



石家莊鐵道大學  
SHIJIAZHUANG TIEDAO UNIVERSITY

在线开放课程

MATLAB绘图

三维图形绘制

主讲：卞建鹏

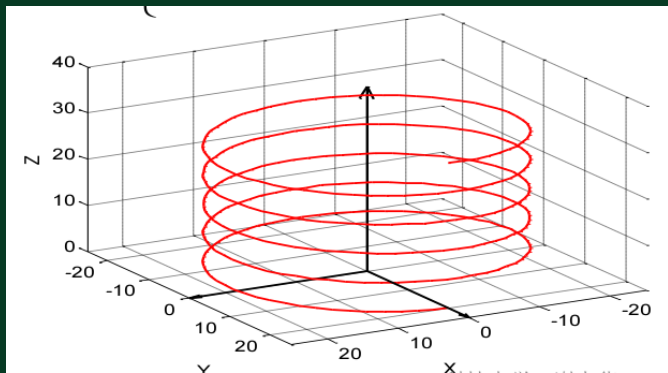
# 1、三维绘图函数

函数名	功能说明	函数名	功能说明
plot3	三维线图	sphere	单位球面
mesh	三维网格图	ellipsoid	椭球面
surf	三维表面图	quiver3	三维箭头
fill3	三维填充图	pie3	三维饼图
trimesh	三角网格图	bar3	竖直三维柱状图
trisurf	三角表面图	bar3h	水平三维柱状图
ezmesh	易用的三维网格绘图	stem3	三维火柴杆图
ezsurf	易用的三维彩色面绘图	contour	矩阵等高线图
meshc	带等高线的网格图	contour3	三维等高线图
surfc	带等高线的面图	contourf	填充二维等高线图
surf1	具有亮度的三维表面图	waterfall	瀑布图
hist3	三维直方图	pcolor	伪色彩图
slice	立体切片图	hidden	设置网格图的透明度
cylinder	圆柱面	alpha	设置图形对象的透明度

# 1、三维线图

用plot3函数绘制三维螺旋线

$$\begin{cases} x = 20 \sin \theta \\ y = 20 \cos \theta \\ z = \theta \end{cases}$$



# 1、三维线图

```
>> t = linspace(0, 10*pi, 300);  
>> x = 20*sin(t); y = 20*cos(t); z = t;  
>> plot3(x, y, z, 'r', 'linewidth', 2);  
>> hold on  
>> quiver3(0,0,0,1,0,0,25,'k', 'LineWidth',2);  
>> quiver3(0,0,0,0,1,0,25,'k', 'LineWidth',2);  
>> quiver3(0,0,0,0,0,1,40,'k', 'LineWidth',2);  
>> grid on  
>> xlabel('X'); ylabel('Y'); zlabel('Z');  
>> axis([-25 25 -25 25 0 40]);  
>> view(-210,30);
```

## 2、三维面图

### (1) 调用meshgrid函数划分网格

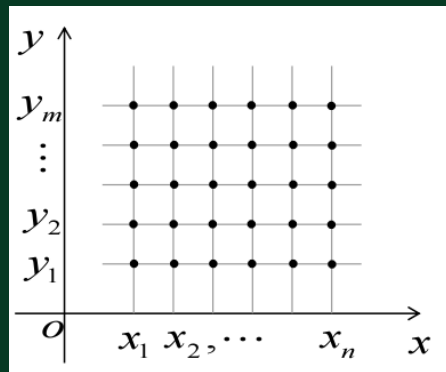
调用格式：

$$[X,Y] = \text{meshgrid}(xgv,ygv)$$

$$[X,Y,Z] = \text{meshgrid}(xgv,ygv,zgv)$$

$$[X,Y] = \text{meshgrid}(gv)$$

$$[X,Y,Z] = \text{meshgrid}(gv)$$



## 2、三维面图

用meshgrid函数生成网格矩阵，并用plot函数画出平面网格图形。

```
>> [x,y] = meshgrid(1:4, 2:5)
```

```
x =
```

```
1 2 3 4
```

```
1 2 3 4
```

```
1 2 3 4
```

```
1 2 3 4
```

```
y =
```

```
2 2 2 2
```

```
3 3 3 3
```

