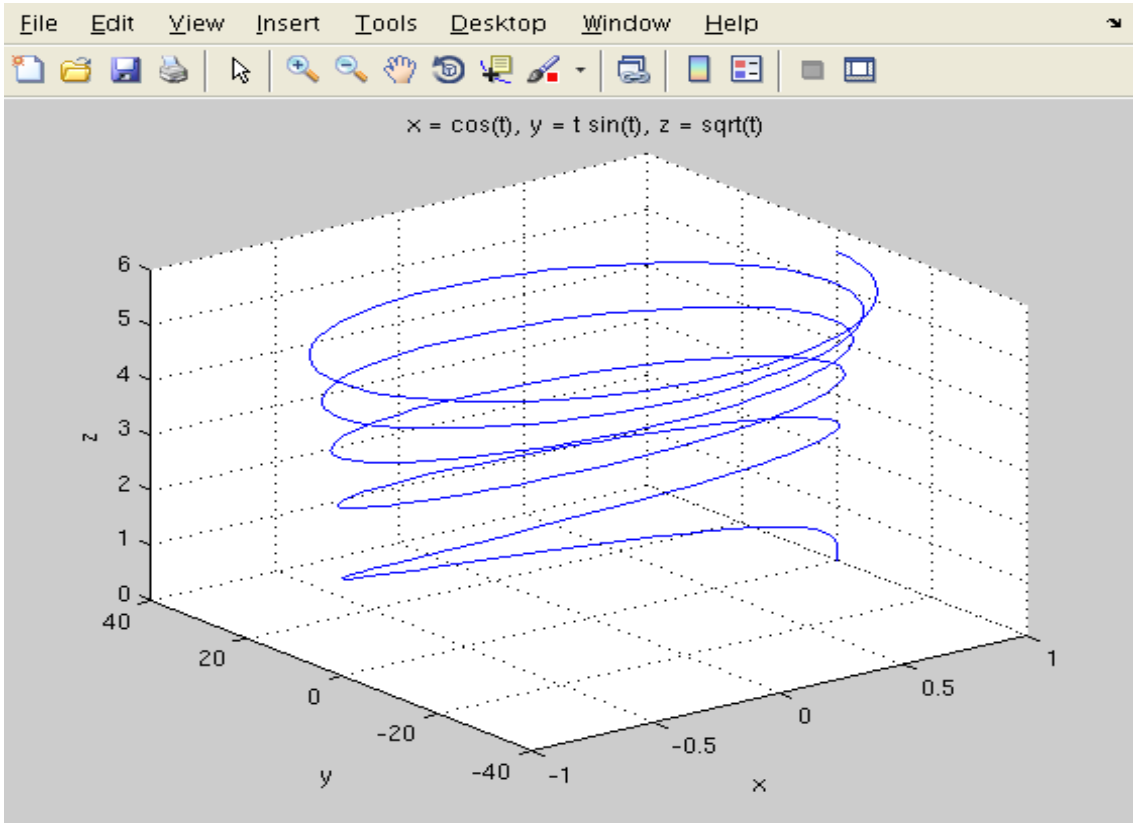
Curvas paramétricas en 3D: *ezplot3*

- Función *ezplot3('x(t)', 'y(t)', 'z(t)', [ini fin])*

  *ezplot3('cos(t)', 't*sin(t)','sqrt(t)', [0 10*pi])*

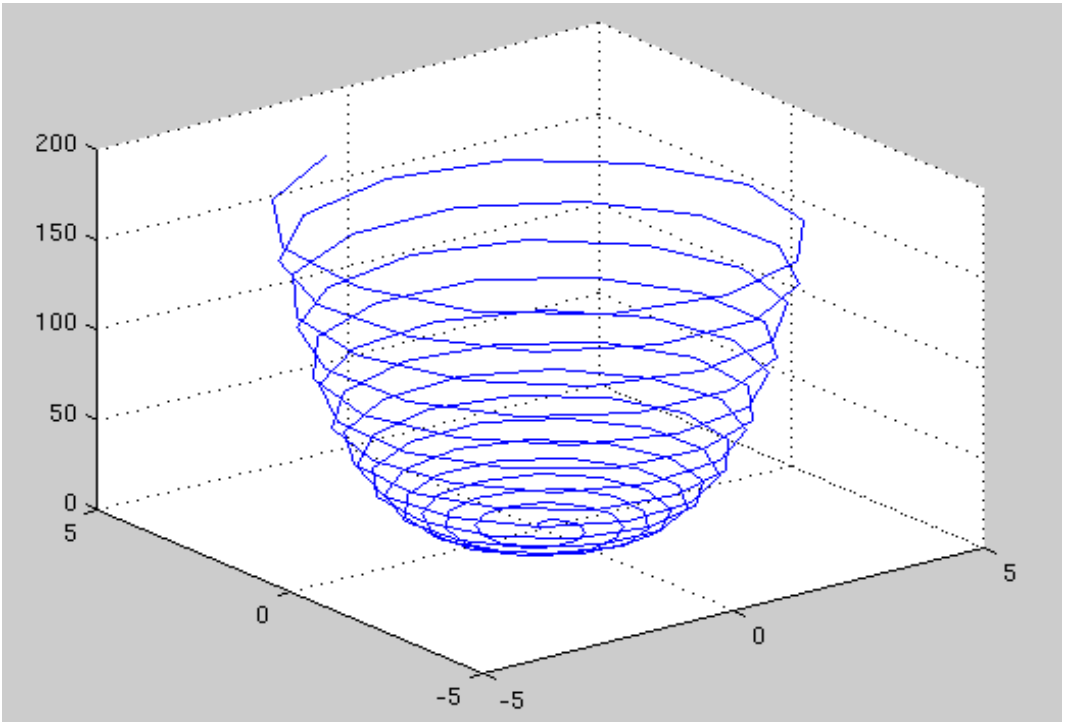
- Por defecto: rango *0..2*pi*



Curvas paramétricas en 3D: *plot3*

