数据科学基础 I (Matlab)

东北大学

三维空间的绘图方式

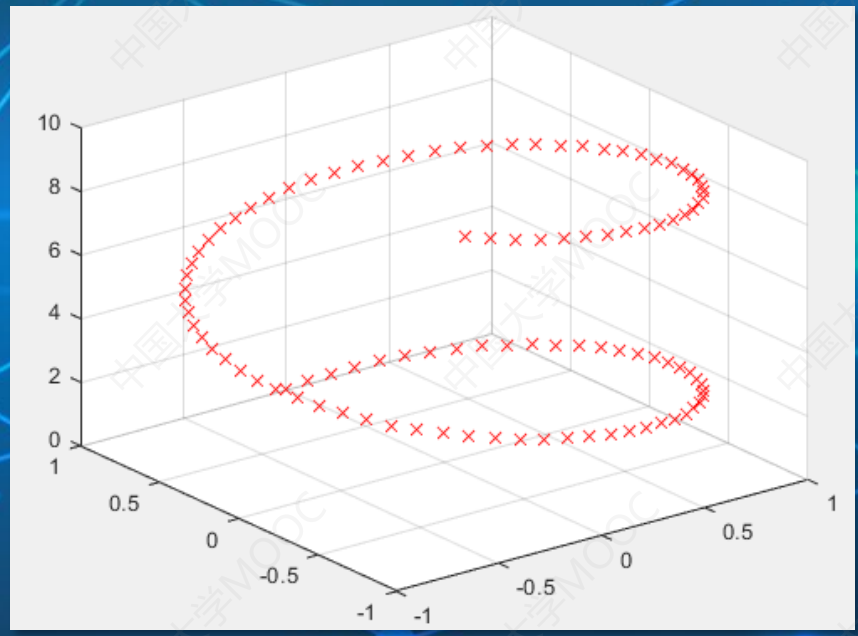
- 使用2D绘图命令对应的3D版本
- mesh网格图
- surf曲面图
- 特殊的三维绘图
- 三维流场绘图

2D/3D命令对应

2D命令	3D命令	2D命令	3D命令
plot	plot3	scatter	scatter3
bar	bar3	stem	stem3
barh	barh3	contour	contour3
fill	fill3	quiver	quiver3
histogram	histogram2	fplot	fplot3

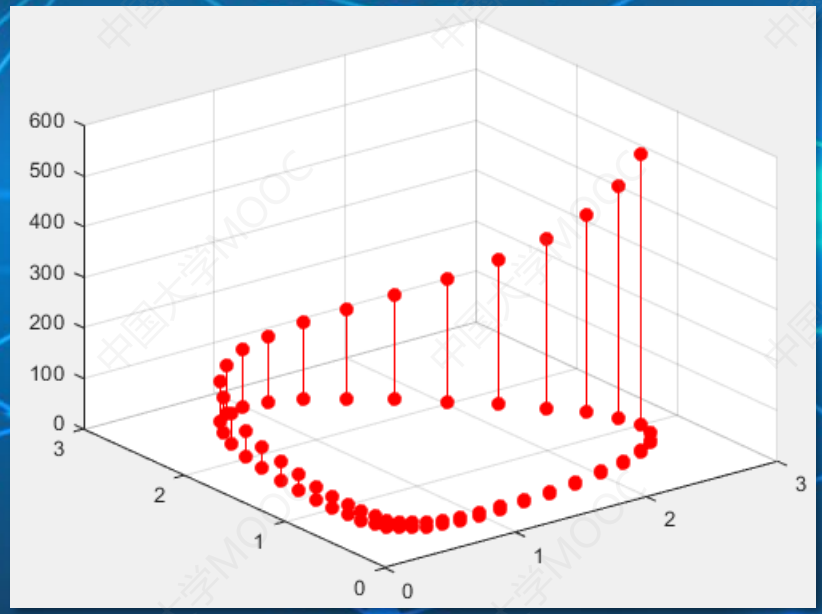
plot3 三维曲线图

```
>> z=linspace(0,10,101);
>> x=sin(z);
>>y=cos(z);
>> plot3(x,y,z,'rx')
>> grid on
```