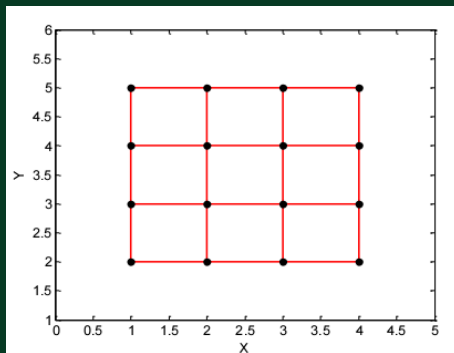
```
4 4 4 4
```

```
5 5 5 5
```

```
>> plot(x, y, 'r', x, y, 'r', x, y, 'k.', 'markersize', 18);
```

```
>> axis([0 5 1 6]);
```

```
>> xlabel('X'); ylabel('Y');
```



## 2、三维面图

### (2) 调用mesh函数绘制网目图

调用格式：

**mesh(X,Y,Z)**

**mesh(Z)**

**mesh(...,C)**

**mesh(...,'PropertyName',PropertyValue,...)**

**mesh(axes\_handles,...)**

**h = mesh(...)**

## 2、三维面图

### (3) 绘制三维曲面图

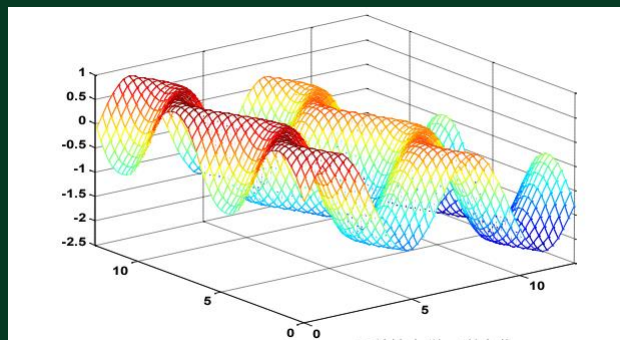
$$z = \sin(x + \sin(y)) - x/10$$

```
>> [x,y]=meshgrid(0:0.25:4*pi);
```

```
>> z=sin(x+sin(y))-x/10;
```

```
>> mesh(x,y,z);
```

```
>> axis([0 4*pi 0 4*pi -2.5 1]);
```





## 2、三维面图

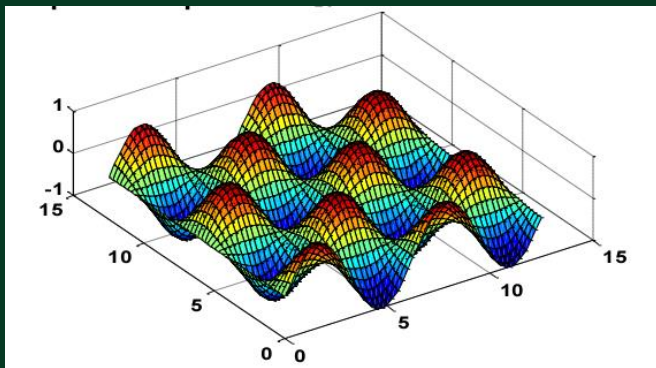
(4) 调用surf函数绘制着色的三维曲面图

$$z = \sin(x) * \cos(y)$$

```
>> [x,y]=meshgrid(0:0.25:4*pi);
```

```
>> z=sin(x).*cos(y); surf(x,y,z);
```

```
>> axis([0 4*pi 0 4*pi -1 1]);
```