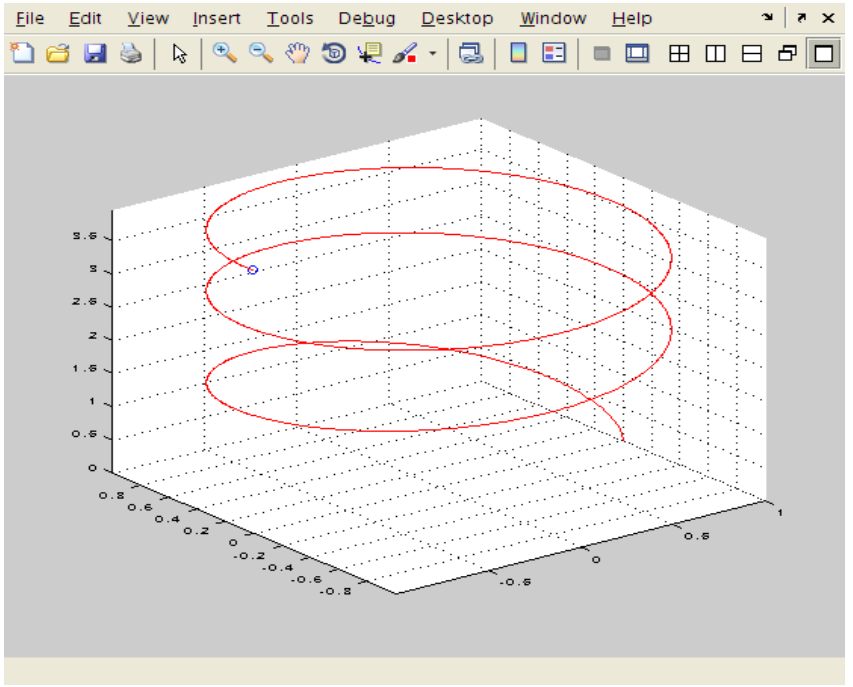
- Función *plot3(x,y,z,opcións)*
- *x, y, z*: vectores coas coordenadas dos puntos (ecuacións paramétricas); opcións: as mesmas que *plot*
- Exemplo:

```
t=0:0.1:6*pi;
x=sqrt(t).*sin(5*t);
y=sqrt(t).*cos(5*t);
z=t.^2./2;
plot3(x,y,z)
```



