

# MATLAB 指令集

## Color controls.

[colormap](#) - Color look-up table.

[caxis](#) - Pseudocolor axis scaling.

[shading](#) - Color shading mode.

## Color maps.

[hsv](#) - Hue-saturation-value color map.

[gray](#) - Linear gray-scale color map.

[hot](#) - Black-red-yellow-white color map.

[cool](#) - Shades of cyan and magenta color map.

[bone](#) - Gray-scale with a tinge of blue color map.

[copper](#) - Linear copper-tone color map.

[pink](#) - Pastel shades of pink color map.

[prism](#) - Prism color map.

[jet](#) - A variant of HSV.

[flag](#) - Alternating red, white, blue,  
and black color map.

## Color map related functions.

[colorbar](#) - Display color bar (color scale).

[hsv2rgb](#) - Hue-saturation-value to red-  
green-blue conversion.

[rgb2hsv](#) - Red-green-blue to hue-saturation  
-value conversion.

[contrast](#) - Gray scale color map to enhance image contrast.

[brighten](#) - Brighten or darken color map.

[spinmap](#) - Spin color map.

[rgbplot](#) - Plot color map.

## Lighting models.

[surfl](#) - 3-D shaded surface with  
lighting.

[specular](#) - Specular reflectance.

[diffuse](#) - Diffuse reflectance.

[surfnorm](#) - Surface normals.

## .c2.14.8.2 Datafun (Data Analysis and Fourier Transformations)

### Basic operations.

[max](#) - Largest component.

[min](#) - Smallest component.

[mean](#) - Average or mean value.

[median](#) - Median value.

- std* - Standard deviation.
- sort* - Sort in ascending order.
- sum* - Sum of elements.
- prod* - *Product of elements.*
- cumsum* - Cumulative sum of elements.
- cumprod* - Cumulative product of elements.
- trapz* - Numerical integration using trapezoidal method.

#### Finite differences.

- diff* - Difference function and approximate derivative.
- gradient* - Approximate gradient.
- del2* - Five-point discrete Laplacian.

#### Vector operations.

- cross* - Vector cross product.
- dot* - Vector dot product.

#### 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.
- deconv* - Deconvolution and polynomial division.

#### Fourier transforms.

- fft* - Discrete Fourier transform.
- fft2* - Two-dimensional discrete Fourier transform.
- ifft* - Inverse discrete Fourier transform.
- ifft2* - Two-dimensional inverse discrete Fourier transform.
- abs* - Magnitude.
- angle* - Phase angle.
- unwrap* - Remove phase angle jumps across 360 degree boundaries.
- fftshift* - Move zeroth lag to center of spectrum.
- cplxpair* - Sort numbers into complex conjugate pairs.
- nextpow2* - Next higher power of 2.

#### .c2.14.8.3Demos (Demonstration and Samples)

## MATLAB/Introduction.

- [expo, demo](#) - Start up The MATLAB Expo and display splash screen.
- [expomap](#) - Open the MATLAB Expo Main Map (avoids Expo splash screen).

## MATLAB/Matrices.

- [intro](#) - Introduction to 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.
- [delsqdemo](#) - Finite difference Laplacian on various domains.
- [sepdemo](#) - Separators for a finite element mesh.
- [airfoil](#) - Display sparse matrix from NASA airfoil.

## MATLAB/Numerics.

- [funfuns](#) - Demonstrate functions that operate on other functions.
- [fitdemo](#) - Nonlinear curve fit with simplex algorithm.
- [sunspots](#) - The answer is 11.08, what is the question?
- [e2pi](#) - Which is greater,  $e^{\pi}$  or  $\pi^e$ ?
- [bench](#) - MATLAB Benchmark.
- [odedemo](#) - Ordinary differential equations.
- [quaddemo](#) - Adaptive quadrature.
- [zerodemo](#) - Zerofinding with fzero.
- [fplotdemo](#) - Plot a function.
- [eigmovie](#) - Symmetric eigenvalue movie.
- [rrefmovie](#) - Computation of Reduced Row Echelon Form.
- [fftdemo](#) - Use of the fast finite Fourier transform.
- [quake](#) - Loma Prieta Earthquake.
- [census](#) - Try to predict the US population in the year 2000.
- [spline2d](#) - Demonstrate GINPUT and SPLINE in two dimensions.