## 2、三维面图

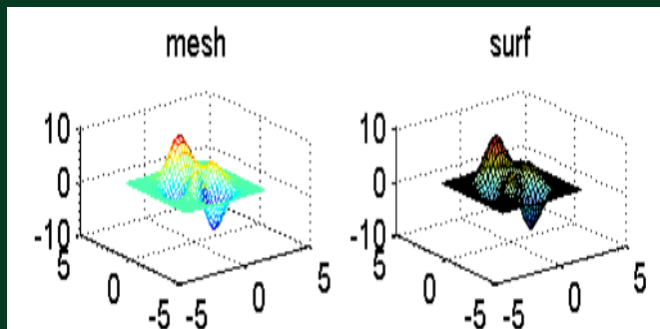
```
>> [X,Y,Z] = peaks(30);
```

```
>> mesh(X, Y, Z);           %彩色曲线组成的网格图
```

```
>> title('mesh');
```

```
>> surf(X, Y, Z, 'FaceAlpha', 0.5);
```

```
>> title('surf');         %着色的三维曲面图
```



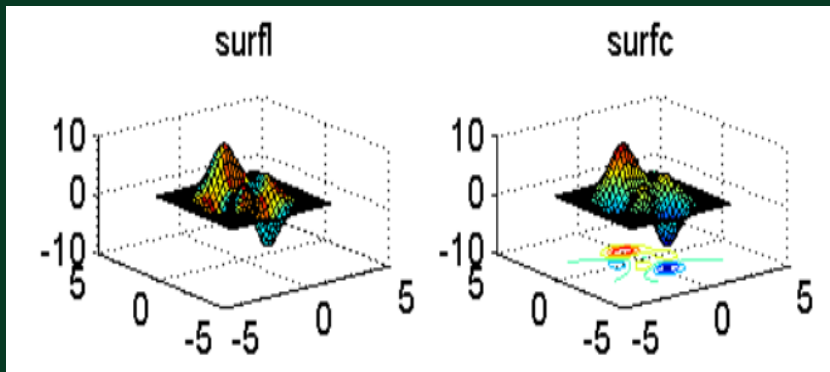
## 2、三维面图

>> **surf**(X, Y, Z);                    %三维曲面有光照效果

>> **title**('surf');

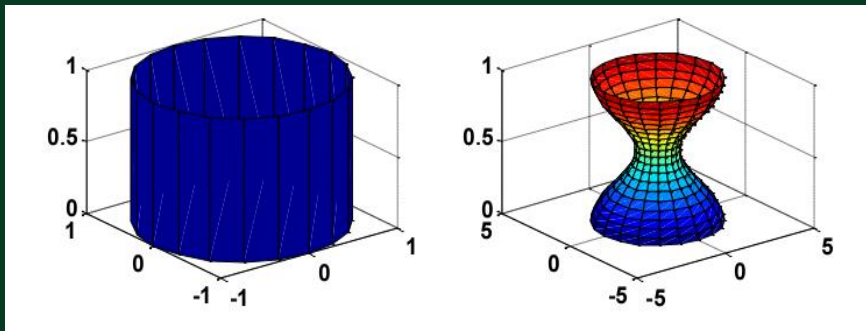
>> **surf****c**(X, Y, Z);                    %三维曲面在曲面底部有等高线图

>> **title**('surfc');



# 3、三维圆柱面图

```
>> [x,y,z] = cylinder;  
>> surf(x,y,z);  
  
>> z = 0:pi/10:2*pi;  
>> y = 2+cos(z);  
>> [X,Y,Z] = cylinder(y);  
>> surf(X,Y,Z); % 绘制哑铃面
```



