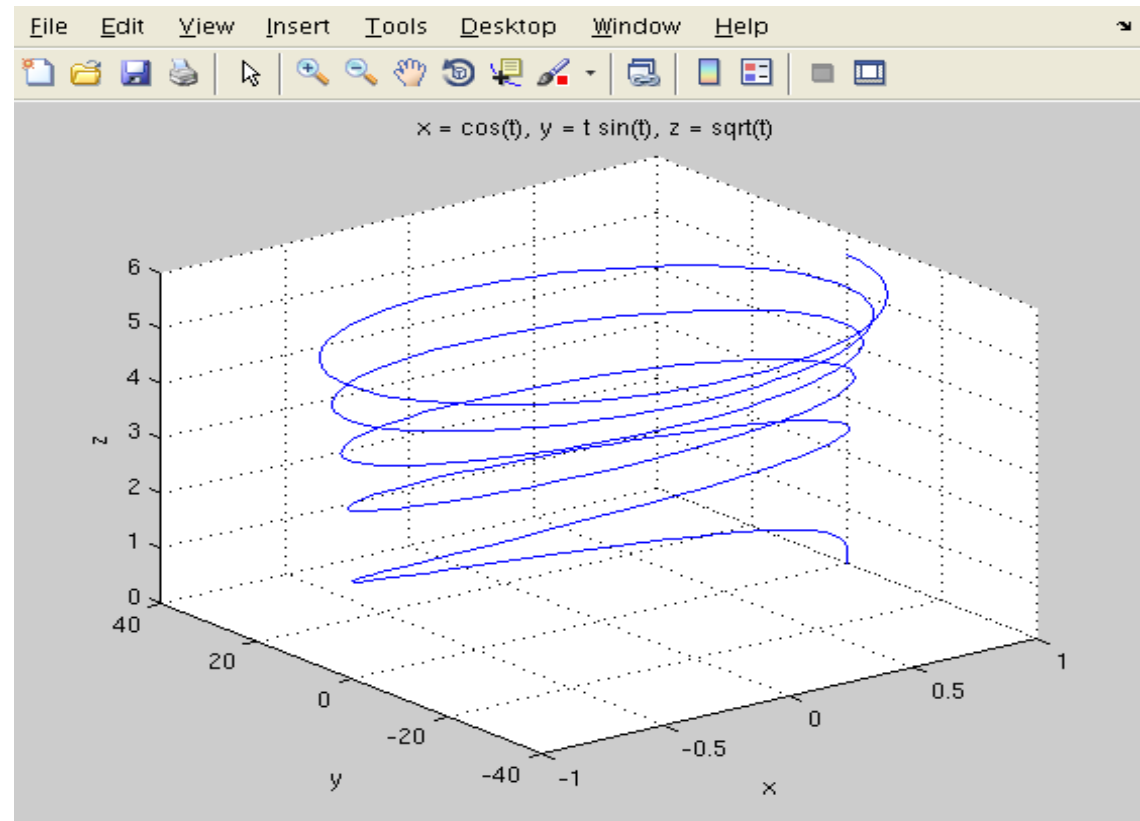


Curvas paramétricas en 3D: *ezplot3*

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

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

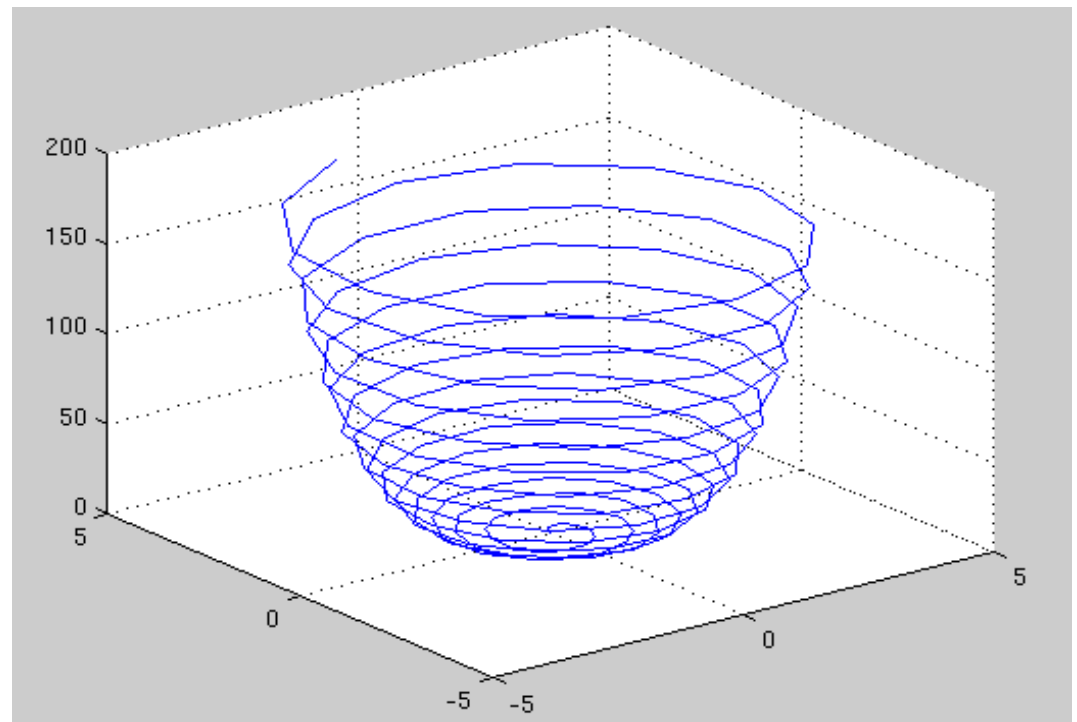
- Por defecto:
rango $0..2\pi$



