
  vco         - Voltage controlled oscillator.

Specialized operations.
  buffer      - Buffer a signal vector into a matrix of data frames.
  cell2sos    - Convert cell array to second-order-section matrix.
  cplxpair    - Order vector into complex conjugate pairs.
  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.
  eqtflength  - Equalize the length of a discrete-time transfer function.
  modulate    - Modulation for communications simulation.
  seqperiod   - Find minimum-length repeating sequence in a vector.
  sos2cell    - Convert second-order-section matrix to cell array.
  specgram    - Spectrogram, for speech signals.
  stem        - Plot discrete data sequence.
  strips      - Strip plot.
  udecode     - Uniform decoding of the input.
  uencode     - Uniform quantization and encoding of the input into N-bits.

Graphical User Interfaces
  fdatool     - Filter Design and Analysis Tool.
  fvtool      - Filter Visualization Tool.
  sptool      - Signal Processing Tool.
  wintool     - Window Design and Analysis Tool.
```

```
    wvtool      - Window Visualization Tool.

  See also SIGDEMOS, AUDIO, and, in the Filter Design Toolbox, FILTERDESIGN.
```

3. SIMULINK

3.1 Simulink

```
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.
  hilite_system    - Hilite objects within 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.
  add_param        - Add a user-defined string parameter to a model.
  delete_param     - Delete a user-defined parameter from a 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.
  boolean          - Convert numeric array to boolean.
  slhelp           - Simulink user's guide or block help.

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.

Diagnostics.
  sllastdiagnostic - Last diagnostic array.
  sllasterror      - Last error array.
  sllastwarning    - Last warning array.
  sldiagnostics    - Get block count and compile stats for a model.

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.
```

3.2 Simulink block library

```
Block libraries.
  simulink        - Open main block library.
  simulink_extras - Simulink Extras block library.

Example S-function models and blocks.
  simo            - simo model, block diagram form.
  simom           - simo model, M-file form.
  simom2          - simo model, M-file form #2.
  simosys         - simo model, S-function block form.
  vdpm            - Van der Pol model, M-file form.
  mixed           - Mixed continuous/discrete model, block diagram form.
  mixedm          - Mixed continuous/discrete model, M-file form.
  limintm         - Limited integrator block, M-file form.
  vlimintm        - Vectorized limited integrator, M-file form.
  vdlmintm        - Discrete-time vectorized limited integrator, M-file.
  sfuntmpl        - M-file S-function template.
  csfunc          - Continuous-time model, M-file form.
  dsfunc          - Discrete-time model, M-file form.
  vsfunc          - Variable sample-time model, M-file form.
  sfuncont        - M-file S-function template, continuous-time model.
  sfundsc1        - M-file S-function template, discrete real-time model.
  sfundsc2        - M-file S-function template, discrete sampled model.
  timestwo        - M-file S-function example.

The MATLABROOT/simulink directory contains the source code for examples
of C, Fortran, and Ada implementations of the above blocks.
```

4. OPTIMIZATION TOOLBOX

```
Nonlinear minimization of functions.
  fminbnd     - Scalar bounded nonlinear function minimization.
  fmincon     - Multidimensional constrained nonlinear minimization.
  fminsearch  - Multidimensional unconstrained nonlinear minimization,
                by Nelder-Mead direct search method.
  fminunc     - Multidimensional unconstrained nonlinear minimization.
  fseminf     - Multidimensional constrained minimization, semi-infinite
                constraints.

Nonlinear minimization of multi-objective functions.
  fgoalattain - Multidimensional goal attainment optimization
  fminimax    - Multidimensional minimax optimization.

Linear least squares (of matrix problems).
  lsqlin      - Linear least squares with linear constraints.
  lsqnonneg   - Linear least squares with nonnegativity constraints.

Nonlinear least squares (of functions).
  lsqcurvefit - Nonlinear curvefitting via least squares (with bounds).
  lsqnonlin   - Nonlinear least squares with upper and lower bounds.

Nonlinear zero finding (equation solving).
  fzero       - Scalar nonlinear zero finding.
  fsolve      - Nonlinear system of equations solve (function solve).

Minimization of matrix problems.
  linprog     - Linear programming.
  quadprog    - Quadratic programming.

Controlling defaults and options.
  optimset - Create or alter optimization OPTIONS structure.
  optimget - Get optimization parameters from OPTIONS structure.

Demonstrations of large-scale methods.
  circustent - Quadratic programming to find shape of a circus tent.
  molecule   - Molecule conformation solution using unconstrained nonlinear
               minimization.
  optdeblur  - Image deblurring using bounded linear least-squares.

Demonstrations of medium-scale methods.
  optdemo     - Demonstration menu.
  tutdemo     - Tutorial walk-through.
  bandemo     - Minimization of banana function.
  goaldemo    - Goal attainment.
  dfildemo    - Finite-precision filter design (requires Signal Processing
                Toolbox).
  datdemo     - Fitting data to a curve.

Medium-scale examples from User's Guide
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  objfun     - nonlinear objective
  confun     - nonlinear constraints
  objfungrad - nonlinear objective with gradient
  confungrad - nonlinear constraints with gradients
  confuneq   - nonlinear equality constraints
  optsim.mdl - simulink model of nonlinear plant process
  optsiminit - init file for optisim.mdl
  tracklsq   - multiobjective lsqnonlin objective
  trackmmobj - multiobjective fminimax objective
  trackmmcon - multiobjective fminimax constraints

Large-scale examples from User's Guide
  nlsf1        - nonlinear equations objective with Jacobian
  nlsf1a       - nonlinear equations objective
  nlsdat1      - MAT-file of Jacobian sparsity pattern (see nlsf1a)
  brownfgh     - nonlinear minimization objective with gradient and Hessian
  brownfg      - nonlinear minimization objective with gradient
  brownhstr    - MAT-file of Hessian sparsity pattern (see brownfg)
  tbroyfg      - nonlinear minimization objective with gradient
  tbroyhstr    - MAT-file of Hessian sparsity pattern (see tbroyfg)
  browneq      - MAT-file of Aeq and beq sparse linear equality constraints
  runfleq1     - demonstrates 'HessMult' option for FMINCON with equalities
  brownvv      - nonlinear minimization with dense structured Hessian
  hmfleq1      - Hessian matrix product for brownvv objective
  fleq1        - MAT-file of V matrix for brownvv, hmfleq1 and Aeq,beq
  qpbox1       - MAT-file of quadratic objective Hessian sparse matrix
  runqpbox4    - demonstrates 'HessMult' option for QUADPROG with bounds
  qpbox4       - MAT-file of quadratic programming problem matrices
  runnls3      - demonstrates 'JacobMult' option for LSQNONLIN
  nlsmm3       - Jacobian multiply function for runnls3/nlsf3a objective
  nlsdat1      - MAT-file of problem matrices for runnls3/nlsf3a objective
  runqpeq5     - demonstrates 'HessMult' option for QUADPROG with equalities
  qpeq5        - MAT-file of quadratic programming matrices for runqpeq5
  particle     - MAT-file of linear least squares C and d sparse matrices
  sc50b        - MAT-file of linear programming example
  densecolumns - MAT-file of linear programming example
```