# 4、三维球面图

```
>> [x,y,z] = sphere;           % 半径为10，球心 (1,1,1)
```

```
>> surf(10*x+1,10*y+1,10*z+1);
```

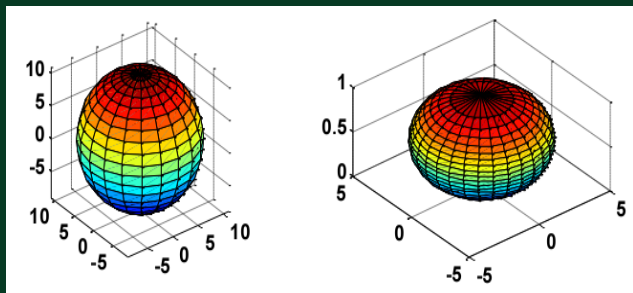
```
>> axis equal;
```

```
>> a=4; b=3;
```

```
>> t = -b:b/10:b;           % 绘制椭球面
```

```
>> [x,y,z] = cylinder(a*sqrt(1-t.^2/b^2),30);
```

```
>> surf(x,y,z);
```



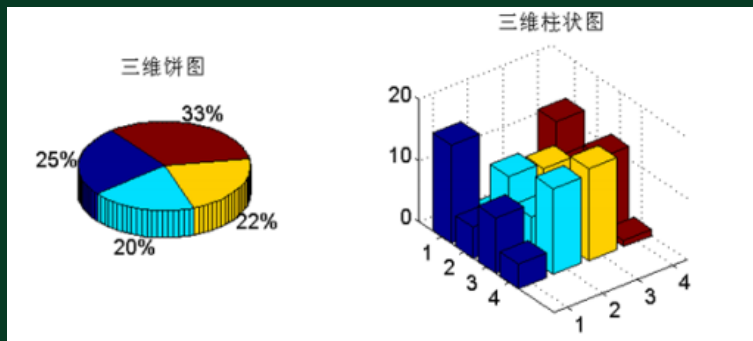
# 5、三维饼图与柱状图

```
>> pie3([2347,1827,2043,3025]);
```

```
>> title('三维饼图');
```

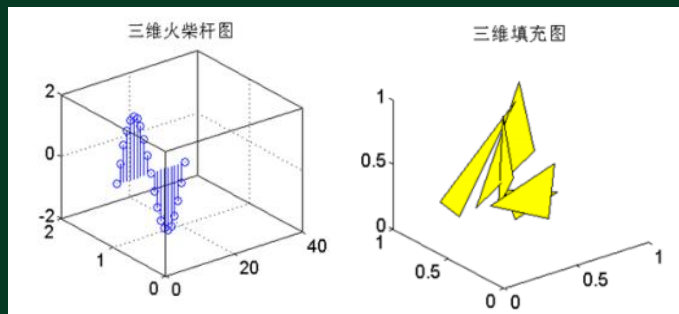
```
>> bar3(magic(4));
```

```
>> title('三维柱状图');
```



# 6、三维火柴杆与填充图

```
>> y=2*sin(0:pi/10:2*pi);  
>> stem3(y);  
>> title('三维火柴杆图');
```



```
>> fill3(rand(3,5),rand(3,5),rand(3,5), 'y' );  
>> title('三维填充图');
```

# 7、三维向量场图

```
>> [X,Y] = meshgrid(0:0.25:4,-2:0.25:2);
```

```
>> Z = sin(X).*cos(Y);
```

```
>> [Nx,Ny,Nz] = surfnorm(X,Y,Z);
```

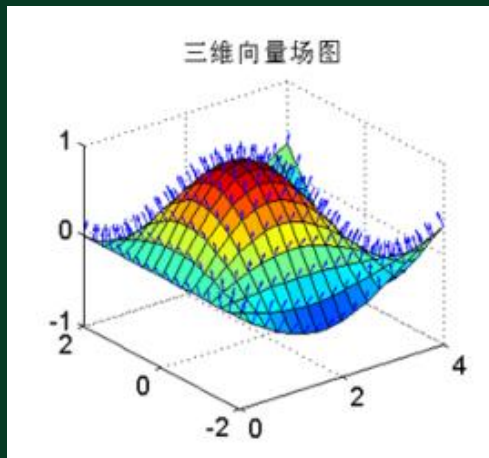
```
>> surf(X,Y,Z);
```

```
>> hold on;
```

```
>> quiver3(X,Y,Z,Nx,Ny,Nz,0.5);
```

```
>> title('三维向量场图');
```

