

Appendix C

Making and Printing Plots in MATLAB

C.1 Introduction

The following information, most directly from MATLAB's `help` function, should be helpful in making and printing plots of functions. Note that MATLAB's help file lists MATLAB commands in all capital letters, though the actual commands are always all lower-case.

C.2 The `plot` Function

The `plot` function is used to plot sets of data on a 2-D grid. What follows comes directly from MATLAB's `help` function (some paragraphs have been snipped out):

```
PLOT    Linear plot.
        PLOT(X,Y) plots vector Y versus vector X. If X or Y is a matrix,
        then the vector is plotted versus the rows or columns of the matrix,
        whichever line up. If X is a scalar and Y is a vector, disconnected
        line objects are created and plotted as discrete points vertically at
        X.

        PLOT(Y) plots the columns of Y versus their index.
        If Y is complex, PLOT(Y) is equivalent to PLOT(real(Y),imag(Y)).
        In all other uses of PLOT, the imaginary part is ignored.

        Various line types, plot symbols and colors may be obtained with
        PLOT(X,Y,S) where S is a character string made from one element
        from any or all the following 3 columns:
```

Color code	Meaning	Symbol code	Meaning	Line code	Meaning
b	blue	.	point	-	solid
g	green	o	circle	:	dotted
r	red	x	x-mark	-.	dashdot
c	cyan	+	plus	-	dashed
m	magenta	*	star		
y	yellow	s	square		
k	black	d	diamond		
w	white	v	triangle (down)		
		^	triangle (up)		
		<	triangle (left)		
		>	triangle (right)		
		p	pentagram		
		h	hexagram		

Table C.1: Color, Point, and Line Codes for plot

(continued)

For example, `PLOT(X,Y,'c+:')` plots a cyan dotted line with a plus at each data point; `PLOT(X,Y,'bd')` plots blue diamond at each data point but does not draw any line.

`PLOT(X1,Y1,S1,X2,Y2,S2,X3,Y3,S3,...)` combines the plots defined by the (X,Y,S) triples, where the X's and Y's are vectors or matrices and the S's are strings.

For example, `PLOT(X,Y,'y-',X,Y,'go')` plots the data twice, with a solid yellow line interpolating green circles at the data points.

The PLOT command, if no color is specified, makes automatic use of the colors specified by the axes `ColorOrder` property. The default `ColorOrder` is listed in the table above for color systems where the default is blue for one line, and for multiple lines, to cycle through the first six colors in the table. For monochrome systems, PLOT cycles over the axes `LineStyleOrder` property.

If you do not specify a marker type, PLOT uses no marker.

If you do not specify a line style, PLOT uses a solid line.

% snip

The X,Y pairs, or X,Y,S triples, can be followed by parameter/value pairs to specify additional properties of the lines. For example, `PLOT(X,Y,'LineWidth',2,'Color',[.6 0 0])` will create a plot with a dark red line width of 2 points.

C.3 The subplot Function

The `subplot` function is used to plot multiple plot windows within the same figure. What follows comes directly from MATLAB's help function.

```

SUBPLOT Create axes in tiled positions.
  H = SUBPLOT(m,n,p), or SUBPLOT(mnp), breaks the Figure window
  into an m-by-n matrix of small axes, selects the p-th axes for
  for the current plot, and returns the axis handle. The axes
  are counted along the top row of the Figure window, then the
  second row, etc. For example,

      SUBPLOT(2,1,1), PLOT(income)
      SUBPLOT(2,1,2), PLOT(outgo)

plots income on the top half of the window and outgo on the
bottom half. If the CurrentAxes is nested in a uipanel the
panel is used as the parent for the subplot instead of the
current figure.

SUBPLOT(m,n,p), if the axis already exists, makes it current.
SUBPLOT(m,n,p,'replace'), if the axis already exists, deletes it and
creates a new axis.
SUBPLOT(m,n,p,'align') places the axes so that the plot boxes
are aligned instead of preventing the labels and ticks from
overlapping.
SUBPLOT(m,n,P), where P is a vector, specifies an axes position
that covers all the subplot positions listed in P.
SUBPLOT(H), where H is an axis handle, is another way of making
an axis current for subsequent plotting commands.

SUBPLOT('position',[left bottom width height]) creates an
axis at the specified position in normalized coordinates (in
in the range from 0.0 to 1.0).

SUBPLOT(m,n,p, PROP1, VALUE1, PROP2, VALUE2, ...) sets the
specified property-value pairs on the subplot axis. To add the
subplot to a specific figure pass the figure handle as the
value for the 'Parent' property.

If a SUBPLOT specification causes a new axis to overlap an
existing axis, the existing axis is deleted - unless the position
of the new and existing axis are identical. For example,
the statement SUBPLOT(1,2,1) deletes all existing axes overlapping
the left side of the Figure window and creates a new axis on that
side - unless there is an axes there with a position that exactly
matches the position of the new axes (and 'replace' was not specified),
in which case all other overlapping axes will be deleted and the
matching axes will become the current axes.
% snip