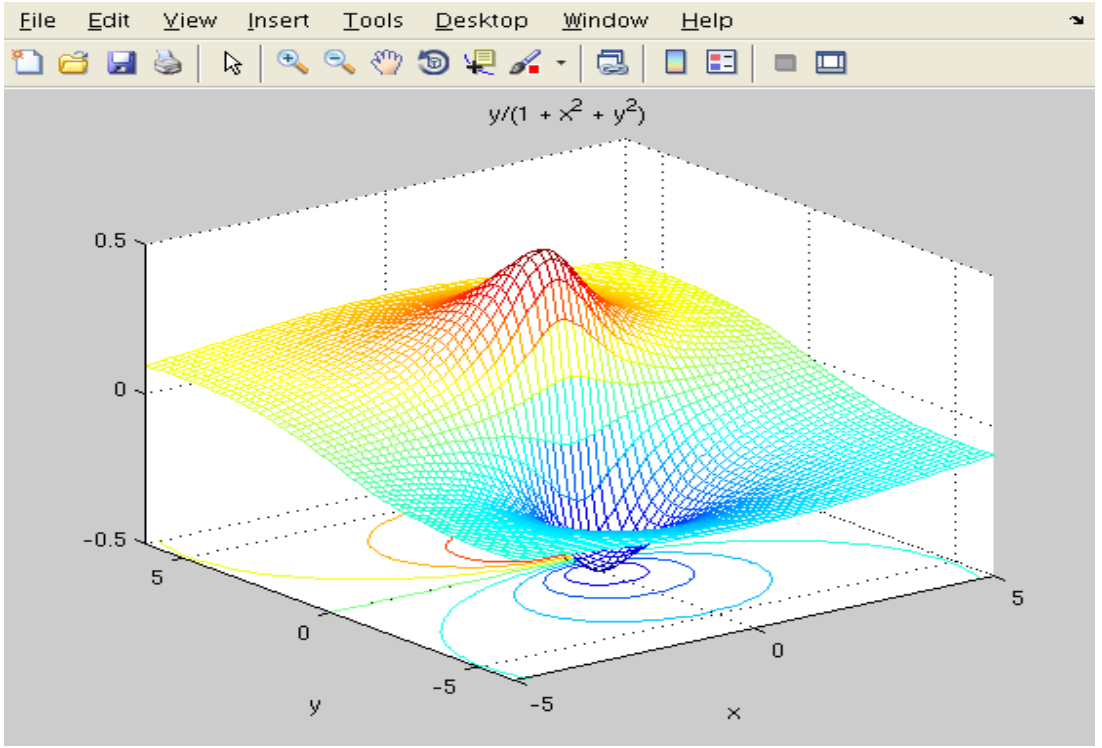
Curva animada en 3D: comet3

- Sintaxe: *comet3(x,y,z)*
- Vectores *x*,*y*,*z* da mesma dimensión
- Lonxitude elevada para que a animación sexa lenta
- Exemplo: *t=0:0.0001:10*pi; comet3(sin(t),cos(t),sqrt(t))*
- Moi útil para visualizar movementos en 3D



Superficies en 3D: *ezmesh, ezsurf*

- Función *ezsurf('f(x,y)',[xmin,xmax,ymin,ymax])*, e *ezmesh*
- Ex: *ezsurf('y/(1 + x^2 + y^2)',[-5,5,-2*pi,2*pi])*
- Tamén funcións *ezmesh(...)* e *ezmeshc(...)*, con contornos no plano XY



Superficies en 3D: *mesh*

Ecuación normal (explícita): $z = f(x, y)$

1. *[X Y]=meshgrid(x, y)* ou *[X Y]=meshgrid(x)*
   - *x,y*: vectores cos puntos en coordenadas. Ex: se os intervalos de representación son [0,1] para x e [-1,1] para y, podemos ter: *x=0:0.1:1* e *y=-1:0.1:1;*
   - *X,Y*: matrices coas coordenadas de tódolos puntos do plano XY para os cales se calcula $z = f(x,y)$

