MATLAB Toolbox Quick Reference

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Signal Processing Toolbox

Filter Analysis

abs	Absolute value (magnitude).
angle	Phase angle.
freqs	Frequency response of analog filters.
freqspace	Frequency spacing for frequency response.
freqz	Compute the frequency response of digital filters.
freqzplot	Plot frequency response data.
grpdelay	Compute the average filter delay (group delay).
impz	Compute the impulse response of digital filters.
unwrap	Unwrap phase angles.
zplane	Zero-pole plot.

Filter Implementation

conv	Convolution and polynomial multiplication.
conv2	Two-dimensional convolution.
deconv	Deconvolution and polynomial division.
fftfilt	FFT-based FIR filtering using the overlap-add method.
filter	Filter data with a recursive (IIR) or nonrecursive (FIR) filter.
filter2	Two-dimensional digital filtering.
filtfilt	Zero-phase digital filtering.
filtic	Find initial conditions for a transposed direct form II filter implementation.
latcfilt	Lattice and lattice-ladder filter implementation.
medfilt1	One-dimensional median filtering.
sgolayfilt	Savitzky-Golay filtering.
sosfilt	Second-order (biquadratic) IIR digital filtering.
upfirdn	Upsample, apply an FIR filter, and downsample.

FIR Digital Filter Design

convmtx	Convolution matrix.
cremez	Complex and nonlinear-phase equiripple FIR filter design.
fir1	Design a window-based finite impulse response filter.
fir2	Design a frequency sampling-based finite impulse response filter.
fircls	Constrained least square FIR filter design for multiband filters.
fircls1	Constrained least square filter design for lowpass and highpass linear phase FIR filters.
firls	Least square linear-phase FIR filter design.
firrcos	Raised cosine FIR filter design.
intfilt	Interpolation FIR filter design.
kaiserord	Estimate parameters for an FIR filter design with Kaiser window.
remez	Compute the Parks-McClellan optimal FIR filter design.
remezord	Parks-McClellan optimal FIR filter order estimation.
sgolay	Savitzky-Golay filter design.

IIR Digital Filter Design--Classical and Direct

butter	Butterworth analog and digital filter design.
cheby1	Chebyshev type I filter design (passband ripple).
cheby2	Chebyshev type II filter design (stopband ripple).
ellip	Elliptic (Cauer) filter design.
maxflat	Generalized digital Butterworth filter design.
prony	Prony's method for time-domain IIR filter design.
stmcb	Compute a linear model using Steiglitz-McBride iteration.
yulewalk	Recursive digital filter design.

IIR Filter Order Estimation

buttord	Calculate the order and cutoff frequency for a Butterworth filter.
cheb1ord	Calculate the order for a Chebyshev type I filter.
cheb2ord	Calculate the order for a Chebyshev type II filter.
ellipord	Calculate the minimum order for elliptic filters.

Analog Lowpass Filter Prototypes

besselap	Bessel analog lowpass filter prototype.
buttap	Butterworth analog lowpass filter prototype.
cheb1ap	Chebyshev type I analog lowpass filter prototype.
cheb2ap	Chebyshev type II analog lowpass filter prototype.
ellipap	Elliptic analog lowpass filter prototype.

Analog Filter Design

besself	Bessel analog filter design.
butter	Butterworth analog and digital filter design.
cheby1	Chebyshev type I filter design (passband ripple).
cheby2	Chebyshev type II filter design (stopband ripple).
ellip	Elliptic (Cauer) filter design.

Analog Filter Transformation

lp2bp	Transform lowpass analog filters to bandpass.
lp2bs	Transform lowpass analog filters to bandstop.
lp2hp	Transform lowpass analog filters to highpass.
lp2lp	Change the cut-off frequency for a lowpass analog filter.

Filter Discretization

bilinear	Bilinear transformation method for analog-to-digital filter conversion.
impinvar	Impulse invariance method for analog-to-digital filter conversion.

Linear System Transformations

latc2tf	Convert lattice filter parameters to transfer function form.
polystab	Stabilize a polynomial.
polyscale	Scale the roots of a polynomial.
residuez	z-transform partial-fraction expansion.
sos2ss	Convert digital filter second-order section parameters to state-space form.
sos2tf	Convert digital filter second-order section data to transfer function form.
sos2zp	Convert digital filter second-order sections parameters to zero-pole-gain form.
ss2sos	Convert digital filter state-space parameters to second-order sections form.
ss2tf	Convert state-space filter parameters to transfer function form.
ss2zp	Convert state-space filter parameters to zero-pole-gain form.

tf2latc	Convert transfer function filter parameters to lattice filter form.
tf2sos	Convert digital filter transfer function data to second-order sections form.
tf2ss	Convert transfer function filter parameters to state-space form.
tf2zp	Convert transfer function filter parameters to zero-pole-gain form.
zp2sos	Convert digital filter zero-pole-gain parameters to second-order sections form.
zp2ss	Convert zero-pole-gain filter parameters to state-space form.
zp2tf	Convert zero-pole-gain filter parameters to transfer function form.