Curvas paramétricas en 3D: *plot3*

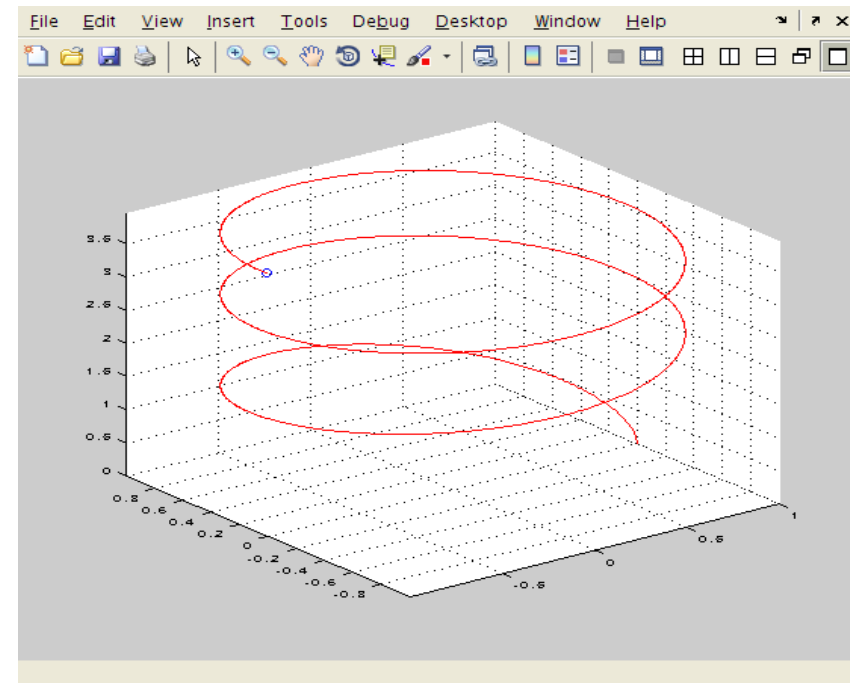
- Función *plot3(x,y,z,opcións)*
- x , y , z : vectores coas coordenadas dos puntos (ecuacións paramétricas); opcións: as mesmas que *plot*
- Exemplo:

```
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)
```