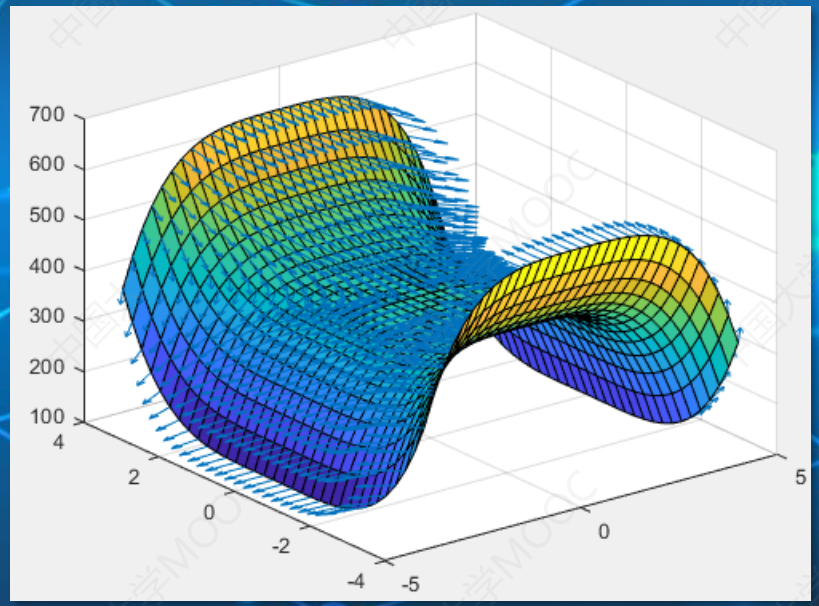
stem3 三维针状图

```
>> t  = -2*pi : pi/20 : 2*pi;
>> x = exp(cos(t));
>> y = exp(sin(t));
>> z = exp(-t);
>> stem3(x,y,z,'fill','r')
```



quiver3

```
>> x = -4:0.25:4;
>> y = x;
>>[X,Y] = meshgrid(x,y);
>> Z = -X.^4 + Y.^4 - X.^2 - Y.^2
+ 2*X*Y;
>> surf(X,Y,Z)
>> hold on
>>[U,V,W] = surfnorm(X,Y,Z);
>> quiver3(X,Y,Z,U,V,W,0.05)
```



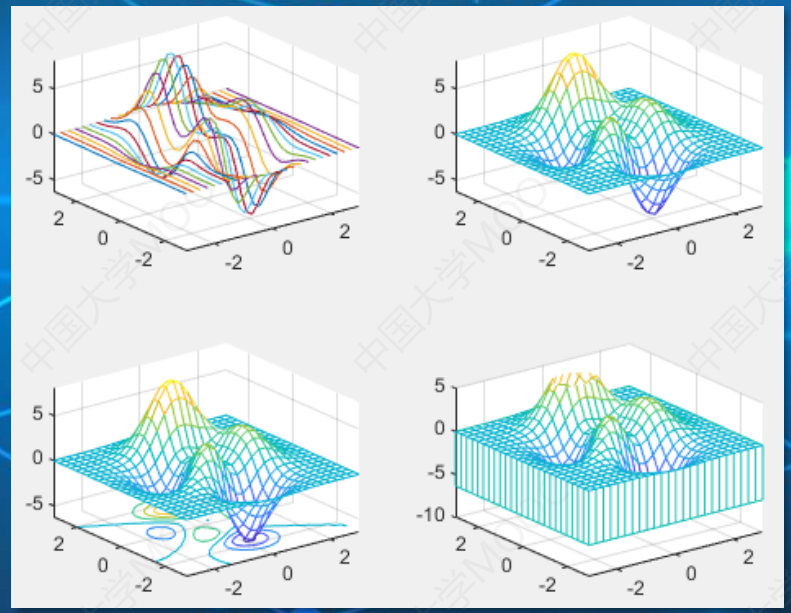
mesh网格图

mesh是由一系列二维线条表示三维图形，是网格状的图形

命令	功能
meshgrid	生成网格矩阵
mesh	网格图
meshc	网格图+基本的等高线图
meshz	网格图+零平面网格图
fmesh	以函数绘制三维网格图