Windows

bartlett	Compute a Bartlett window.
blackman	Compute a Blackman window.
boxcar	Compute a rectangular window.
chebwin	Compute a Chebyshev window.
hamming	Compute a Hamming window.
hann	Compute the Hann (Hanning) window.
kaiser	Compute a Kaiser window.
triang	Compute a triangular window.

Transforms

czt	Chirp z-transform.
dct	Discrete cosine transform (DCT).
dftmtx	Discrete Fourier transform matrix.
fft	Compute the one-dimensional fast Fourier transform.
fft2	Compute the two-dimensional fast Fourier transform.
fftshift	Rearrange the outputs of the FFT functions.
hilbert	Compute the discrete-time analytic signal using the Hilbert transform.
idct	Inverse discrete cosine transform.
ifft	One-dimensional inverse fast Fourier transform.
ifft2	Two-dimensional inverse fast Fourier transform.

Cepstral Analysis

cceps	Complex cepstral analysis.
icceps	Inverse complex cepstrum.
rceps	Real cepstrum and minimum phase reconstruction.

Statistical Signal Processing and Spectral Analysis

cohere	Estimate magnitude squared coherence function between two signals.
corrcoef	Compute the correlation coefficient matrix.
corrmtx	Compute a data matrix for autocorrelation matrix estimation.
cov	Compute the covariance matrix.
csd	Estimate the cross spectral density (CSD) of two signals.
pburg	Estimate the power spectral density using the Burg method.
pcov	Estimate the power spectral density using the covariance method.
peig	Estimate the pseudospectrum using the eigenvector method.
periodogram	Estimate the power spectral density (PSD) of a signal using a periodogram.
pmcov	Estimate the power spectral density using the modified covariance method.
pmtm	Estimate the power spectral density using the multitaper method (MTM).
pmusic	Estimate the power spectral density using MUSIC algorithm.
psdplot	Plot power spectral density (PSD) data.
pwelch	Estimate the power spectral density (PSD) of a signal using Welch's method.
pyulear	Estimate the power spectral density using the Yule-Walker AR method.
rooteig	Estimate frequency and power content using the eigenvector method.
rootmusic	Estimate frequency and power content using the root MUSIC algorithm.
tfe	Estimate the transfer function from input and output.
xcorr	Estimate the cross-correlation function.
xcorr2	Estimate the two-dimensional cross-correlation.
xcov	Estimate the cross-covariance function (equal to mean-removed cross-correlation).

Parametric Modeling

arburg	Compute an estimate of AR model parameters using the Burg method.
arcov	Compute an estimate of AR model parameters using the covariance method.
armcov	Compute an estimate of AR model parameters using the modified covariance method.
aryule	Compute an estimate of AR model parameters using the Yule-Walker method.
ident	See the System Identification Toolbox documentation.
invfreqs	Identify continuous-time filter parameters from frequency response data.
invfreqz	Identify discrete-time filter parameters from frequency response data.
prony	Prony's method for time domain IIR filter design.
stmcb	Compute a linear model using Steiglitz-McBride iteration.

Linear Prediction

ac2poly	Convert an autocorrelation sequence to prediction polynomial.
ac2rc	Convert an autocorrelation sequence to reflection coefficients.
is2rc	Convert inverse sine parameters to reflection coefficients.
lar2rc	Convert log area ratio parameters to reflection coefficients.
levinson	Compute the Levinson-Durbin recursion.
lpc	Compute linear prediction filter coefficients.
lsf2poly	Convert line spectral frequencies to a prediction filter coefficients.
poly2ac	Convert a prediction filter polynomial to an autocorrelation sequence.
poly2lsf	Convert prediction filter coefficients to line spectral frequencies.
poly2rc	Convert a prediction filter polynomial to reflection coefficients.
rc2ac	Convert reflection coefficients to an autocorrelation sequence.
rc2is	Convert reflection coefficients to inverse sine parameters.
rc2lar	Convert reflection coefficients to log area ratio parameters.
rc2poly	Convert reflection coefficients to a prediction filter polynomial.
rlevinson	Compute the reverse Levinson-Durbin recursion.
schurrc	Compute reflection coefficients from an autocorrelation sequence.

Multirate Signal Processing

decimate	Decrease the sampling rate for a sequence (decimation).
Interp	Increase sampling rat e by an integer factor (interpolation).
interp1	One-dimensional data interpolation (table lookup).
resample	Change sampling rate by any rational factor.
spline	Cubic spline interpolation.
upfirdn	Upsample, apply an FIR filter, and downsample.

Waveform Generation

chirp	Generate a swept-frequency cosine.
diric	Compute the Dirichlet or periodic sinc function.
gauspuls	Generate a Gaussian-modulated sinusoidal pulse.
gmonopuls	Generate a Gaussian monopulse.
pulstran	Generate a pulse train.
rectpuls	Generate a sampled aperiodic rectangle.
sawtooth	Generate a sawtooth or triangle wave.
sinc	Sinc function.
square	Generate a square wave.
tripuls	Generate a sampled aperiodic triangle.
vco	Voltage controlled oscillator.