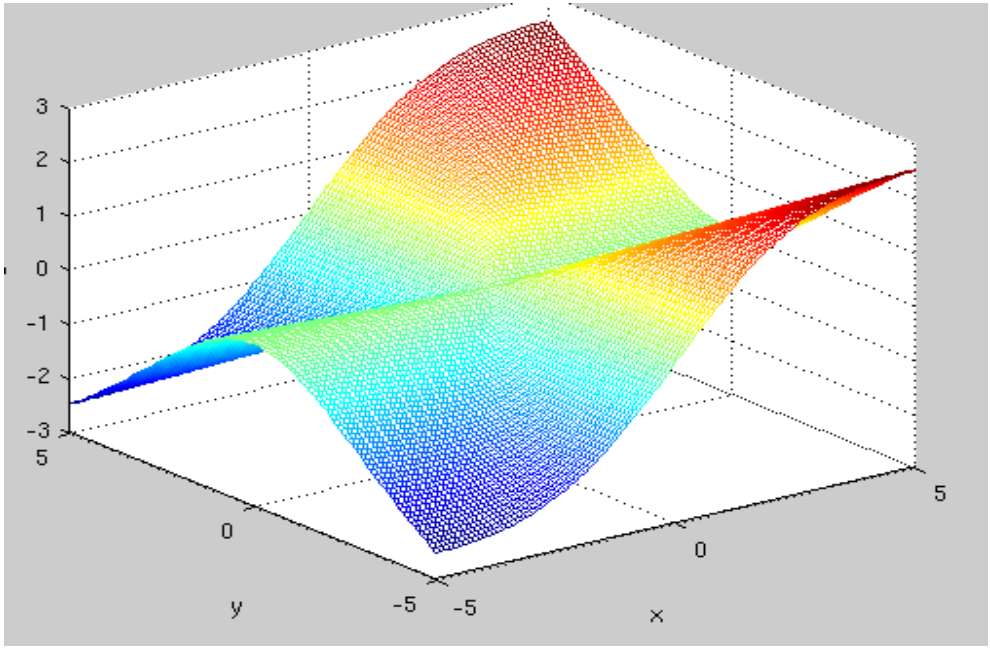
2. Cálculo de Z: $Z = f(X, Y)$. A expresión *f* debe estar vectorizada (operacións .* ./ .^)

3. Representación: *mesh(X, Y, Z)*

Superficies en 3D: *mesh*

- Exemplo: función $z = \frac{xy^2}{x^2+y^2}$ en [-5,5]x[-5,5]

```
x=[-5:0.1:5];y=[-5:0.1:5];
[X Y] = meshgrid(x, y);
Z = X.*Y.^2./(X.^2 + Y.^2 + eps);
mesh(X, Y, Z)
xlabel('x');ylabel('y');
zlabel('z')
```



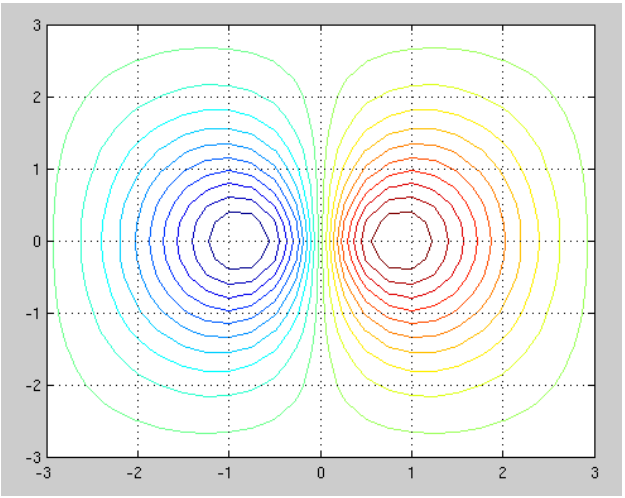
Superficies en 3D: *surf*, *contour*

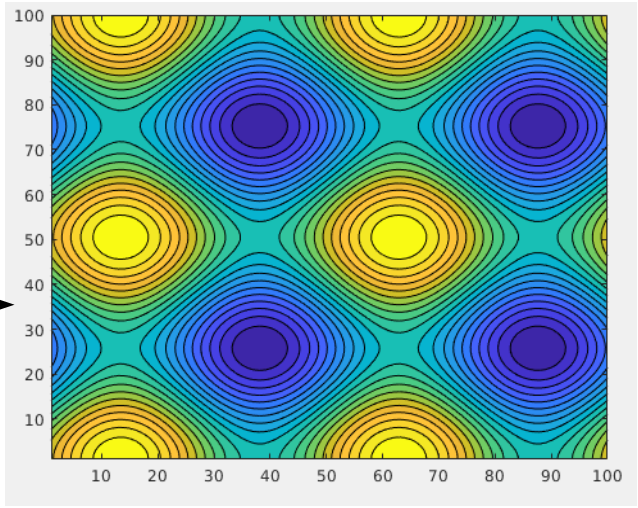
- Tamén se pode emprega-la función *surf(X,Y,Z)*, que rechea a superficie
- Contorno: *contour(X,Y,Z,n)*

  contorno da superficie 3D sobre o plano XY; n=nº niveis do contorno (opcional)

- Mapa de calor: *contourf(Z,n)*

```
x = linspace(-2*pi,2*pi);
[X,Y] = meshgrid(x);
Z = sin(X)+cos(Y);
contourf(Z)
```