## MATLAB/Visualization.

- [graf2d](#) - Demonstrate XY plots in MATLAB.
- [graf2d2](#) - Demonstrate XYZ plots in MATLAB.
- [grafcplx](#) - Demonstrate complex function plots in MATLAB.
- [lorenz](#) - Plot the orbit around the Lorenz chaotic attractor.
- [xpsound](#) - Demonstrate MATLAB V4's sound capability.
- [vibes](#) - Vibrating L-shaped membrane.
- [xpklein](#) - Klein bottle demo.
- [xfourier](#) - Graphics demo of Fourier series expansion.
- [cplxdemo](#) - Maps of functions of a complex variable.
- [peaks](#) - A sample function of two

variables.

[membrane](#) - Generate MathWorks's logo.

[penny](#) - Several views of the penny data.

[earthmap](#) - View Earth's topography.

[sqdemo](#) - Superquadrics using UIControls.

[imagedemo](#) - Demonstrate MATLAB V4's image capability.

[colormenu](#) - Select color map.

#### MATLAB/Language.

[xplang](#) - Introduction to the MATLAB language.

[graf3d](#) - Demonstrate Handle Graphics for surface plots.

[hdlgraf](#) - Demonstrate Handle Graphics for line plots.

[hdlaxis](#) - Demonstrate Handle Graphics for axes.

#### SIMULINK/Simple Systems.

[simintro](#) - A quick introduction to SIMULINK.

[libintro](#) - A quick introduction to the SIMULINK Libraries.

[simpPEND](#) - SIMULINK system modeling a simple pendulum.

[onecart](#) - SIMULINK system modeling a mass-spring system.

[bounce](#) - SIMULINK system modeling a bouncing ball.

[vdp](#) - SIMULINK system modeling the Van der Pol equations.

#### SIMULINK/Complex Systems.

[dblcart1](#) - SIMULINK system modeling a mass-spring system.

[dblpend1](#) - SIMULINK system modeling a double-pendulum system.

[dblpend2](#) - SIMULINK system modeling a double-pendulum system.

[penddemo](#) - SIMULINK system modeling an inverted pendulum.

[dblcart](#) - SIMULINK system modeling a double-cart system.

[thermo](#) - SIMULINK system modeling a thermostat heating a house.

[f14](#) - SIMULINK system modeling an aircraft in flight.

#### SIMULINK/Advanced Products.

[xpaccel](#) - Provide information about the SIMULINK Accelerator.

[ccodegen](#) - Provide information about the C-Code Generator.

#### Toolbox/Signal Processing.

[filtDEM](#) - Signal Processing filter demo.

[filtDEM2](#) - Demonstrate filter design techniques.

[sigdemo1](#) - Discrete-time Fourier transform of a signal.

[sigdemo2](#) - Continuous-time Fourier transform of a signal.

[phone](#) - Signal processing and the touch-tone phone.

#### Toolbox/System Identification.

[sysiddm](#) - Identify "hairdryer" system

characteristics.

[iddems](#) - Set up System Identification command line demos.

Toolbox/Optimization.

[bandem](#) - Banana function minimization demonstration.

[optdems](#) - Set up Optimization command line demos.

Toolbox/Neural Networks.

[bckprp12](#) - Demonstrate backpropagation.

[bckprp62](#) - Demonstrate backpropagation with momentum.

[neural](#) - Neural network character recognition.

Toolbox/Control System.

[dskdemo](#) - Build controller for a disk read/write head.

[ctrldems](#) - Set up Control System command line demos.

Toolbox/Robust Control.

[accdm2](#) - Demo of the 1990 ACC benchmark.

[rctdems](#) - Set up Robust Control command line demos.

Toolbox/Mu-Analysis and Synthesis.

[xpmu](#) - Description of the Mu-Analysis and Synthesis process.