```

C.4 The orient Function

The `orient` function is used to change how the plot is oriented on the page when printing. Note that it does not affect how the plot looks on the screen. Furthermore, the `orient` command must be used each time a new figure opens for that figure to have a specified orientation. What follows comes directly from MATLAB's help function.

```
ORIENT Set paper orientation for printing.
  ORIENT is used to set up the orientation of a Figure or Model
  window for printing.

  ORIENT LANDSCAPE causes subsequent PRINT operations from the current
  Figure window to generate output in full-page landscape orientation
  on the paper.

  ORIENT ROTATED causes subsequent PRINT operations from the current
  Figure window to generate output in full-page rotated orientation
  on the paper.

  ORIENT PORTRAIT causes subsequent PRINT operations from the current
  Figure window to generate output in portrait orientation.

  ORIENT TALL causes the current Figure window to map to the whole page
  in portrait orientation for subsequent PRINT operations.

  ORIENT, by itself, returns a string containing the paper
  orientation, either PORTRAIT, LANDSCAPE, ROTATED or TALL
  of the current Figure.

  ORIENT(FIGHandle) or ORIENT(MODELName) returns the current
  orientation of the Figure or Model.

  ORIENT( FIG, ORIENTATION) specifies which figure to orient and how to
  orient it based on the rules given above. ORIENTATION is one of
  'landscape', 'portrait', 'rotated', or 'tall'.
% snip
```

C.5 The print Function

The `print` function is used to save a plot as a PostScript file. What follows comes directly from MATLAB's help function. Note that the entire help file is not reproduced here – only the parts that are most useful.

```

PRINT Print figure or model. Save to disk as image or M-file.
SYNTAX:
  print
  PRINT alone sends the current figure to your current printer.
  The size and position of the printed output depends on the figure's
  PaperPosition[mode] properties and your default print command
  as specified in your PRINTOPT.M file.
% snip
  print -device -options
  You can optionally specify a print device (i.e., an output format such
  as tiff or PostScript or a print driver that controls what is sent to
  your printer) and options that control various characteristics of the
  printed file (i.e., the resolution, the figure to print
  etc.). Available devices and options are described below.

  print -device -options filename
  If you specify a filename, MATLAB directs output to a file instead of
  a printer. PRINT adds the appropriate file extension if you do not
  specify one.
% snip
  SPECIFYING THE OUTPUT FILE:
  <filename> % String on the command line
% snip
  COMMON DEVICE DRIVERS
  Output format is specified by the device driver input argument. This
  argument always starts with '-d' and falls into one of several
  categories:
% snip
  Built-in MATLAB Drivers:
  -dps      % PostScript for black and white printers
  -dpsc     % PostScript for color printers
  -dps2     % Level 2 PostScript for black and white printers
  -dpsc2    % Level 2 PostScript for color printers

  -deps     % Encapsulated PostScript
  -depsc    % Encapsulated Color PostScript
  -deps2    % Encapsulated Level 2 PostScript
  -depsc2   % Encapsulated Level 2 Color PostScript

  -dhpgl    % HPGL compatible with Hewlett-Packard 7475A plotter
  -dill     % Adobe Illustrator 88 compatible illustration file
  -djpeg<nn> % JPEG image, quality level of nn (figures only)
             E.g., -djpeg90 gives a quality level of 90.
             Quality level defaults to 75 if nn is omitted.
  -dtiff    % TIFF with packbits (lossless run-length encoding)
             compression (figures only)
  -dtiffnocompression % TIFF without compression (figures only)
  -dpng     % Portable Network Graphic 24-bit truecolor image
             (figures only)
% snip

```

C.6 Example

The following MATLAB code demonstrates how to fill the fourth window of a 2x3 plot figure, save the figure as a PostScript file, and preview it with `kghostview`:

<code>>>x=-1:0.001:1;</code>	Create a vector of numbers between -1 and 1 with 0.001 between numbers
<code>>>usf = inline('t>=0', 't');</code>	This formula for usf is one of several ways to define the unit step function
<code>>>subplot(2,3,4)</code>	Create a figure with two rows of three figures and make subplot 4 (bottom row left) current
<code>>>plot(x, usf(x))</code>	Plot the function usf against the vector x
<code>>>axis([-1, 1, -1, 2])</code>	Change the axes so the function is not covered by the subplot box. The values are $[x_{min}, x_{max}, y_{min}, y_{max}]$
<code>>>title('Unit Step Function')</code>	Give the current subplot a title
<code>>>xlabel('x')</code>	Set the x-label
<code>>>ylabel('u(x)')</code>	Set the y-label
<code>>>orient landscape</code>	Use landscape (wide) orientation
<code>>>print -deps usfplot</code>	Send the current figure to a file named usfplot.eps . Note that the '.eps' is automatically added
<code>>>!kghostview usfplot.eps</code>	The ! character lets MATLAB act as if you were at a regular terminal. This command lets you view usfplot.eps using kghostview .

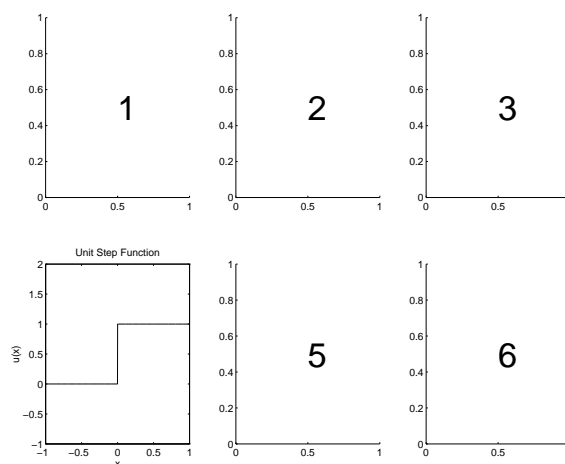


Figure C.1: Sample Output