Superficies en 3D

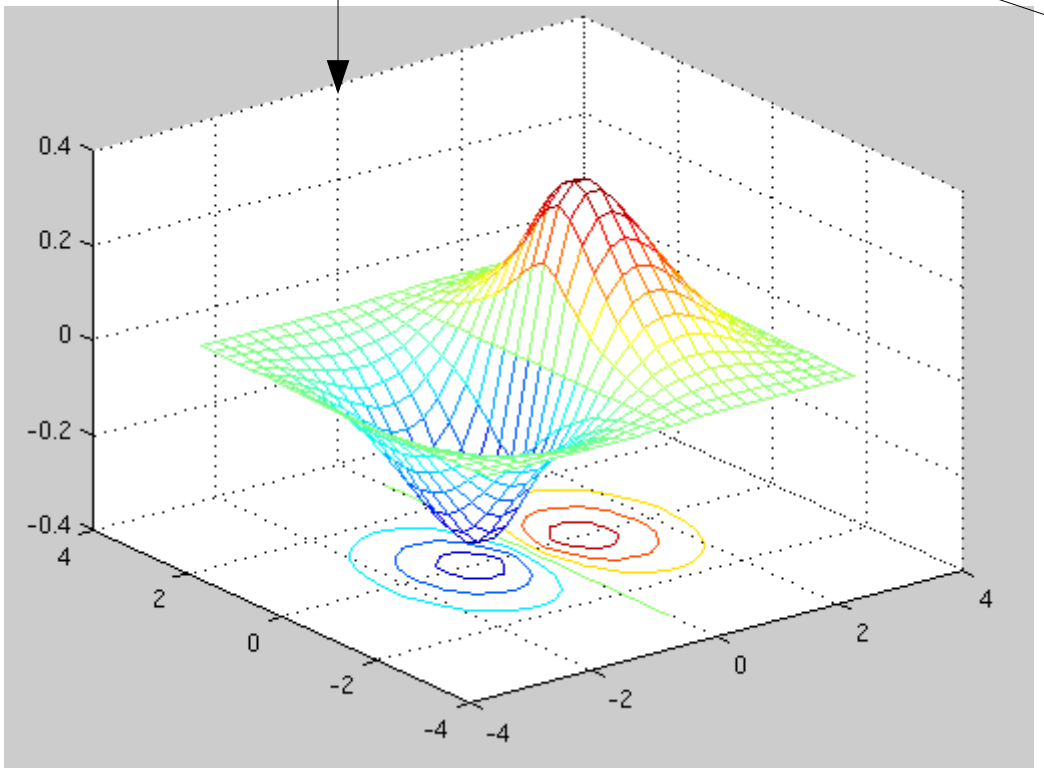
$$z = f(x,y) = 1.8^{-1.5\sqrt{x^2+y^2}} \cdot \sin x \cdot \cos y$$