[mudems](#) - Set up Mu-Analysis and Synthesis command line demos.

Toolbox/Spline.

[spapidm2](#) - Demonstrate spline interpolation.

[spldems](#) - Set up Spline command line demos.

Toolbox/Symbolic Math.

[xpcalc](#) - Calculus operations.

[xpgiv](#) - Givens transformation.

Toolbox/Image Processing.

[xpimage](#) - Demonstrate some Image Processing capabilities.

Toolbox/Statistics.

[xppolytl](#) - Interactively fit a polynomial to noisy data.

[statdems](#) - Set up Statistics command line demos.

Extras/Gallery.

[knot](#) - Tube surrounding a three-dimensional knot.

[quivdemo](#) - Demonstrate the quiver function.

[modes](#) - Plot 12 modes of the L-shaped membrane.

- [logo](#) - Display the MATLAB L-shaped membrane logo.
- [klein1](#) - Construct a Klein bottle.
- [cruller](#) - Construct cruller.
- [tori4](#) - Construct four linked tori.
- [spharm2](#) - Construct spherical surface harmonic.

#### Extras/Games.

- [xpbombs](#) - Minesweeper game.
- [life](#) - Conway's Game of Life.
- [bblwrap](#) - Bubblewrap.

#### Extras/Miscellaneous.

- [truss](#) - Animation of a bending bridge truss.
- [travel](#) - Traveling salesman problem.
- [wrldtry](#) - Great circle flight routes around the globe.
- [makevase](#) - Generate and plot a surface of revolution.
- [logospin](#) - Movie of The MathWorks' logo spinning.
- [crulspin](#) - Spinning cruller movie.
- [xpquad](#) - Superquadrics plotting demonstration.
- [spinner](#) - Colorful lines spinning through space.

#### Extras/Contact Info.

- [contact1](#) - How to reach The MathWorks, Inc.
- [contact2](#) - How to reach The MathWorks, Inc. by email.
- [contact3](#) - How to reach international agents for The MathWorks, Inc.
- [agents](#) - International distributors' locations and contact information.

#### .c2.14.8.4 Elfun (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 logarithm.
- [sqrt](#) - Square root.

#### Complex.

- [abs](#) - Absolute value.
- [angle](#) - Phase angle.
- [conj](#) - Complex conjugate.
- [imag](#) - Complex imaginary part.
- [real](#) - Complex real part.

#### Numeric.

- [fix](#) - Round towards zero.
- [floor](#) - Round towards minus infinity.
- [ceil](#) - Round towards plus infinity.
- [round](#) - Round towards nearest integer.
- [rem](#) - Remainder after division.
- [sign](#) - Signum function.

#### .c2.14.8.5 Elmat (Elementary Matrices and Manipulation)

##### Elementary matrices.

- [zeros](#) - Zeros matrix.
- [ones](#) - Ones matrix.
- [eye](#) - Identity matrix.
- [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.

### Special variables and constants.

- ans* - Most recent answer.
- eps* - Floating point relative accuracy.
- realmax* - Largest floating point number.
- realmin* - Smallest positive floating point number.
- pi* - 3.1415926535897....
- i, j* - Imaginary unit.
- inf* - Infinity.
- NaN* - Not-a-Number.
- flops* - Count of floating point operations.
- nargin* - Number of function input arguments.
- nargout* - Number of function output arguments.
- computer* - Computer type.
- isieee* - True for computers with IEEE arithmetic.
- isstudent* - True for the Student Edition.
- why* - Succinct answer.
- version* - MATLAB version number.

### Time and dates.

- clock* - Wall clock.
- cputime* - Elapsed CPU time.
- date* - Calendar.
- etime* - Elapsed time function.
- tic, toc* - Stopwatch timer functions.

### Matrix manipulation.

- diag* - Create or extract diagonals.
- fliplr* - Flip matrix in the left/right direction.
- flipud* - Flip matrix in the up/down direction.
- reshape* - Change size.
- rot90* - Rotate matrix 90 degrees.
- tril* - Extract lower triangular part.
- triu* - Extract upper triangular part.
- :* - Index into matrix, rearrange matrix.