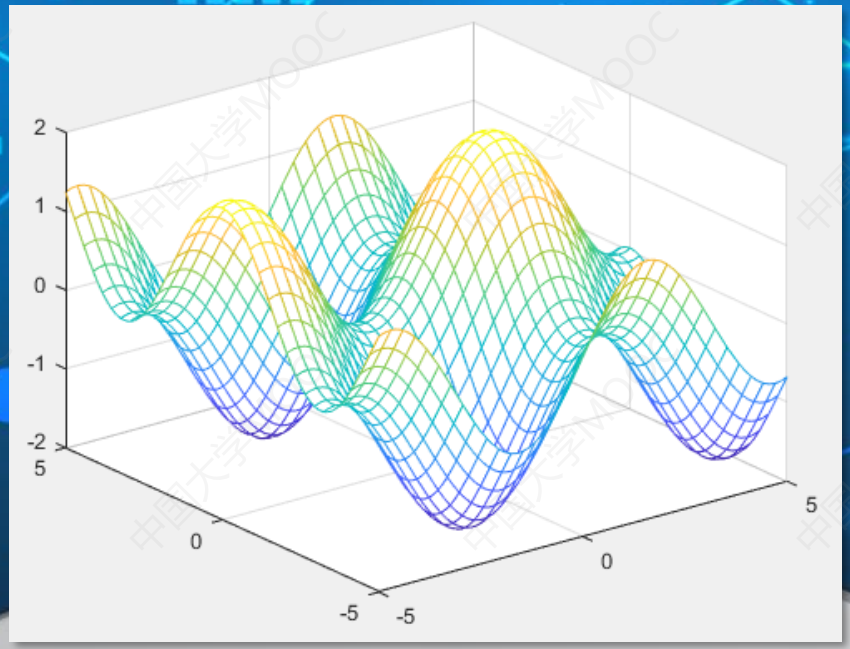
mesh网格图

```
>> [X,Y] = meshgrid(-3:.25:3);
>> Z = peaks(X,Y);
>> subplot(2,2,1);
>> plot3(X,Y,Z);
>> subplot(2,2,2);
>> mesh(X,Y,Z);
>> subplot(2,2,3);
>> meshc(X,Y,Z);
>> subplot(2,2,4);
>> meshz(X,Y,Z);
```



