

# Numerical Analysis MTH614

Spring 2012, Korea University

**MATLAB basic II**  
**Graph plots**

# 2 Dimensional plot

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- Basic commands

- figure : figure creates figure graphics objects.
- hold on : hold on retains the current graph and adds another graph to it.
- hold off : hold off resets hold on.

- plot

- plot(Y) plots the columns of Y versus the index of each value when Y is a real number.
- plot(X, Y) plots the columns of Y versus the corresponding X values.
- Can choose colors and line styles in the order specified by Color and Line Style command, plot(X, Y, S).

- Allowable color and symbols types are summarized in the following tables.

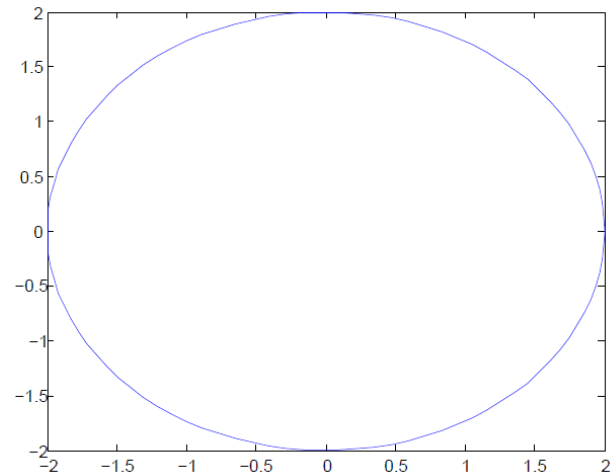
'c' character	Line color
y	yellow
m	magenta
c	cyan
r	red
g	green
b	blue
w	white
k	black

'ss' string	symbol
.	point
o	circle
x	X-mark
+	plus
-	solid line
*	star
:	dotted line
-.	dashdot line

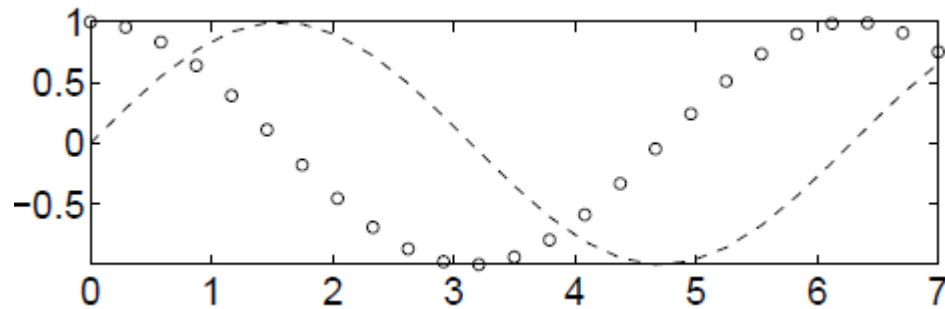
For example, `plot( X, Y, 'b' );`  
`plot( X1, Y1, 'o', X2, Y2, 'x', X3, Y3, '-' );`

For example

```
t=linspace(0,2*pi,100); x=2*cos(t); y=2*sin(t);  
plot(x,y)
```



```
plot(x,sin(x),'k--',x,cos(x),'ko')
```



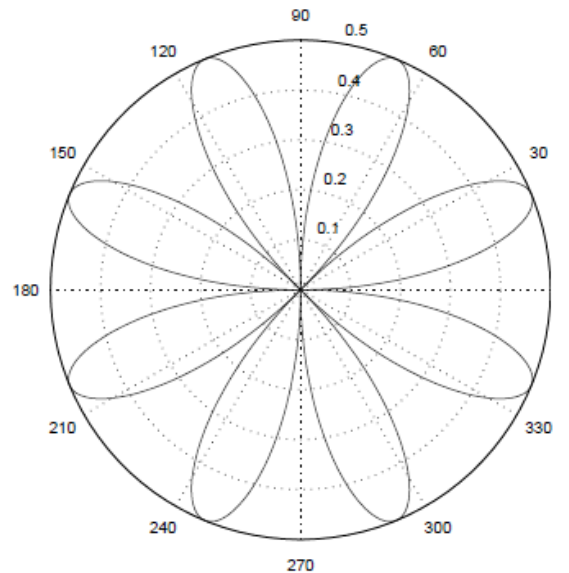
- Polar coordinates

“polar” matlab command enables us to draw the graphs of polar equations having the form  $r = f(\theta)$ .