### .c2.14.8.6 Funfun (Function Functions)

#### Function functions - nonlinear numerical methods.

- ode23* - Solve differential equations, low order method.
- ode23p* - Solve and plot solutions.



- ode45* - Solve differential equations, high order method.
- quad* - Numerically evaluate integral, low order method.
- quad8* - Numerically evaluate integral, high order method.
- fmin* - Minimize function of one variable.
- fmins* - Minimize function of several variables.
- fzero* - Find zero of function of one variable.
- fplot* - Plot function.

#### .c2.14.8.7 General (General Purpose Command)

Managing commands and functions.

- help* - On-line documentation.
- doc* - Load hypertext documentation.
- what* - Directory listing of M-, MAT- and MEX-files.
- type* - List M-file.
- lookfor* - Keyword search through the HELP entries.
- which* - Locate functions and files.
- demo* - Run demos.
- path* - Control MATLAB's search path.

Managing variables and the workspace.

- who* - List current variables.
- whos* - List current variables, long form.
- load* - Retrieve variables from disk.
- save* - Save workspace variables to disk.
- clear* - Clear variables and functions from memory.
- pack* - Consolidate workspace memory.
- size* - Size of matrix.
- length* - Length of vector.
- disp* - Display matrix or text.

Working with files and the operating system.

- cd* - Change current working directory.
- dir* - Directory listing.
- delete* - Delete file.
- getenv* - Get environment value.
- !* - Execute operating system command.
- unix* - Execute operating system command & return result.
- diary* - Save text of MATLAB session.

Controlling the command window.

- edit* - Set command line edit/recall facility parameters.
- clc* - Clear command window.

- home - Send cursor home.
- format - Set output format.
- echo - Echo commands inside script files.
- more - Control paged output in command window.

Starting and quitting from MATLAB.

- quit - Terminate MATLAB.
- startup - M-file executed when MATLAB is invoked.
- matlabrc - Master startup M-file.

General information.

- info - Information about MATLAB and The MathWorks, Inc.
- subscribe - Become subscribing user of MATLAB.
- hostid - MATLAB server host identification number.
- whatsnew - Information about new features not yet documented.
- ver - MATLAB, SIMULINK, and TOOLBOX version information.

.c2.14.8.8 Graphics (General Purpose Graphics Functions)

Figure window creation and control.

- figure - Create Figure (graph window).
- gcf - Get handle to current figure.
- clf - Clear current figure.
- close - Close 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.
- caxis - Control pseudocolor axis scaling.
- hold - Hold current graph.

Handle Graphics objects.

- figure - Create figure window.
- axes - Create axes.
- line - Create line.
- text - Create text.
- patch - Create patch.
- surface - Create surface.
- image - Create image.
- uicontrol - Create user interface control.

*uimenu* - Create user interface 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.  
*drawnow* - Flush pending graphics events.  
*newplot* - M-file preamble for NextPlot property.  
*findobj* - Find objects with specified property values.

Hardcopy and storage.

*print* - Print graph or save graph to file.  
*printopt*- Configure local printer defaults.  
*orient* - Set paper orientation.  
*capture* - Screen capture of current figure.

Movies and animation.

*moviein* - Initialize movie frame memory.  
*getframe*- Get movie frame.  
*movie* - Play recorded movie frames.

Miscellaneous.

*ginput* - Graphical input from mouse.  
*ishold* - Return hold state.  
*graymon* - Set graphics window defaults for gray-scale monitors.  
*rbbox* - Rubberband box.  
*rotate* - Rotate an object about a specified direction.  
*terminal* - Set graphics terminal type.  
*uiputfile*- Put up dialog box for saving files.  
*uigetfile*- Put up dialog box which queries for file names.  
*whitebg* - Set graphics window defaults for white background.  
*zoom* - Zoom in and out on a 2-D plot.  
*waitforbuttonpress*- Wait for key/buttonpress over figure.

.c2.14.8.9 Iofun (Low-Level File I/O Functions)

File opening and closing.