Specialized Operations

buffer	Buffer a signal vector into a matrix of data frames.
cell2sos	Convert a cell array for second-order sections to a second-order section matrix.
cplxpair	Group complex numbers 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 sequences database directory.
dpssload	Load discrete prolate spheroidal sequences from database.
dpsssave	Save discrete prolate spheroidal sequences in database.
eqtflength	Make the lengths of a transfer function's numerator and denominator equal.
modulate	Modulation for communications simulation.
seqperiod	Compute the period of a sequence.
sos2cell	Convert a second-order section matrix to cell arrays.
specgram	Time-dependent frequency analysis (spectrogram).
stem	Plot discrete sequence data.
strips	Strip plot.
udecode	Decode 2^n-level quantized integer inputs to floating-point outputs.
uencode	Quantize and encode floating-point inputs to integer outputs.

Graphical User Interfaces

fdatool	Open the Filter Design and Analysis Tool.
sptool	Interactive digital signal processing tool (SPTool).

Image Processing Toolbox

Image Display

colorbar	Display colorbar. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
getimage	Get image data from axes
image	Create and display image object. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
imagesc	Scale data and display as image. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
immovie	Make movie from multiframe indexed image
imshow	Display image
montage	Display multiple image frames as rectangular montage
subimage	Display multiple images in single figure
truesize	Adjust display size of image
warp	Display image as texture-mapped surface
zoom	Zoom in and out of image or 2-D plot. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)

Image File I/O

imfinfo	Return information about image file. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
imread	Read image file. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
imwrite	Write image file. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)

Geometric Operations

imcrop	Crop image
imresize	Resize image
imrotate	Rotate image
interp2	2-D data interpolation. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)

Pixel Values and Statistics

corr2	Compute 2-D correlation coefficient
imcontour	Create contour plot of image data
imfeature	Compute feature measurements for image regions
imhist	Display histogram of image data
impixel	Determine pixel color values
improfile	Compute pixel-value cross-sections along line segments
mean2	Compute mean of matrix elements
pixval	Display information about image pixels
std2	Compute standard deviation of matrix elements

Image Analysis

edge	Find edges in intensity image
qtdecomp	Perform quadtree decomposition
qtgetblk	Get block values in quadtree decomposition
qtsetblk	Set block values in quadtree decomposition

Image Enhancement

histeq	Enhance contrast using histogram equalization
imadjust	Adjust image intensity values or colormap
imnoise	Add noise to an image
medfilt2	Perform 2-D median filtering
ordfilt2	Perform 2-D order-statistic filtering

wiener2	Perform 2-D adaptive noise-removal filtering

Linear Filtering

conv2	Perform 2-D convolution. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
convmtx2	Compute 2-D convolution matrix
convn	Perform N-D convolution. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
filter2	Perform 2-D filtering. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
fspecial	Create predefined filters

Linear 2-D Filter Design

freqspace	Determine 2-D frequency response spacing. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
freqz2	Compute 2-D frequency response
fsamp2	Design 2-D FIR filter using frequency sampling
ftrans2	Design 2-D FIR filter using frequency transformation
fwind1	Design 2-D FIR filter using 1-D window method
fwind2	Design 2-D FIR filter using 2-D window method

Image Transforms

dct2	Compute 2-D discrete cosine transform
dctmtx	Compute discrete cosine transform matrix
fft2	Compute 2-D fast Fourier transform. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
fftn	Compute N-D fast Fourier transform. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
fftshift	Reverse quadrants of output of FFT. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
idct2	Compute 2-D inverse discrete cosine transform
ifft2	Compute 2-D inverse fast Fourier transform. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
ifftn	Compute N-D inverse fast Fourier transform. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
iradon	Compute inverse Radon transform
phantom	Generate a head phantom image
radon	Compute Radon transform

Neighborhood and Block Processing

bestblk	Choose block size for block processing
blkproc	Implement distinct block processing for image
col2im	Rearrange matrix columns into blocks
colfilt	Perform neighborhood operations using columnwise functions
im2col	Rearrange image blocks into columns
nlfilter	Perform general sliding-neighborhood operations

Binary Image Operations

applylut	Perform neighborhood operations using lookup tables
bwarea	Compute area of objects in binary image
bweuler	Compute Euler number of binary image
bwfill	Fill background regions in binary image
bwlabel	Label connected components in binary image
bwmorph	Perform morphological operations on binary image
bwperim	Determine perimeter of objects in binary image
bwselect	Select objects in binary image
dilate	Perform dilation on binary image
erode	Perform erosion on binary image
makelut	Construct lookup table for use with applylut

Region-Based Processing

roicolor	Select region of interest, based on color
roifill	Smoothly interpolate within arbitrary region
roifilt2	Filter a region of interest
roipoly	Select polygonal region of interest

Colormap Manipulation

brighten	Brighten or darken colormap. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
cmpermute	Rearrange colors in colormap
cmunique	Find unique colormap colors and corresponding image
colormap	Set or get color lookup table. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
imapprox	Approximate indexed image by one with fewer colors
rgbplot	Plot RGB colormap components. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)

Color Space Conversions

hsv2rgb	Convert HSV values to RGB color space. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
ntsc2rgb	Convert NTSC values to RGB color space
rgb2hsv	Convert RGB values to HSV color space. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
rgb2ntsc	Convert RGB values to NTSC color space
rgb2ycbcr	Convert RGB values to YCbCr color space
ycbcr2rgb	Convert YCbCr values to RGB color space