For example

$$r = \sin 2\theta \cos 2\theta, \quad 0 \leq \theta \leq 2\pi$$

```
t = 0:0.01:2*pi;  
polar(t,sin(2*t).*cos(2*t),'k-')
```



- Bar graph

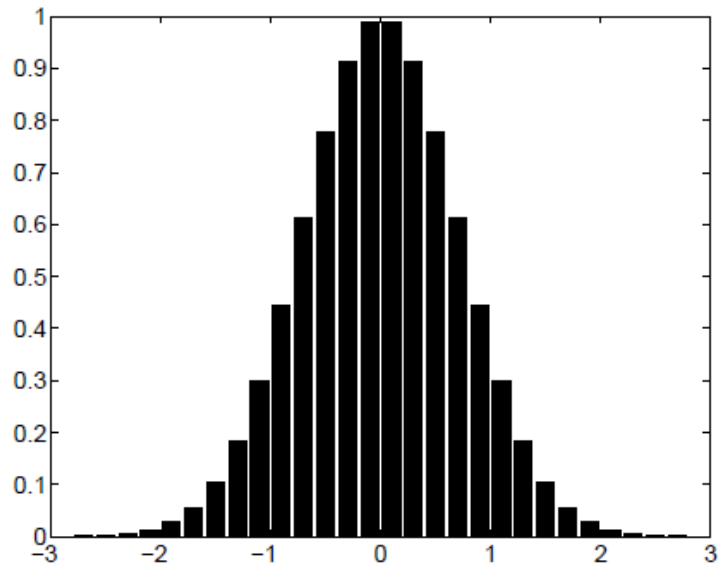
`bar(X,Y)` draws a bar for each element in `Y` at locations specified in `X`.

For example

Let us draw the exponential function with the bar command.

$$y = e^{-x^2}$$

```
x = -2.9:0.2:2.9;  
bar(x,exp(-x.*x),'k')
```

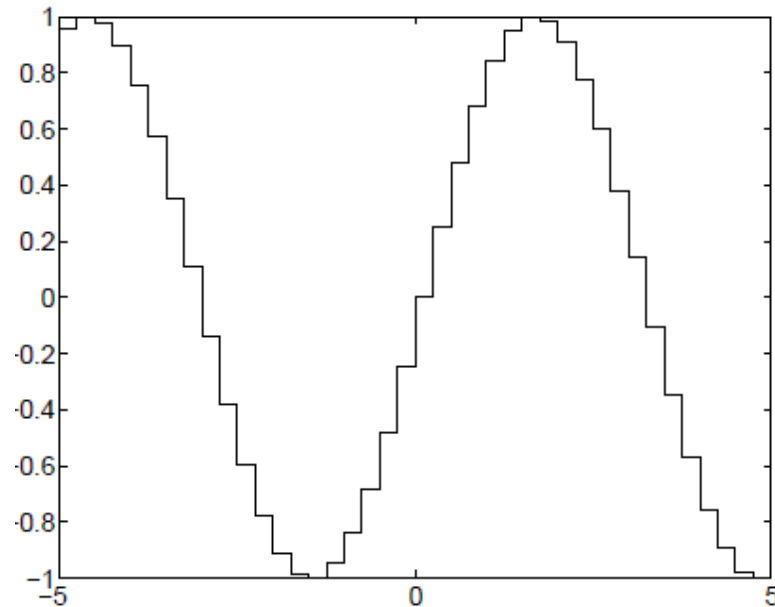


- Stairstep graph

`stairs(X,Y)` plots a stairstep graph of elements of  $Y$  at the locations specified in  $X$ .