mesh网格图

```
>> fmesh(@(x,y) sin(x)+cos(y))
```



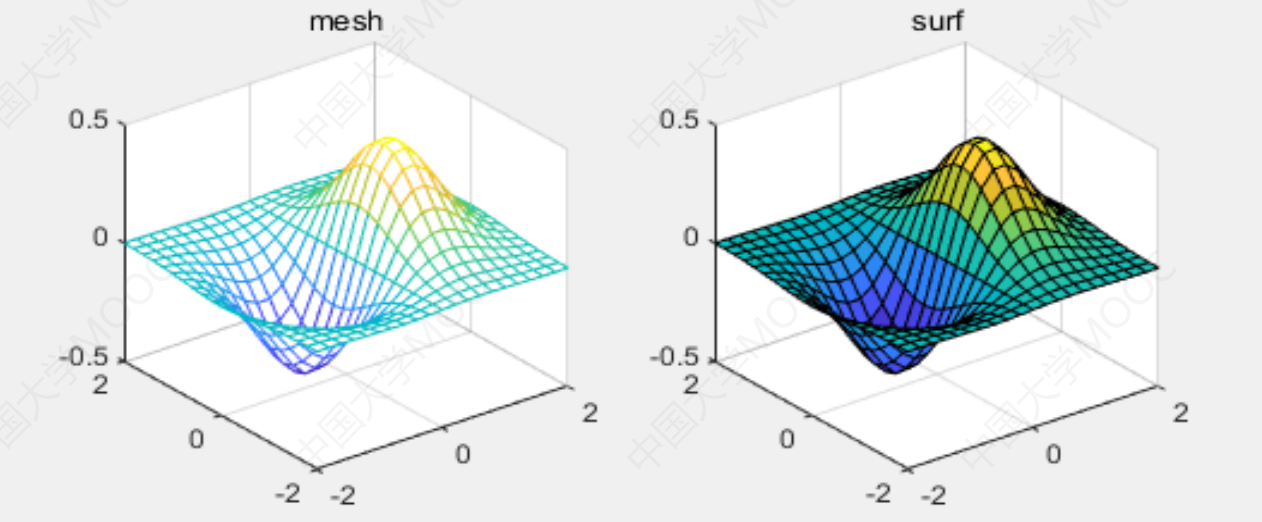
surf曲面绘图

surf生成的是表面图形，由一系列面片拼接生成的

命令	功能
meshgrid	生成网格矩阵
surf	曲面图
surfc	曲面图+基本的等高线图
surfl	具有基于颜色图的光照的曲面图
fsurf	以函数绘制三维曲面图

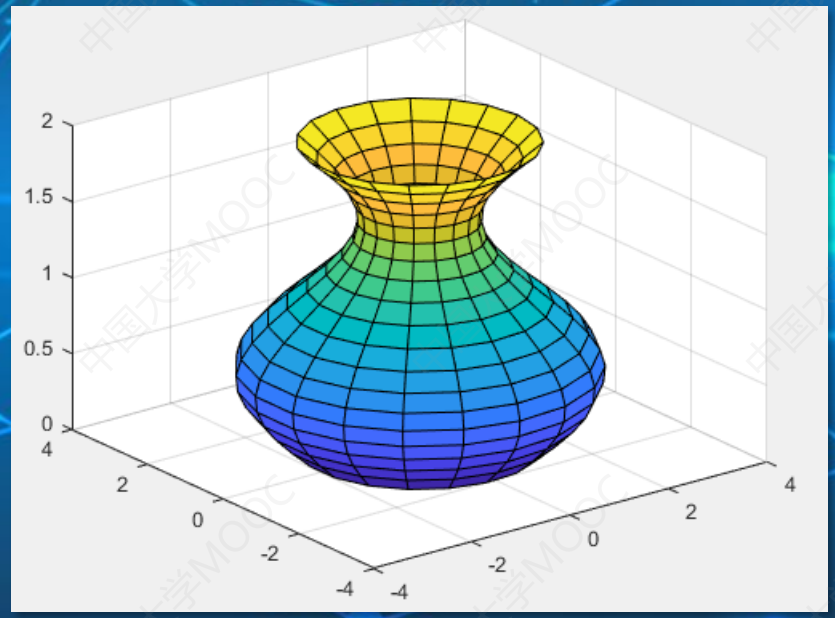
mesh vs surf

```
>> [x,y]=meshgrid(-2:0.2:2); z=x.*exp(-x.^2-y.^2);
>>subplot(1,2,1); mesh(x,y,z); title('mesh');
>>subplot(1,2,2); surf(x,y,z); title('surf');
```