Image Types and Type Conversions

dither	Convert image using dithering
double	Convert data to double precision. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)
gray2ind	Convert intensity image to indexed image
grayslice	Create indexed image from intensity image by thresholding
im2bw	Convert image to binary image by thresholding
im2double	Convert image array to double precision
im2uint16	Convert image array to 16-bit unsigned integers
im2uint8	Convert image array to 8-bit unsigned integers
ind2gray	Convert indexed image to intensity image
ind2rgb	Convert indexed image to RGB image
isbw	Return true for binary image
isgray	Return true for intensity image
isind	Return true for indexed image
isrgb	Return true for RGB image
mat2gray	Convert matrix to intensity image
rgb2gray	Convert RGB image or colormap to grayscale
rgb2ind	Convert RGB image to indexed image
uint16	Convert data to unsigned 16-bit integers. (This is a MATLAB function. See the online MATLAB

	Function Reference for its reference page.)
uint8	Convert data to unsigned 8-bit integers. (This is a MATLAB function. See the online MATLAB Function Reference for its reference page.)

Toolbox Preferences

iptgetpref	Get value of Image Processing Toolbox preference
iptsetpref	Set value of Image Processing Toolbox preference

Demos

dctdemo	2-D DCT image compression demo
edgedemo	Edge detection demo
firdemo	2-D FIR filtering and filter design demo
imadjdemo	Intensity adjustment and histogram equalization demo
nrfiltdemo	Noise reduction filtering demo
qtdemo	Quadtree decomposition demo
roidemo	Region-of-interest processing demo

Slide Shows

ipss001	Region labeling of steel grains
ipss002	Feature-based logic
ipss003	Correction of nonuniform illumination

Neural Network Toolbox

Analysis Functions

errsurf	Error surface of a single input neuron.
maxlinlr	Maximum learning rate for a linear neuron.

Distance Functions

boxdist	Distance between two position vectors.
dist	Euclidean distance weight function.
linkdist	Link distance function.
mandist	Manhattan distance weight function.

Graphical Interface Function

nntool	Neural Network Tool - Graphical User Interface.

Layer Initialization Functions

initnw	Nguyen-Widrow layer initialization function.
initwb	By-weight-and-bias layer initialization function.

Learning Functions

learncon	Conscience bias learning function.
learngd	Gradient descent weight/bias learning function.
learngdm	Grad. descent w/momentum weight/bias learning function.
learnh	Hebb weight learning function.
learnhd	Hebb with decay weight learning rule.
learnis	Instar weight learning function.
learnk	Kohonen weight learning function.
learnlv1	LVQ1 weight learning function.
learnlv2	LVQ2 weight learning function.
learnos	Outstar weight learning function.
learnp	Perceptron weight and bias learning function.
learnpn	Normalized perceptron weight and bias learning function.
learnsom	Self-organizing map weight learning function.
learnwh	Widrow-Hoff weight and bias learning rule.

Line Search Functions

srchbac	One-dim. minimization using backtracking search.
srchbre	One-dim. interval location using Brent's method.
srchcha	One-dim. minimization using Charalambous' method.
srchgol	One-dim. minimization using Golden section search.
srchhyb	One-dim. minimization using Hybrid bisection/cubic search.

Net Input Derivative Functions

dnetprod	Product net input derivative function.
dnetsum	Sum net input derivative function.

Net Input Functions

netprod	Product net input function.
netsum	Sum net input function.

Network Initialization Functions

initlay	Layer-by-layer network initialization function.

Network Use Functions

adapt	Allow a neural network to adapt.
disp	Display a neural network's properties.
display	Display a neural network variable's name and properties.
init	Initialize a neural network.
sim	Simulate a neural network.
train	Train a neural network.

New Networks Functions

network	Create a custom neural network.
newc	Create a competitive layer.
newcf	Create a cascade-forward backpropagation network.
newelm	Create an Elman backpropagation network.
newff	Create a feed-forward backpropagation network.
newfftd	Create a feed-forward input-delay backprop network.
newgrnn	Design a generalized regression neural network.
newhop	Create a Hopfield recurrent network.
newlin	Create a linear layer.
newlind	Design a linear layer.
newlvq	Create a learning vector quantization network
newp	Create a perceptron.
newpnn	Design a probabilistic neural network.
newrb	Design a radial basis network.
newrbe	Design an exact radial basis network.
newsom	Create a self-organizing map.

Performance Derivative Functions

dmae	Mean absolute error performance derivative function.
dmse	Mean squared error performance derivatives function.
dmsereg	Mean squared error w/reg performance derivative function.
dsse	Sum squared error performance derivative function.

Performance Functions

mae	Mean absolute error performance function.
mse	Mean squared error performance function.
msereg	Mean squared error w/reg performance function.
sse	Sum squared error performance function.

Plotting Functions

hintonw	Hinton graph of weight matrix.
hintonwb	Hinton graph of weight matrix and bias vector.
plotbr	Plot network perf. for Bayesian regularization training.
plotep	Plot weight and bias position on error surface.
plotes	Plot error surface of single input neuron.
plotpc	Plot classification line on perceptron vector plot.
plotperf	Plot network performance.
plotpv	Plot perceptron input target vectors.
plotsom	Plot self-organizing map.
plotv	Plot vectors as lines from the origin.
plotvec	Plot vectors with different colors.