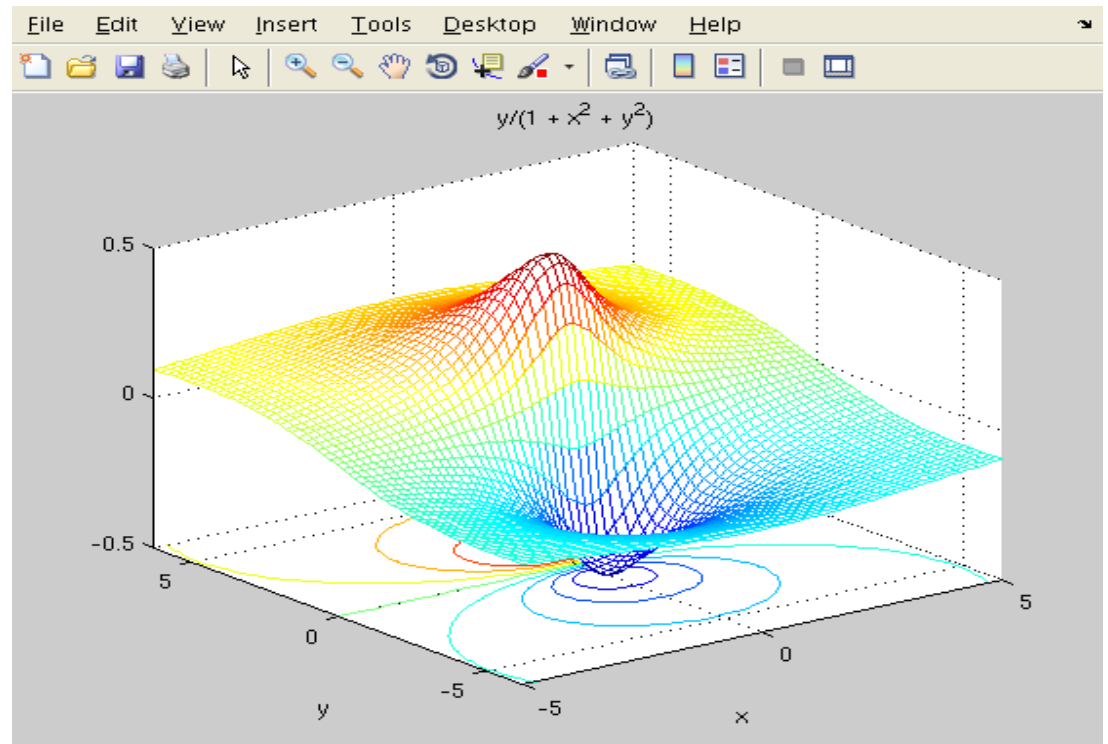
Curva animada en 3D: comet3

- 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])`
- También funciones `ezmesh(...)` e `ezmeshc(...)`, con contornos no plano XY



Superficies en 3D: *mesh*

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

1. $[X \ Y] = \text{meshgrid}(x, y)$ ou $[X \ Y] = \text{meshgrid}(x)$

- 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: $\text{mesh}(X, Y, Z)$

Superficies en 3D: *mesh*

- Exemplo: función $z = \frac{xy^2}{x^2 + y^2}$ en $[-5,5] \times [-5,5]$
 $x = [-5:0.1:5]; y = [-5:0.1:5];$