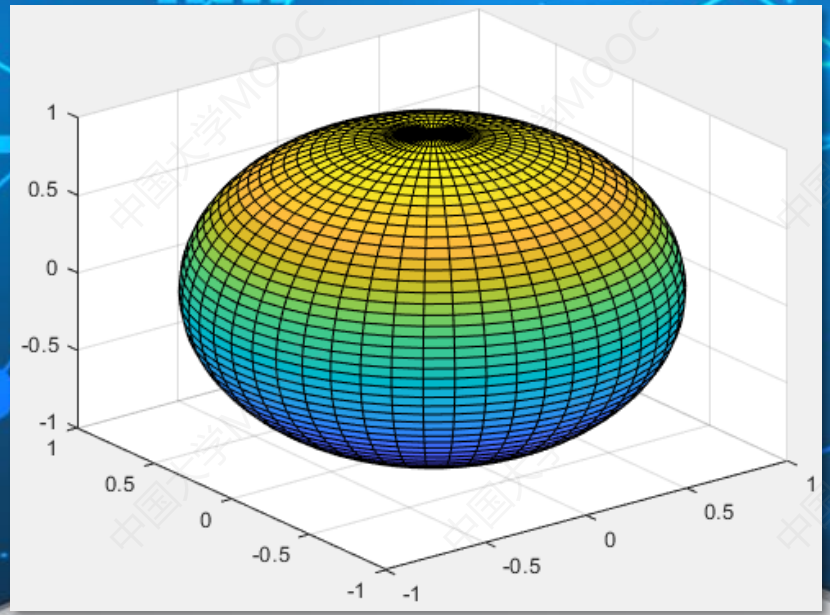
surf曲面绘图

```
>> t = linspace(0,2*pi,20);
>> s = linspace(0,2*pi, 20)';
>> r = (2 + sin(s));
>> h = linspace(0,2, 20)';
>> X = r*cos(t);
>> Y = r*sin(t);
>> Z = h*ones(size(t));
>> surf(X,Y,Z);
```