Pre and Post Processing Functions

postmnmx	Unnormalize data which has been norm. by prenmmx.
postreg	Postprocess network response w. linear regression analysis.
poststd	Unnormalize data which has been normalized by prestd.
premnmx	Normalize data for maximum of 1 and minimum of -1.
prepca	Principal component analysis on input data.
prestd	Normalize data for unity standard deviation and zero mean.
tramnmx	Transform data with precalculated minimum and max.
trapca	Transform data with PCA matrix computed by prepca.
trastd	Transform data with precalc. mean & standard deviation.

Simulink Support Function

gensim	Generate a Simulink block for neural network simulation.

Topology Functions

gridtop	Gridtop layer topology function.
hextop	Hexagonal layer topology function.
randtop	Random layer topology function.

Training Functions

trainb	Batch training with weight and bias learning rules.
trainbfg	BFGS quasi-Newton backpropagation.
trainbr	Bayesian regularization.
trainc	Cyclical order incremental update.
traincgb	Powell-Beale conjugate gradient backpropagation.
traincgf	Fletcher-Powell conjugate gradient backpropagation.
traincgp	Polak-Ribiere conjugate gradient backpropagation.
traingd	Gradient descent backpropagation.
traingda	Gradient descent with adaptive lr backpropagation.
traingdm	Gradient descent with momentum backpropagation.
traingdx	Gradient descent with momentum & adaptive lr backprop.
trainlm	Levenberg-Marquardt backpropagation.
trainoss	One step secant backpropagation.
trainr	Random order incremental update.
trainrp	Resilient backpropagation (Rprop).
trains	Sequential order incremental update.
trainscg	Scaled conjugate gradient backpropagation.

Transfer Derivative Functions

dhardlim	Hard limit transfer derivative function.
dhardlms	Symmetric hard limit transfer derivative function.
dlogsig	Log sigmoid transfer derivative function.
dposlin	Positive linear transfer derivative function.
dpurelin	Linear transfer derivative function.
dradbas	Radial basis transfer derivative function.
dsatlin	Saturating linear transfer derivative function.
dsatlins	Symmetric saturating linear transfer derivative function.
dtansig	Hyperbolic tangent sigmoid transfer derivative function.
dtribas	Triangular basis transfer derivative function.

Transfer Functions

compet	Competitive transfer function.
hardlim	Hard limit transfer function.
hardlims	Symmetric hard limit transfer function.
logsig	Log sigmoid transfer function.
poslin	Positive linear transfer function.
purelin	Hard limit transfer function.
radbas	Radial basis transfer function.
satlin	Saturating linear transfer function.
satlins	Symmetric saturating linear transfer function.
softmax	Softmax transfer function.
tansig	Hyperbolic tangent sigmoid transfer function.
tribas	Triangular basis transfer function.

Utility Functions

calca	Calculate network outputs and other signals.
calca1	Calculate network signals for one time step.
calce	Calculate layer errors.
calce1	Calculate layer errors for one time step.
calcgx	Calc. weight and bias perform. gradient as a single vector.
calcjejj	Calculate Jacobian performance vector.
calcjx	Calculate weight and bias performance Jacobian as a single matrix.
calcpd	Calculate delayed network inputs.
calcperf	Calculation network outputs, signals, and performance.
formx	Form bias and weights into single vector.
getx	Get all network weight and bias values as a single vector.
setx	Set all network weight and bias values with a single vector.

Vector Functions

cell2mat	Combine a cell array of matrices into one matrix.
combvec	Create all combinations of vectors.

con2seq	Converts concurrent vectors to sequential vectors.
concur	Create concurrent bias vectors.
ind2vec	Convert indices to vectors.
mat2cell	Break matrix up into cell array of matrices.
minmax	Ranges of matrix rows.
normc	Normalize columns of matrix.
normr	Normalize rows of matrix.
pnormc	Pseudo-normalize columns of matrix.
quant	Discretize value as multiples of a quantity.
seq2con	Convert sequential vectors to concurrent vectors.
sumsqr	Sum squared elements of matrix.
vec2ind	Convert vectors to indices.

Weight and Bias Initialization Functions

initcon	Conscience bias initialization function.
initzero	Zero weight and bias initialization function.
midpoint	Midpoint weight initialization function.
randnc	Normalized column weight initialization function.
randnr	Normalized row weight initialization function.
rands	Symmetric random weight/bias initialization function.
revert	Change ntwk wts. and biases to prev. initialization values.

Weight Derivative Function

ddotprod	Dot product weight derivative function.

Weight Functions

dist	Euclidean distance weight function.
dotprod	Dot product weight function.
mandist	Manhattan distance weight function.
negdist	Negative distance weight function.
normprod	Normalized dot product weight function.

Transfer Function

compet	Competitive transfer function. 
hardlim	Hard limit transfer function. 
hardlims	Symmetric hard limit transfer function 
logsig	Log sigmoid transfer function. 
poslin	Positive linear transfer function 
purelin	Linear transfer function. 
radbas	Radial basis transfer function. 
satlin	Saturating linear transfer function. 
satlins	Symmetric saturating linear transfer function 
softmax	Softmax transfer function. 
tansig	Hyperbolic tangent sigmoid transfer function. 
tribas	Triangular basis transfer function. 