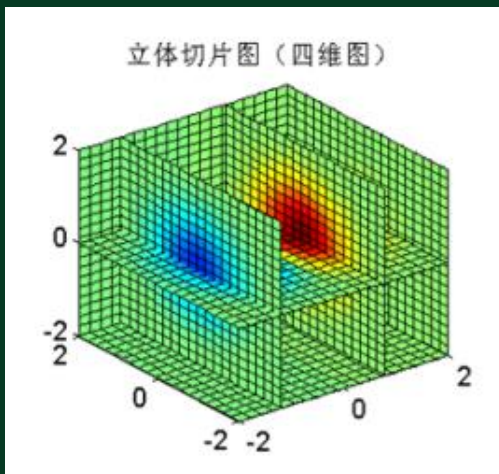
```
>> axis([0 4 -2 2 -1 1]);
```





## 8、三维立体切片图

```
>> t = linspace(-2,2,20);  
>> [X,Y,Z] = meshgrid(t,t,t);  
>> V = X.*exp(-X.^2-Y.^2-Z.^2);  
>> xslice = [-1.2,.8,2];  
>> yslice = 2;  
>> zslice = [-2,0];  
>> slice(X,Y,Z,V,xslice,yslice,zslice);  
>> title('立体切片图（四维图）');
```



# 9、等高线图和梯度场图

绘制三维曲面  $z = xe^{-(x^2+y^2)}$  的等高线图和梯度场。

```
>> [X,Y] = meshgrid(-2:0.2:2);
```

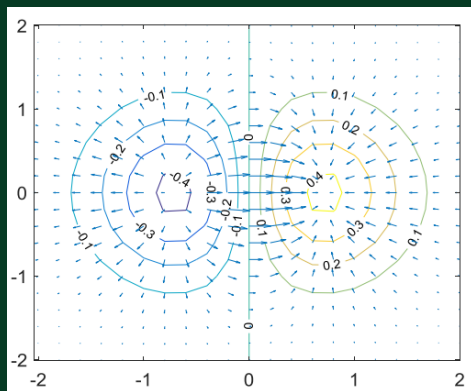
```
>> Z = X.*exp(-X.^2 - Y.^2);
```

```
>> [DX,DY] = gradient(Z,0.2,0.2);
```

```
>> contour(X,Y,Z,'ShowText','on');
```

```
>> hold on;
```

```
>> quiver(X,Y,DX,DY);
```



# 10、填充式等高线图

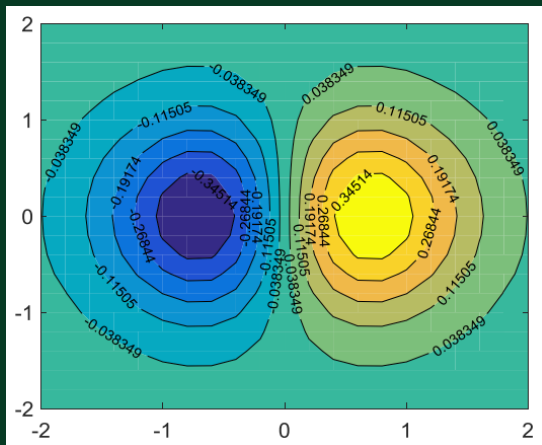
绘制三维曲面  $z = xe^{-(x^2+y^2)}$  的填充式等高线图

```
>> [X,Y] = meshgrid(-2:0.2:2);
```

```
>> Z = X.*exp(-X.^2 - Y.^2);
```

```
>> contourf(X, Y, Z, 10,...
```

```
'ShowText','on');
```



# 小结

1. 三维线图、三维面图
2. 三维圆柱面图、球面图
3. 三维饼图与柱状图
4. 三维火柴杆与填充图
5. 三维立体切片图
6. 等高线图和梯度场图
7. 填充式等高线图