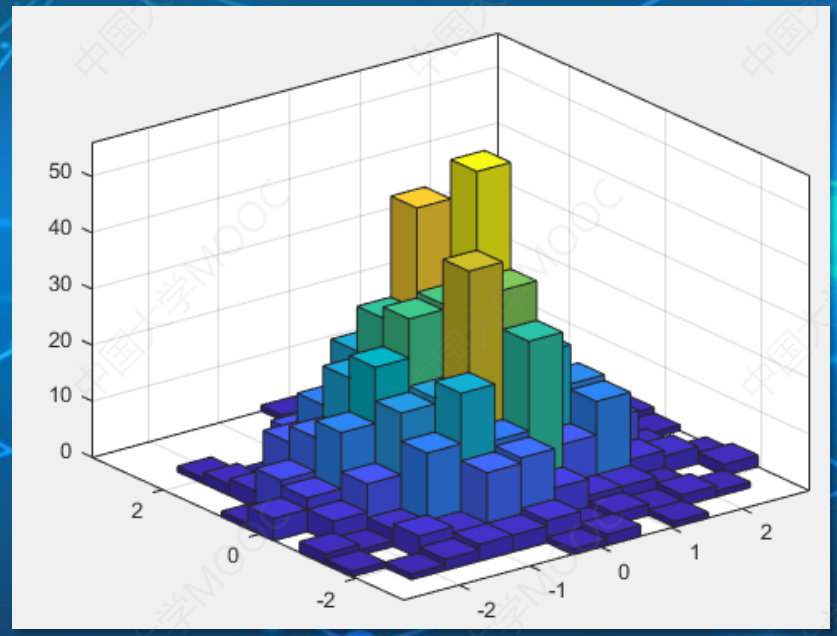
sphere 球面

```
>> sphere(50)
```



histogram2

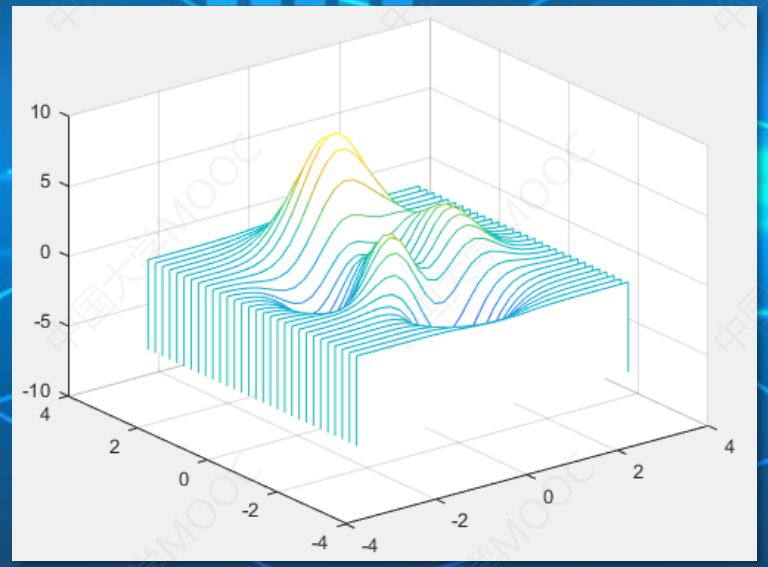
```
>> x=randn(1000,1);
>> y=randn(1000,1);
>> histogram2(x,y,[12 12],
    'FaceColor','flat');
```



waterfall 瀑布图

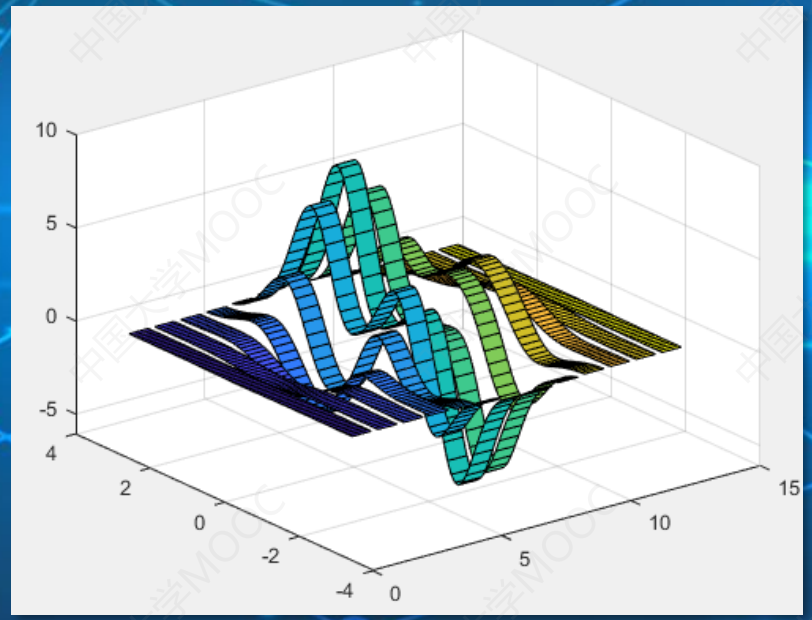
类似于 meshz 的网格

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



ribbon 条带图

```
>> [x,y] = meshgrid(-3:.5:3,
-3:.1:3);
>> z = peaks(x,y);
>> ribbon(y,z)
```