For example

```
x = -5:0.25:5;  
stairs(x,sin(x),'k-')
```

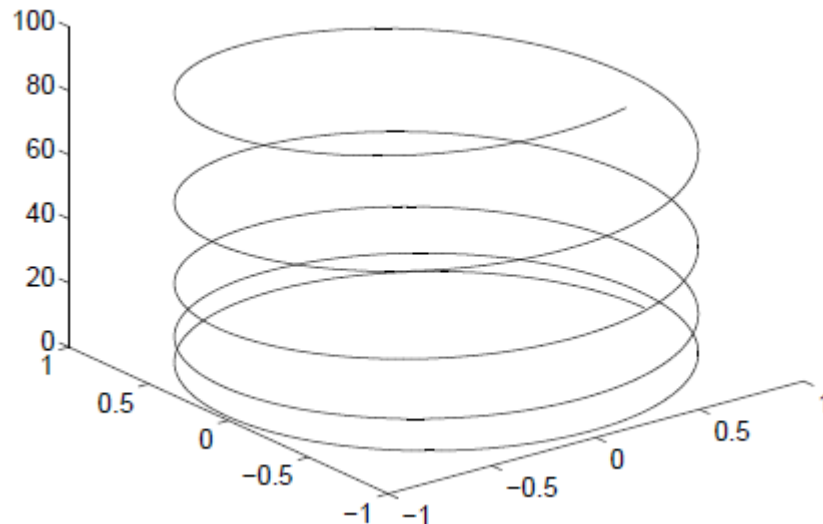


- 3-D line plot

`plot3(X1,Y1,Z1)`, where  $X1$ ,  $Y1$ ,  $Z1$  are vectors, plots one line in three-dimensional space through the points whose coordinates are the elements of  $X1$ ,  $Y1$ , and  $Z1$ .

For example, let us draw a curve in three dimensional space. We have a function  $f(t) = \cos 3t\mathbf{i} + \sin 3t\mathbf{j} + t^2\mathbf{k}$  in given interval  $[0, 10]$ .

```
t = 0:0.01:10; x = cos(3*t); y = sin(3*t); z = t.^2;  
plot3(x,y,z,'k-')
```





- Mesh plot

meshgrid: Generate X and Y matrices for three-dimensional plot.

- `[X,Y]=meshgrid(xmin:xmax, ymin:ymax)`

mesh(X,Y,Z) draws a wireframe mesh with color determined by the height or the value of Z. Since X and Y are matrices, (X(i,j), Y(i,j), Z(i,j)) are the intersections of the wireframe grid lines.

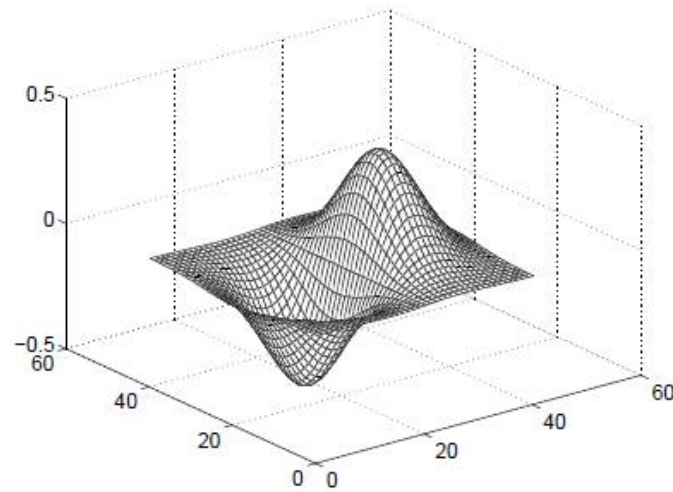
meshc(X,Y,Z) also draws a contour plot beneath the mesh.

For example, we create a three dimensional surface  $z = xe^{-x^2-y^2}$ .  
First, define the domain  $[-2, 2] \times [-1, 1] \in \mathbb{R}^2$  using meshgrid command.  
Then we evaluate the function.