*fopen* - Open file.  
*fclose* - Close file.

Unformatted I/O.

- fread* - Read binary data from file.
- fwrite* - Write binary data to file.

#### Formatted I/O.

- 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.

#### File positioning.

- ferror* - Inquire file I/O error status.
- feof* - Test for end-of-file.
- fseek* - Set file position indicator.
- ftell* - Get file position indicator.
- frewind* - Rewind file.

#### String conversion.

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

#### File Import/Export Routines.

##### WK1 Format.

- wk1const* - WK1 record definitions.
- wk1read* - Read WK1 file/range.
- wk1write* - Write out matrix in a WK1 formatted file.
- wk1wrec* - Write a WK1 record header.

##### CSV Format.

- csvread* - Read Comma Separated Value formatted file into a matrix.
- csvwrite* - Write out matrix in a CSV formatted file.

##### ASCII Delimited Format.

- dlmread* - Read ASCII delimited file into a matrix.
- dlmwrite* - Write out matrix in ASCII delimited file format.

#### .c2.14.8.10 Lang (Language Constructs and Debuggings)

##### MATLAB as a programming language.

- script* - About MATLAB scripts and M-files.
- function* - Add new function.
- eval* - Execute string with MATLAB expression.
- feval* - Execute function specified by string.
- global* - Define global variable.

nargchk - Validate number of input arguments.  
lasterr - Last error message.

#### Control flow.

if - Conditionally execute statements.  
else - Used with IF.  
elseif - Used with IF.  
end - Terminate the scope of FOR, WHILE and IF statements.  
for - Repeat statements a specific number of times.  
while - Repeat statements an indefinite number of times.  
break - Terminate execution of loop.  
return - Return to invoking function.  
error - Display message and abort function.

#### Interactive input.

input - Prompt for user input.  
keyboard - Invoke keyboard as if it were a Script-file.  
menu - Generate menu of choices for user input.  
pause - Wait for user response.  
uimenu - Create user interface menu.  
uicontrol - Create user interface control.

#### Debugging commands.

dbstop - Set breakpoint.  
dbclear - Remove breakpoint.  
dbcont - Resume execution.  
dbdown - Change local workspace context.  
dbstack - List who called whom.  
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.  
mexdebug - Debug MEX-files.

#### .c2.14.8.11 Matfun (Matrix Functions)

##### Matrix analysis.

cond - Matrix condition number.  
norm - Matrix or vector norm.  
rcond - LINPACK reciprocal condition estimator.  
rank - Number of linearly independent rows or columns.  
det - Determinant.  
trace - Sum of diagonal elements.  
null - Null space.  
orth - Orthogonalization.

[rref](#) - Reduced row echelon form.

Linear equations.

[\](#) and [/](#) - Linear equation solution; use "help slash".

[chol](#) - Cholesky factorization.

[lu](#) - Factors from Gaussian elimination.

[inv](#) - Matrix inverse.

[qr](#) - Orthogonal-triangular decomposition.

[qrdelete](#) - Delete a column from the QR factorization.

[qrinsert](#) - Insert a column in the QR factorization.

[nnls](#) - Non-negative least-squares.

[pinv](#) - Pseudoinverse.

[lscov](#) - Least squares in the presence of known covariance.

[Eigenvalues](#) and singular values.

[eig](#) - Eigenvalues and eigenvectors.

[poly](#) - Characteristic polynomial.

[polyeig](#) - Polynomial eigenvalue problem.

[hess](#) - Hessenberg form.

[qz](#) - Generalized eigenvalues.

[rsf2csf](#) - Real block diagonal form to complex diagonal form.

[cdf2rdf](#) - Complex diagonal form to real block diagonal form.

[schur](#) - Schur decomposition.

[balance](#) - Diagonal scaling to improve eigenvalue accuracy.

[svd](#) - Singular value decomposition.

Matrix functions.

[expm](#) - Matrix exponential.

[expm1](#) - M-file implementation of expm.

[expm2](#) - Matrix exponential via Taylor series.

[expm3](#) - Matrix exponential via eigenvalues and eigenvectors.