Statistics Toolbox

Parameter Estimation

betafit	Parameter estimation for the beta distribution
betalike	Beta log-likelihood function
binofit	Parameter estimation for the binomial distribution
expfit	Parameter estimation for the exponential distribution
gamfit	Parameter estimation for the gamma distribution
gamlike	Gamma log-likelihood function
mle	Maximum likelihood estimation
normfit	Parameter estimation for the normal distribution
normlike	Normal log-likelihood function
poissfit	Parameter estimation for the Poisson distribution
raylfit	Rayleigh parameter estimation
unifit	Parameter estimation for the uniform distribution
weibfit	Weibull parameter estimation

Cumulative Distribution Functions (cdf)

betacdf	Beta cdf
binocdf	Binomial cdf
cdf	Parameterized cdf routine
chi2cdf	Chi-square cdf
expcdf	Exponential cdf
fcdf	F cdf
gamcdf	Gamma cdf
geocdf	Geometric cdf
hygecdf	Hypergeometric cdf
logncdf	Lognormal cdf
nbincdf	Negative binomial cdf
ncfcdf	Noncentral F cdf
nctcdf	Noncentral t cdf
ncx2cdf	Noncentral Chi-square cdf
normcdf	Normal (Gaussian) cdf
poisscdf	Poisson cdf
raylcdf	Rayleigh cdf
tcdf	Student's t cdf
unidcdf	Discrete uniform cdf
unifcdf	Continuous uniform cdf
weibcdf	Weibull cdf

Probability Density Functions (pdf)

betapdf	Beta pdf
binopdf	Binomial pdf
chi2pdf	Chi-square pdf
exppdf	Exponential pdf
fpdf	F pdf
gampdf	Gamma pdf
geopdf	Geometric pdf

hygepdf	Hypergeometric pdf
lognpdf	Lognormal pdf
nbinpdf	Negative binomial pdf
ncfpdf	Noncentral F pdf
nctpdf	Noncentral t pdf
ncx2pdf	Noncentral Chi-square pdf
normpdf	Normal (Gaussian) pdf
pdf	Parameterized pdf routine
poisspdf	Poisson pdf
raylpdf	Rayleigh pdf
tpdf	Student's t pdf
unidpdf	Discrete uniform pdf
unifpdf	Continuous uniform pdf
weibpdf	Weibull pdf

Inverse Cumulative Distribution Functions

betainv	Beta critical values
binoinv	Binomial critical values
chi2inv	Chi-square critical values
expinv	Exponential critical values
finv	F critical values
gaminv	Gamma critical values
geoinv	Geometric critical values
hygeinv	Hypergeometric critical values
icdf	Parameterized inverse distribution routine
logninv	Lognormal critical values
nbininv	Negative binomial critical values
ncfinv	Noncentral F critical values
nctinv	Noncentral t critical values
ncx2inv	Noncentral Chi-square critical values
norminv	Normal (Gaussian) critical values
poissinv	Poisson critical values
raylinv	Rayleigh critical values
tinv	Student's t critical values
unidinv	Discrete uniform critical values
unifinv	Continuous uniform critical values
weibinv	Weibull critical values

Random Number Generators

betarnd	Beta random numbers
binornd	Binomial random numbers
chi2rnd	Chi-square random numbers
exprnd	Exponential random numbers
frnd	F random numbers
gamrnd	Gamma random numbers
geornd	Geometric random numbers
hygernd	Hypergeometric random numbers
lognrnd	Lognormal random numbers
mvnrnd	Multivariate normal random numbers
mvtrnd	Multivariate t random numbers
nbinrnd	Negative binomial random numbers
ncfrnd	Noncentral F random numbers
nctrnd	Noncentral t random numbers
ncx2rnd	Noncentral Chi-square random numbers
normrnd	Normal (Gaussian) random numbers
poissrnd	Poisson random numbers
random	Parameterized random number routine
raylrnd	Rayleigh random numbers
trnd	Student's t random numbers
unidrnd	Discrete uniform random numbers
unifrnd	Continuous uniform random numbers
weibrnd	Weibull random numbers

Moments of Distribution Functions

betastat	Beta mean and variance
binostat	Binomial mean and variance
chi2stat	Chi-square mean and variance
expstat	Exponential mean and variance
fstat	F mean and variance
gamstat	Gamma mean and variance
geostat	Geometric mean and variance
hygestat	Hypergeometric mean and variance
lognstat	Lognormal mean and variance
nbinstat	Negative binomial mean and variance
ncfstat	Noncentral F mean and variance
nctstat	Noncentral t mean and variance
ncx2stat	Noncentral Chi-square mean and variance
normstat	Normal (Gaussian) mean and variance
poisstat	Poisson mean and variance
raylstat	Rayleigh mean and variance
tstat	Student's t mean and variance
unidstat	Discrete uniform mean and variance
unifstat	Continuous uniform mean and variance
weibstat	Weibull mean and variance