Let's see the following MATLAB script

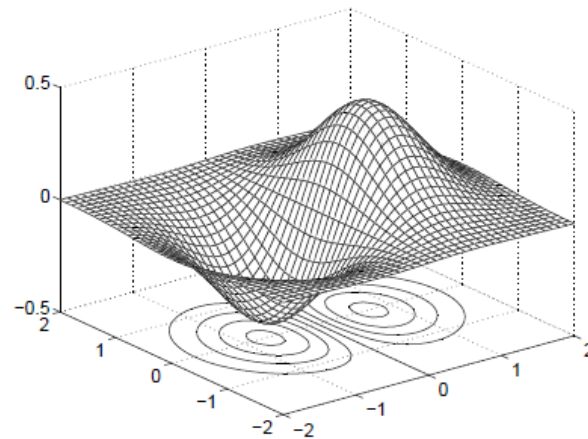
Draw a wireframe mesh

```
[X,Y] = meshgrid(-2:0.1:2, -2:0.1:2);  
Z = X.*exp(-X.^2 -Y.^2); mesh(Z)
```



Plot a contour graph under mesh graph

```
[x, y] = meshgrid(-2:0.1:2, -2:0.1:2);  
z = x.*exp(-x.^2 -y.^2); meshc(x,y,z);
```



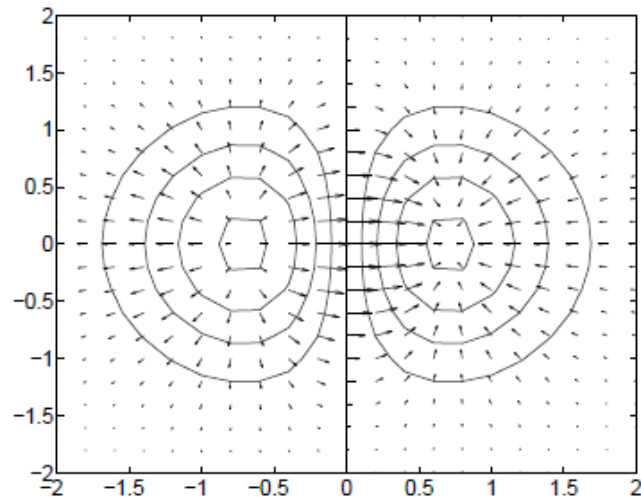
- velocity plot "quiver"

A quiver plot displays velocity vectors as arrows with components (u,v) at the points (x,y).

MATLAB command "quiver(x,y,u,v)" plots vectors as arrows at the coordinates specified in each corresponding pair of elements in x and y.

For example, we draw the vector plot of the same function  $z = xe^{-x^2-y^2}$ .

```
[x, y] = meshgrid(-2:0.2:2); z = x.*exp(-x.^2 -y.^2);  
[px,py] = gradient(z,0.2,0.2); contour(x,y,z)  
hold on; quiver(x,y,px,py)
```



- Isosurface

`fv = isosurface(X,Y,Z,V,isovalue)` computes isosurface data from the volume data `V` at the isosurface value specified in `isovalue`. You can pass the `fv` structure created by `isosurface` directly to the `patch` command.

`patch` can create one or more filled polygons.  
Set also can handle graphics object properties.

For example, we draw a sphere using `isosurface`, `patch`, and `set`.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%% show_isosur.m %%%%%%%%%%  
clear; n=64; x=linspace(0,1,n); y=x; z=x;  
[xx,yy,zz]=meshgrid(x,y,z);  
for k=1:n  
    for j=1:n  
        for i=1:n  
            S(i,j,k)=0.5*(1.0+tanh(0.25-sqrt((x(i)-0.5)^2+(y(j)-0.5)^2+...  
                (z(k)-0.5)^2)));  
        end  
    end  
end  
p=patch(isosurface(xx,yy,zz,S,0.5));
```

```
set(p,'FaceColor','magenta','EdgeColor','none'); daspect([1 1 1])  
camlight;lighting phong; axis image;  
axis([0.2 0.8 0.2 0.8 0.2 0.8])
```