[logm](#) - Matrix logarithm.

[sqrtm](#) - Matrix square root.

[funm](#) - Evaluate general matrix function.

.c2.14.8.12 OPS (Operators and Special Characters)

Arithmetic and Matrix Operators.

Char      Name                                      HELP topic

+	Plus arith	
-	Minus arith	
*	Matrix multiplication	arith
.*	Array multiplication	arith
^	Matrix power	arith
.^	Array power	arith
\	Backslash or left division	slash
/	Slash or right division	slash
./	Array division	slash
<u>kron</u>	Kronecker tensor product	kron
:	Colon	colon
( )	Parentheses	paren
[ ]	Brackets	paren
.	Decimal point	punct
..	Parent directory	punct
...	Continuation	punct
,	Comma	punct
;	Semicolon	punct
%	Comment	punct
!	Exclamation point	punct
'	Transpose and quote	punct
=	Assignment	punct
==	Equality	relop
<>	Relational operators	relop
&	Logical AND	relop
	Logical OR	relop
~	Logical NOT	relop
<u>xor</u>	Logical EXCLUSIVE OR	xor

#### Logical characteristics.

<u>exist</u>	- Check if variables or functions are defined.
<u>any</u>	- True if any element of vector is true.
<u>all</u>	- True if all elements of vector are true.
<u>find</u>	- Find indices of non-zero elements.
<u>isnan</u>	- True for Not-A-Number.
<u>isinf</u>	- True for infinite elements.
<u>finite</u>	- True for finite elements.
<u>isempty</u>	- True for empty matrix.
<u>isreal</u>	- True for real matrix.
<u>issparse</u>	- True for sparse matrix.
<u>isstr</u>	- True for text string.
<u>isglobal</u>	- True for global variables.

#### .c2.14.8.13 Plotxy (Two-Dimensional Graphics)

Elementary X-Y graphs.

- plot - Linear plot.
- loglog - Log-log scale plot.
- semilogx- Semi-log scale plot.
- semilogy- Semi-log scale plot.
- fill - Draw filled 2-D polygons.

Specialized X-Y graphs.

- polar - Polar coordinate plot.
- bar - Bar graph.
- stem - Discrete sequence or "stem" plot.
- stairs - Stairstep plot.
- errorbar- Error bar plot.
- hist - Histogram plot.
- rose - Angle histogram plot.
- compass - Compass plot.
- feather - Feather plot.
- fplot - Plot function.
- comet - Comet-like trajectory.

Graph annotation.

- title - Graph title.
- xlabel - X-axis label.
- ylabel - Y-axis label.
- text - Text annotation.
- gtext - Mouse placement of text.
- grid - Grid lines.

.c2.14.8.14 Plotxyz (Three-Dimensional Graphics)

Line and area fill commands.

- plot3 - Plot lines and points in 3-D space.
- fill3 - Draw filled 3-D polygons in 3-D space.
- comet3 - 3-D comet-like trajectories.

Contour and other 2-D plots of 3-D data.

- contour - Contour plot.
- contour3 - 3-D contour plot.
- clabel - Contour plot elevation labels.
- contourc - Contour plot computation (used by contour).
- pcolor - Pseudocolor (checkerboard) plot.
- quiver - Quiver plot.

Surface and mesh plots.

- mesh - 3-D mesh surface.



- meshc - Combination mesh/contour plot.
- meshz - 3-D Mesh with zero plane.
- surf - 3-D shaded surface.
- surfc - Combination surf/contour plot.
- surfl - 3-D shaded surface with lighting.
- waterfall - Waterfall plot.

Volume visualization.

- slice - Volumetric visualization plots.

Graph appearance.

- view - 3-D graph viewpoint specification.
- viewmtx - View transformation matrices.
- hidden - Mesh hidden line removal mode.
- shading - Color shading mode.
- axis - Axis scaling and appearance.
- caxis - Pseudocolor axis scaling.
- colormap - Color look-up table.

Graph annotation.