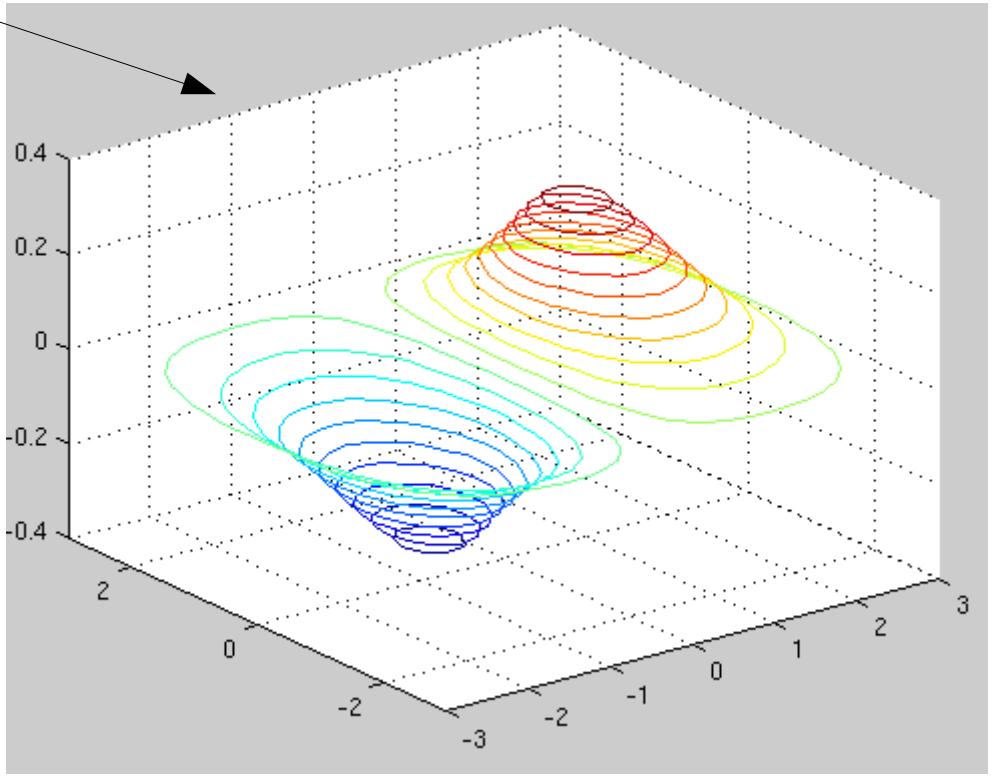
x=-3:0.25:3

[X Y] = meshgrid(x);

*Z=1.8.^(-1.5*sqrt(X.^2+Y.^2)).*cos(0.5*Y).*sin(X);*

meshc(X,Y,Z); contour3(X,Y,Z,20)