Descriptive Statistics

bootstrp	Bootstrap statistics for any function
corrcoef	Correlation coefficients (in MATLAB)
cov	Covariance matrix (in MATLAB)
crosstab	Cross tabulation
geomean	Geometric mean
grpstats	Summary statistics by group
harmmean	Harmonic mean
iqr	Interquartile range
kurtosis	Sample kurtosis
mad	Mean absolute deviation
mean	Arithmetic average (in MATLAB)
median	50th percentile (in MATLAB)
moment	Central moments of all orders
nanmax	Maximum ignoring missing data
nanmean	Average ignoring missing data
nanmedian	Median ignoring missing data
nanmin	Minimum ignoring missing data
nanstd	Standard deviation ignoring missing data
nansum	Sum ignoring missing data
prctile	Empirical percentiles of a sample
range	Sample range
skewness	Sample skewness
std	Standard deviation (in MATLAB)
tabulate	Frequency table
trimmean	Trimmed mean
var	Variance

Statistical Plotting

boxplot	Box plots
cdfplot	Plot of empirical cumulative distribution function
errorbar	Error bar plot

fsurfht	Interactive contour plot of a function
gline	Interactive line drawing
gname	Interactive point labeling
gplotmatrix	Matrix of scatter plots grouped by a common variable
gscatter	Scatter plot of two variables grouped by a third
lsline	Add least-squares fit line to plotted data
normplot	Normal probability plots
pareto	Pareto charts
qqplot	Quantile-Quantile plots
rcoplot	Regression case order plot
refcurve	Reference polynomial
refline	Reference line
surfht	Interactive interpolating contour plot
weibplot	Weibull plotting

Statistical Process Control

capable	Quality capability indices
capaplot	Plot of process capability
ewmaplot	Exponentially weighted moving average plot
histfit	Histogram and normal density curve
normspec	Plot normal density between limits
schart	Time plot of standard deviation
xbarplot	Time plot of means

Cluster Analysis

cluster	Create clusters from linkage output
clusterdata	Create clusters from a dataset
cophenet	Calculate the cophenetic correlation coefficient
dendrogram	Plot a hierarchical tree in a dendrogram graph
inconsistent	Calculate the inconsistency values of objects in a cluster hierarchy tree
linkage	Link objects in a dataset into a hierarchical tree of binary clusters
pdist	Calculate the pairwise distance between objects in a dataset
squareform	Reformat output of pdist function from vector to square matrix
zscore	Normalize a dataset before calculating the distance

Linear Models

anova1	One-way Analysis of Variance (ANOVA)
anova2	Two-way Analysis of Variance
anovan	N-way analysis of variance
aoctool	Interactive tool for analysis of covariance
dummyvar	Dummy-variable coding
friedman	Friedman's test (nonparametric two-way anova)
glmfit	Generalized linear model fitting
kruskalwallis	Kruskal-Wallis test (nonparametric one-way anova)
leverage	Regression diagnostic
lscov	Regression given a covariance matrix (in MATLAB)
manova1	One-way multivariate analysis of variance
manovacluster	Draw clusters of group means for manova1
multcompare	Multiple comparisons of means and other estimates
polyconf	Polynomial prediction with confidence intervals
polyfit	Polynomial fitting (in MATLAB)
polyval	Polynomial prediction (in MATLAB)
rcoplot	Residuals case order plot
regress	Multiple linear regression
regstats	Regression diagnostics
ridge	Ridge regression
rstool	Response surface tool
robustfit	Robust regression model fitting
rstool	Multidimensional response surface visualization (RSM)
stepwise	Stepwise regression GUI
x2fx	Factor settings matrix (X) to design matrix (D)

Nonlinear Regression

nlinfit	Nonlinear least-squares fitting
nlintool	Prediction graph for nonlinear fits
nlparci	Confidence intervals on parameters
nlpredci	Confidence intervals for prediction
nnls	Nonnegative least squares (in MATLAB)

Design of Experiments

cordexch	D-optimal design using coordinate exchange
daugment	D-optimal augmentation of designs
dcovary	D-optimal design with fixed covariates
ff2n	Two-level full factorial designs
fracfact	Two-level fractional factorial design
fullfact	Mixed level full factorial designs
hadamard	Hadamard designs (in MATLAB)
rowexch	D-optimal design using row exchange

Principal Components Analysis

barttest	Bartlett's test
pcacov	PCA from covariance matrix
pcares	Residuals from PCA
princomp	PCA from raw data matrix

Multivariate Statistics

classify	Linear Discriminant Analysis
mahal	Mahalanobis distance
manova1	One-way multivariate analysis of variance
manovacluster	Draw clusters of group means for manova1

Hypothesis Tests

ranksum	Wilcoxon rank sum test
signrank	Wilcoxon signed rank test
signtest	Sign test for paired samples
ttest	One sample t-test
ttest2	Two sample t-test
ztest	Z-test

Distribution Testing

jbtest	Jarque-Bera test of normality
kstest	Kolmogorov-Smirnov test for one sample
kstest2	Kolmogorov-Smirnov test for two samples
lillietest	Lilliefors test of normality