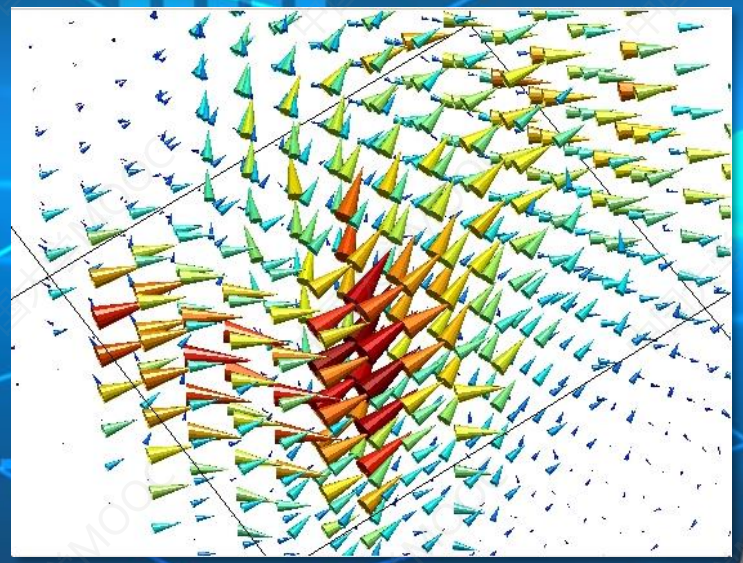
三维流场绘图

流场是流体运动所占据的空间

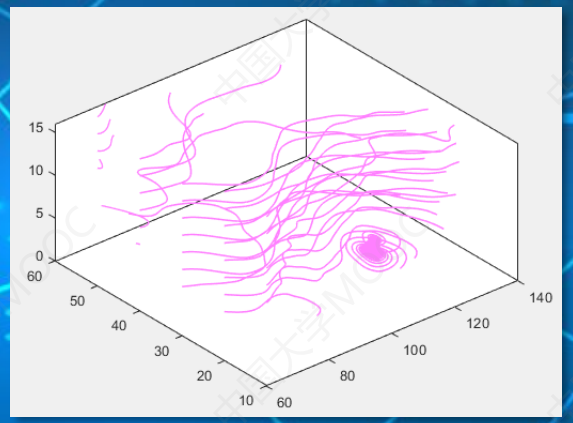
命令	功能
coneplot	流锥图
streamline	流线图
streamtube	流管图
streamribbons	流带图

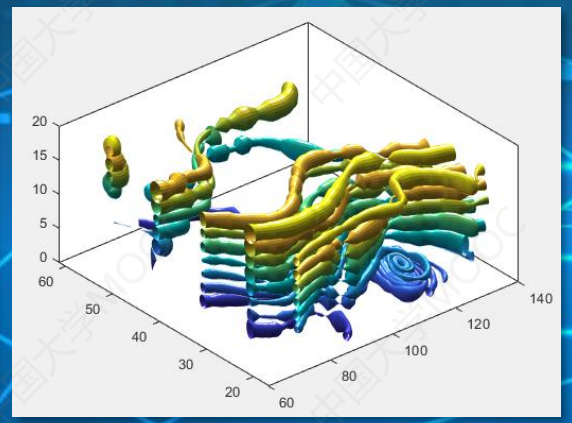
coneplot 流锥图

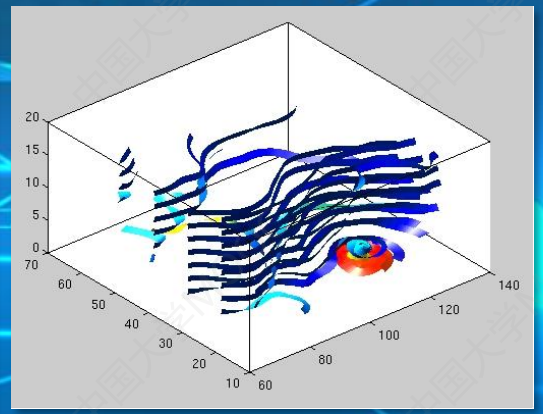
```
>> load wind;
……
>> wind_speed = sqrt(u.^2 + v.^2 + w.^2);
>> colors = wind_speed;
>> scale = 4;
>>[cx cy cz] =
meshgrid(xmin:5:xmax,ymin:5:ymax,
zmin:2:zmax);
>> c = coneplot(x,y,z,u,v,w,cx,cy,cz,scale,colors);
……
```



流线图/流管图/流带图








```
>> streamline(x,y,z,u,v,w,sx,sy,sz);  %流线图
>> streamtube(x,y,z,u,v,w,sx,sy,sz); %流管图
>> streamribbon(x,y,z,u,v,w,sx,sy,sz); %流带图
```