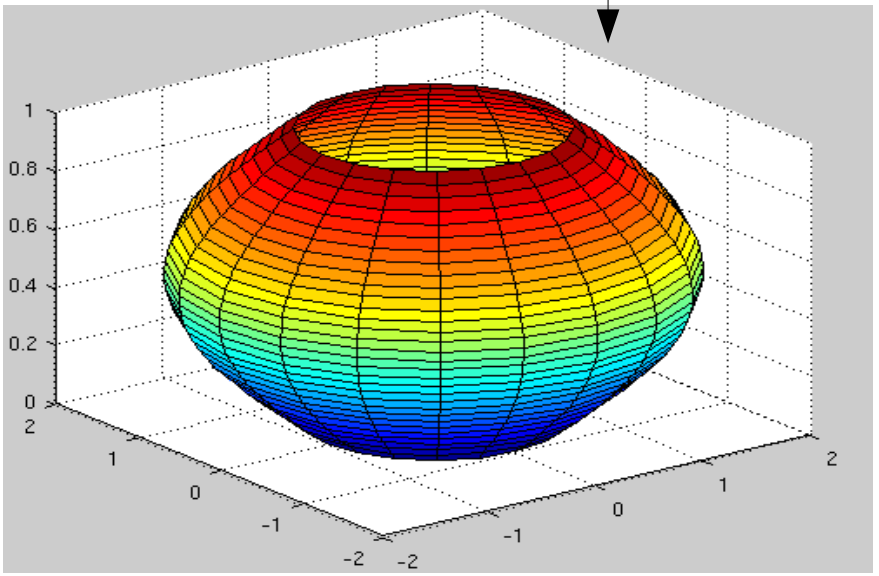


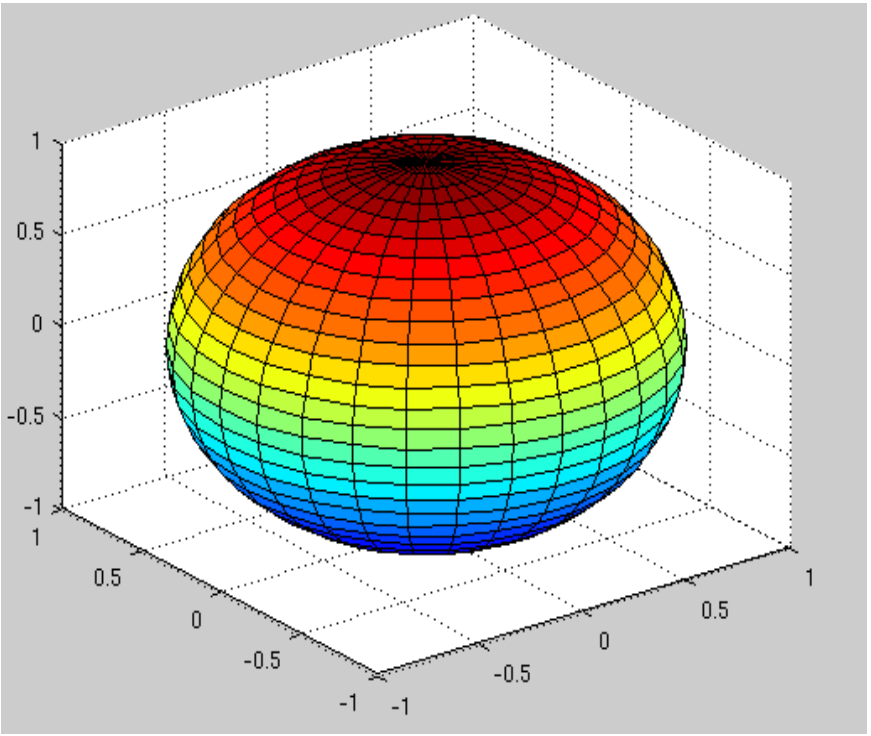


Outras gráficas

- Esfera: *sphere(50)* % nº de puntos
- Cilindro: *cylinder(r)* %r= vector cos radios

```
t=0:0.1:pi;
r=1+sin(t);
cylinder(r);
```





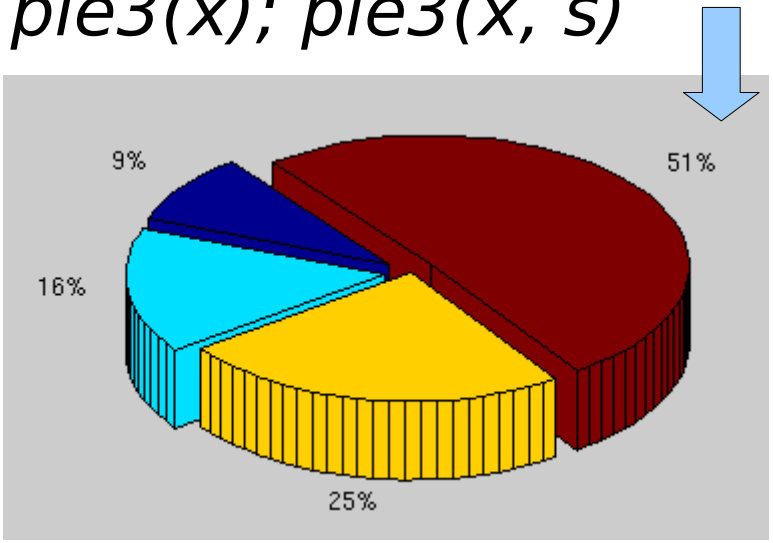
Outros diagramas 3D

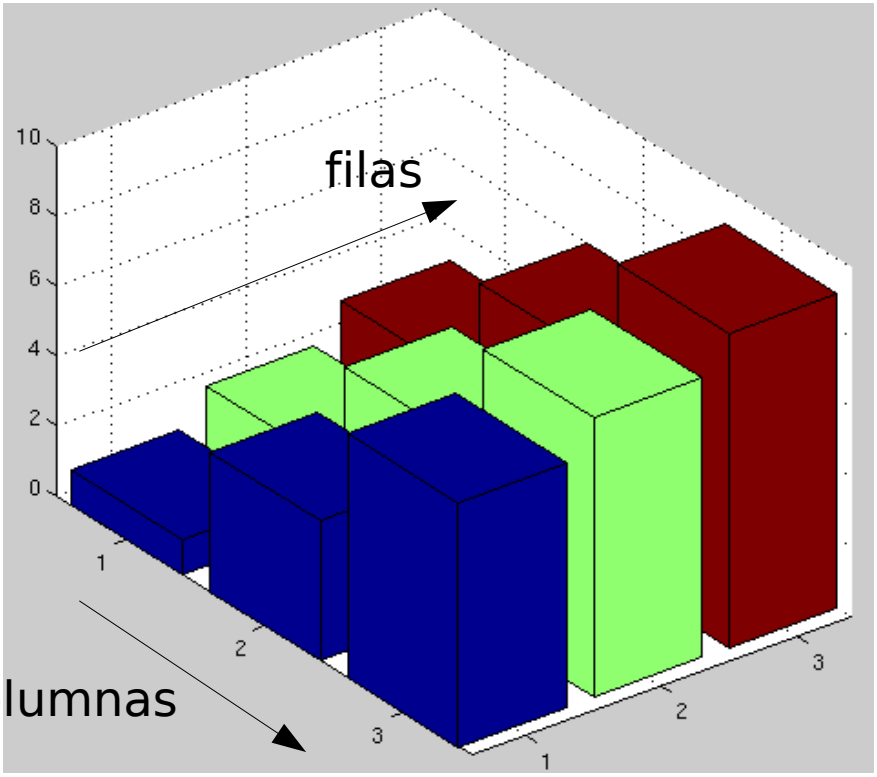
- Diagrama de barras 3D

  y=[1 2 3; 4 5 6; 7 8 9]; bar3(y)