Nonparametric Testing

friedman	Friedman's test (nonparametric two-way anova)
kruskalwallis	Kruskal-Wallis test (nonparametric one-way anova)
ranksum	Wilcoxon rank sum test (independent samples)
signrank	Wilcoxon sign rank test (paired samples)
signtest	Sign test (paired samples)

File I/O

caseread	Read casenames from a file
casewrite	Write casenames from a string matrix to a file
tblread	Retrieve tabular data from the file system
tblwrite	Write data in tabular form to the file system
tdfread	Read in text and numeric data from tab-delimited file

Demonstrations

aoctool	Interactive tool for analysis of covariance
disttool	Interactive exploration of distribution functions
glmdemo	Generalized linear model slide show
randtool	Interactive random number generation
polytool	Interactive fitting of polynomial models
rsmdemo	Interactive process experimentation and analysis
robustdemo	Interactive tool to compare robust and least squares fits

Data

census.mat	U. S. Population 1790 to 1980
cities.mat	Names of U.S. metropolitan areas
discrim.mat	Classification data
gas.mat	Gasoline prices
hald.mat	Hald data
hogg.mat	Bacteria counts from milk shipments
lawdata.mat	GPA versus LSAT for 15 law schools
mileage.mat	Mileage data for three car models from two factories
moore.mat	Five factor - one response regression data
parts.mat	Dimensional runout on 36 circular parts
popcorn.mat	Data for popcorn example (anova2, friedman)
polydata.mat	Data for polytool demo
reaction.mat	Reaction kinetics data
sat.dat	ASCII data for tblread example

Optimization Toolbox

Minimization

fgoalattain	Multiobjective goal attainment
fminbnd	Scalar nonlinear minimization with bounds
fmincon	Constrained nonlinear minimization
fminimax	Minimax optimization
fminsearch,fminunc	Unconstrained nonlinear minimization
fseminf	Semi-infinite minimization
linprog	Linear programming
quadprog	Quadratic programming

Equation Solving

****	Use \ (left division) to solve linear equations. See the Arithmetic Operators reference page.
fsolve	Nonlinear equation solving
fzero	Scalar nonlinear equation solving

Least Squares (Curve Fitting)

****	Use \ (left division) for linear least squares with no constraints. See the Arithmetic Operators reference page.
lsqlin	Constrained linear least squares
lsqcurvefit	Nonlinear curve fitting
lsqnonlin	Nonlinear least squares
lsqnonneg	Nonnegative linear least squares
optimset,optimget	Parameter setting

Database Toolbox

General

logintimeout	Set or get time allowed to establish database connection.
setdbprefs	Set preferences for database actions for handling NULL values.

Database Connection

clearwarnings	Clear warnings for database connection.
close	Close database connection.
database	Connect to database.
get	Get property of database connection.
isconnection	Detect if database connection is valid.
isreadonly	Detect if database connection is read-only.
ping	Get status information about database connection.
set	Set properties for database connection.
sql2native	Convert JDBC SQL grammar to system's native SQL grammar.

SQL Cursor

close	Close cursor.
exec	Execute SQL statement and open cursor.
get	Get property of cursor object.
querytimeout	Get time allowed for a database SQL query to succeed.
set	Set RowLimit for cursor fetch.

Importing Data into MATLAB

attr	Get attributes of columns in fetched data set.
cols	Get number of columns in fetched data set.
columnnames	Get names of columns in fetched data set.
fetch	Import data into MATLAB cell array.
rows	Get number of rows in fetched data set.
width	Get field size of column in fetched data set.

Exporting Data to a Database

commit	Make database changes permanent.
insert	Export MATLAB cell array data into database table.
rollback	Undo database changes.
update	Replace data in database table with data from MATLAB cell array.

Database Metadata Object

bestrowid	Get database table unique row identifier.
columnprivileges	Get database column privileges.
columns	Get database table column names.
crossreference	Get information about primary and foreign keys.
dmd	Construct database metadata object.
exportedkeys	Get information about exported foreign keys.
get	Get database metadata properties.
importedkeys	Get information about imported foreign keys.
indexinfo	Get indices and statistics for database table.
primarykeys	Get primary key information for database table or schema.
procedurecolumns	Get catalog's stored procedure parameters and result columns.
procedures	Get catalog's stored procedures.
supports	Detect if property is supported by database metadata object.
tableprivileges	Get database table privileges.
tables	Get database table names.
versioncolumns	Get automatically updated table columns.

Driver Object

driver	Construct database driver object.
get	Get database driver properties.
isdriver	Detect if driver is a valid JDBC driver object.
isjdbc	Detect if driver is JDBC-compliant.
isurl	Detect if the database URL is valid.
register	Load database driver.
unregister	Unload database driver.

Drivermanager Object

drivermanager	Construct database drivermanager object.
get	Get database drivermanager properties.
set	Set database drivermanager properties.

Resultset Object

clearwarnings	Clear the warnings for the resultset.
close	Close resultset object.
get	Get resultset properties.
isnullcolumn	Detect if last record read in resultset was NULL.
namecolumn	Map resultset column name to resultset column index.

Resultset Metadata Object

get	Get resultset metadata properties.
rsmd	Construct resultset metadata object.

Visual Query Builder

confds	Configure data source for use with Visual Query Builder (JDBC only).
querybuilder	Start visual SQL query builder.