- title - Graph title.
- xlabel - X-axis label.
- ylabel - Y-axis label.
- zlabel - Z-axis label for 3-D plots.
- text - Text annotation.
- gtext - Mouse placement of text.
- grid - Grid lines.

3-D objects.

- cylinder - Generate cylinder.
- sphere - Generate sphere.

.c2.14.8.15 Polyfun (Polynomial and Interpolation Functions)

Polynomials.

- roots - Find polynomial roots.
- poly - Construct polynomial with specified roots.
- 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.

Data interpolation.

[interp1](#) - 1-D interpolation (1-D table lookup).

[interp2](#) - 2-D interpolation (2-D table lookup).

[interpft](#) - 1-D interpolation using FFT method.

[griddata](#) - Data gridding.

[Spline](#) interpolation.

[spline](#) - Cubic spline data interpolation.

[ppval](#) - Evaluate piecewise polynomial.

.c2.14.8.16 Sparfun (Sparse Matrix Functions)

Elementary sparse matrices.

[speye](#) - Sparse identity matrix.

[sprandn](#) - Sparse random matrix.

[sprandsym](#) - Sparse symmetric random matrix.

[spdiags](#) - Sparse matrix formed from diagonals.

Full to sparse conversion.

[sparse](#) - Create sparse matrix from nonzeros and indices.

[full](#) - Convert sparse matrix to full matrix.

[find](#) - Find indices of nonzero entries.

[spconvert](#) - Convert from sparse matrix external format.

Working with nonzero entries of sparse matrices.

[nnz](#) - Number of nonzero entries.

[nonzeros](#) - Nonzero entries.

[nzmax](#) - Amount of storage allocated for nonzero entries.

[spones](#) - Replace nonzero entries with ones.

[spalloc](#) - Allocate memory for nonzero entries.

[issparse](#) - True if matrix is sparse.

[spfun](#) - Apply function to nonzero entries.

Visualizing sparse matrices.

[spy](#) - Visualize sparsity structure.

[gplot](#) - Plot graph, as in "graph theory".

Reordering algorithms.

[colmmd](#) - Column minimum degree.

[symmmd](#) - Symmetric minimum degree.

[symrcm](#) - Reverse Cuthill-McKee ordering.

[colperm](#) - Order columns based on nonzero count.

[randperm](#) - Random permutation vector.

[dmperm](#) - Dulmage-Mendelsohn decomposition.

Norm, condition number, and rank.

[normest](#) - Estimate 2-norm.

[condest](#) - Estimate 1-norm condition.

[sprank](#) - Structural rank.

Operations on trees.

[treelayout](#) - Lay out a tree or forest.

[treeplot](#) - Plot a picture of a tree.

[etree](#) - Elimination tree of a matrix.

[etreeplot](#) - Plot the elimination tree.

Miscellaneous.

[symbfact](#) - Symbolic factorization analysis.

[spparms](#) - Set parameters for sparse matrix routines.

[spaugment](#) - Form least squares augmented system.

.c2.14.8.17 Specfun (Specialized Math Function)

[besselj](#) - Bessel function of the first kind.

[bessely](#) - Bessel function of the second kind.

[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.

[gcd](#) - Greatest common divisor.

[gammaln](#) - Incomplete gamma function.

[lcm](#) - Least common multiple.

[legendre](#) - Associated Legendre function.

[gammaln](#) - Logarithm of gamma function.

[log2](#) - Dissect floating point numbers.

[pow2](#) - Scale floating point numbers.

[rat](#) - Rational approximation.

[rats](#) - Rational output.

[cart2sph](#) - Transform from Cartesian to spherical coordinates.

[cart2pol](#) - Transform from Cartesian to

- polar coordinates.
- [pol2cart](#) - Transform from polar to Cartesian coordinates.
- [sph2cart](#) - Transform from spherical to Cartesian coordinates.