- Tarta 3D (sentido antihorario): *x* e *s* deben ter igual lonxitude

  x = [5 9 14 29];
  s=[1 2 0 1]; %separación
  pie3(x); pie3(x, s)





Exercicios

Representa as seguintes curvas e superficies 3D:

1) $f(x,y)=\frac{sen\left(\sqrt{x^2+y^2}\right)}{\sqrt{x^2+y^2}}$ $x,y\in[-20,20]$

2) $x(t) = \cos t - t \operatorname{sen} t;\ y(t) = \operatorname{sen} t - t \cos t;\ z(t) = t^2$

3) $x(\theta) = 1 + \cos\theta;\ y(\theta) = 1 + \operatorname{sen}\theta;\ z(\theta)=4\theta$

4) $z=f(x,y)=\frac{1}{\pi}\sum_{n=1}^{10}\operatorname{sin}\left[(2n-1)\pi\ x\right]\operatorname{sinh}\left[(2n-1)\pi\ y\right], x,y\in[-0.1,0.1]$

5) $z=-x^2/4-y^2/4,\ x,y\in[-4,4]$ (fai o contorno 3D)

6) $z=(y+3)^2+1.5x^2-x^2y,\ x,y\in[-3,3]$ (ídem)

7) $x(t)=2\cos(2\pi t),\ y(t)=2\operatorname{sen}(2\pi t),\ z(t)=t$

8) $z=\frac{x}{x^2+y^2}, x,y\in[-0.1,0.1]$

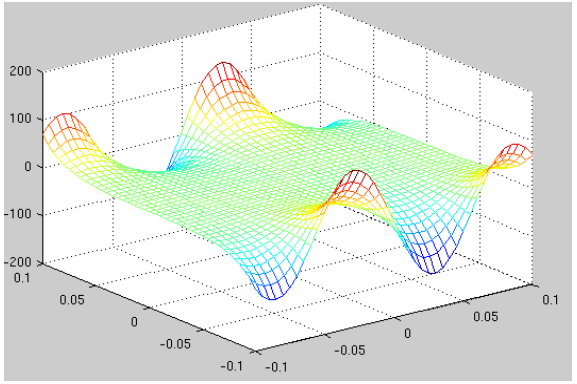
Solucións aos exercicios (I)

1) *ezmesh('sin(x^2 + y^2)/(x^2 + y^2)')*; ou ben: *[X Y] = meshgrid(-20:0.1:20); Z = sin(X.^2 + Y.^2)./(X.^2 + Y.^2) mesh(X, Y, Z)*

2) *ezplot3('cos(t)-t*sin(t)','sin(t)-t*cos(t)','t^2',[0 10*pi]);* ou ben: *t = 0:0.1:10*pi; x= cos(t) – t.*sin(t); y = sin(t) – t.*cos(t); z= t.*t; plot3(x, y, z)*

3) *ezplot3('1+cos(t)','1+sin(t)','4*t',[0 10*pi])* ou ben: *t = 0:0.1:10*pi; x= 1+cos(t); y=1+sin(t); z=4*t; plot3(x, y, z)*

4) *[X Y] = meshgrid(-0.1:0.005:0.1); Z = f(X, Y); mesh(X, Y, Z)*




```
function z = f(x, y)
z = 0;
for n = 1:10
    z = z + sin((2*n - 1)*pi*x).*sinh((2*n - 1)*pi*y);
end
z = z/pi;
end
```

Solucións aos exercicios (II)

5) ezmesh('-x^2/4 – y^2/4',[-4 4])
ou ben: [X Y] = meshgrid(-4:0.1:4); Z=-X.^2/4 -Y.^2/4; meshc(X, Y, Z)

*6) ezmesh('(y+3)^3 + 1.5x^2*y',[-3 3])*
ou ben: *[X Y] = meshgrid(-3:0.1:3); Z = (Y + 3).^2 + 1.5*X.^2 – X.^2.*Y; meshc(X, Y, Z)*

*7) ezplot3('2*cos(2*pi*t)','2*sin(2*pi*t)','t',[0 pi])*
ou ben: *t = 0:0.1:2*pi; x = 2*cos(2*pi*t); y = 2*sin(2*pi*t); z = t; plot3(x, y, z)*

8) ezmesh('x/(x^2 + y^2)',[-1 1])
ou ben: *[X Y] = meshgrid(-1:0.1:1); Z = X./(X.^2 + Y.^2); mesh(X, Y, Z)*