#### .c2.14.8.18 Specmat (Specialized Matrices)

- [compan](#) - Companion matrix.
- [gallery](#) - Several small test matrices.
- [hadamard](#) - Hadamard matrix.
- [hankel](#) - Hankel matrix.
- [hilb](#) - Hilbert matrix.
- [invhilb](#) - Inverse Hilbert matrix.
- [kron](#) - Kronecker tensor product.
- [magic](#) - Magic square.
- [pascal](#) - Pascal matrix.
- [rosser](#) - Classic symmetric eigenvalue test problem.
- [toeplitz](#) - Toeplitz matrix.
- [vander](#) - Vandermonde matrix.
- [wilkinson](#) - Wilkinson's eigenvalue test matrix

#### .c2.14.8.19 Sounds (Sound Processing Functions)

General sound functions.

- [sound](#) - Convert vector into sound.
- [saxis](#) - Sound axis scaling.

[Computer](#)-specific sound functions.

- [auwrite](#) - Write mu-law encoded audio file.
- [auread](#) - Read mu-law encoded audio file.
- [wavwrite](#) - Write MS Windows .WAV audio file.
- [wavread](#) - Read MS Windows .WAV audio file.
- [mu2lin](#) - Mu-law to linear conversion.
- [lin2mu](#) - Linear to mu-law conversion.

#### .c2.14.8.20 Strfun (Character String Functions)

General.

- [strings](#) - About character strings in MATLAB.
- [abs](#) - Convert string to numeric values.
- [setstr](#) - Convert numeric values to string.
- [isstr](#) - True for string.
- [blanks](#) - String of blanks.
- [deblank](#) - Remove trailing blanks.
- [str2mat](#) - Form text matrix from

individual strings.  
eval - Execute string with MATLAB expression.

String comparison.

strcmp - Compare strings.  
findstr - Find one string within another.  
upper - Convert string to uppercase.  
lower - Convert string to lowercase.  
isletter - True for letters of the alphabet.  
isspace - True for white space characters.  
strrep - Replace a string with another.  
strtok - Find a token in a string.

String to number conversion.

num2str - Convert number to string.  
int2str - Convert integer to string.  
str2num - Convert string to number.  
sprintf - Convert number to string under format control.  
sscanf - Convert string to number under format control.

Hexadecimal to number conversion.

hex2num - Convert hex string to IEEE floating point number.  
hex2dec - Convert hex string to decimal integer.  
dec2hex - Convert decimal integer to hex string.

## 影像與 MATLAB

```
w=imread('wombat.tif');  
figure, imshow(w), pixval on
```

```
size(w)
```

```
imfinfo('emu.tif')
```

影像格式: JPEG、TIFF、GIF、BMP、PNG、HDF、PCX、ICO、CUR、HDF

`imwrite(X, map, 'filename', 'fmt')`

## 影像顯示

## 點處理

### 1. 數學運算

`b= imread('blocks.tif');`

`b1=b+128` (✗)

`y=x+128: b1=unit(double(b)+128` or `b1=imadd(b, 128)`

`y=x-128: b2=imsubtract(b, 128)`

`imshow(b1), figure, imshow(b2)`

`y=x/2: b3=immultiply(b, 0.5);` or `b3=imdivide(b,2);`

`y=2x: b4= immultiply(b, 2);`

`y=x/2+128: b5=imadd(immultiply(b, 0.5), 128);`  
or `b5=imadd(imdivide(b,2), 128);`

### 2. 補色

`y= 255-x: bc=imcomplement(b);`  
`imshow(bc)`

### 3. 直方圖(灰階值分佈圖)

`p=imread('pout.tif');`  
`imshow(p), figure, imhist(p), axis tight`

### 4. 擴展其灰階

```
imadjust(im, [a b], [c d])
```

```
t=imread('tire.tif');  
th=imadjust(t, [], [], 0.5);  
imshow(t), figure, imshow(th)
```

```
plot(t, th, '.'), axis tight
```

## **5. 直方圖等化(equalization)**

```
p=imread('pout.tif');  
ph=histeq(p);  
imshow(p), figure, imhist(ph), axis tight
```

```
en=imread('engineer.tif');  
e=imdivide(en, 4);  
imshow(e), figure, imhist(e), axis tight  
eh=histeq(e);  
imshow(eh), figure, imhist(eh), axis tight
```