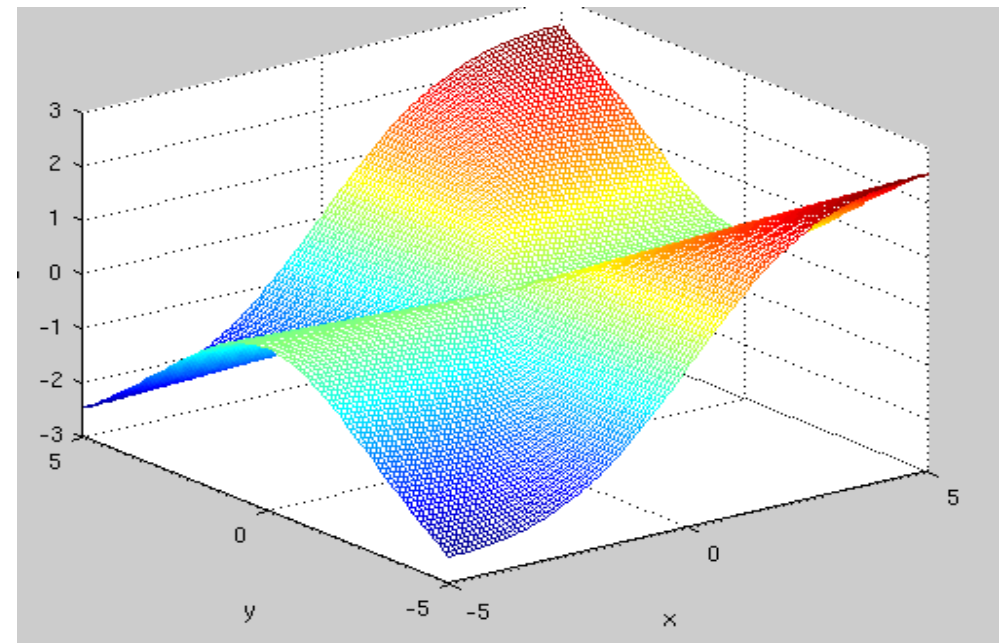
```
[X Y] = meshgrid(x, y);
```

```
Z = X.*Y.^2./(X.^2 + Y.^2 + eps);
```

```
mesh(X, Y, Z)
```

```
xlabel('x'); ylabel('y');
```

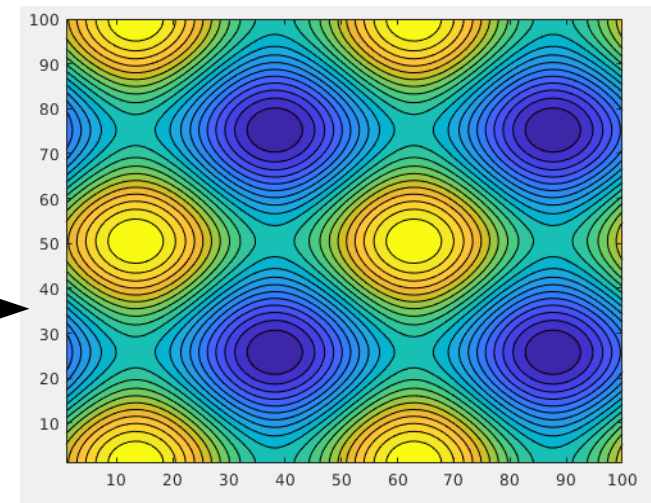
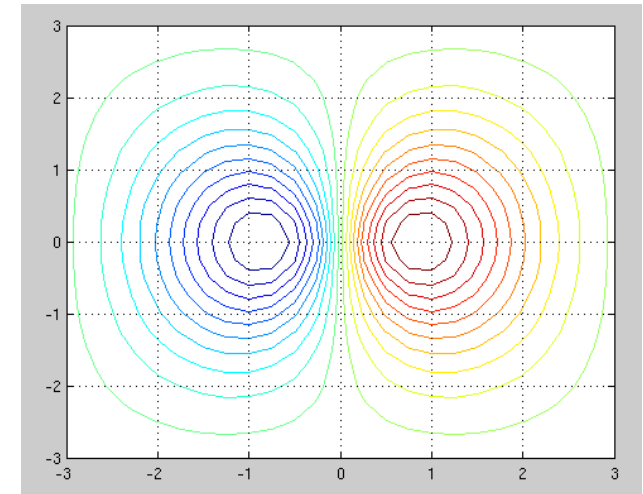
```
zlabel('z')
```



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

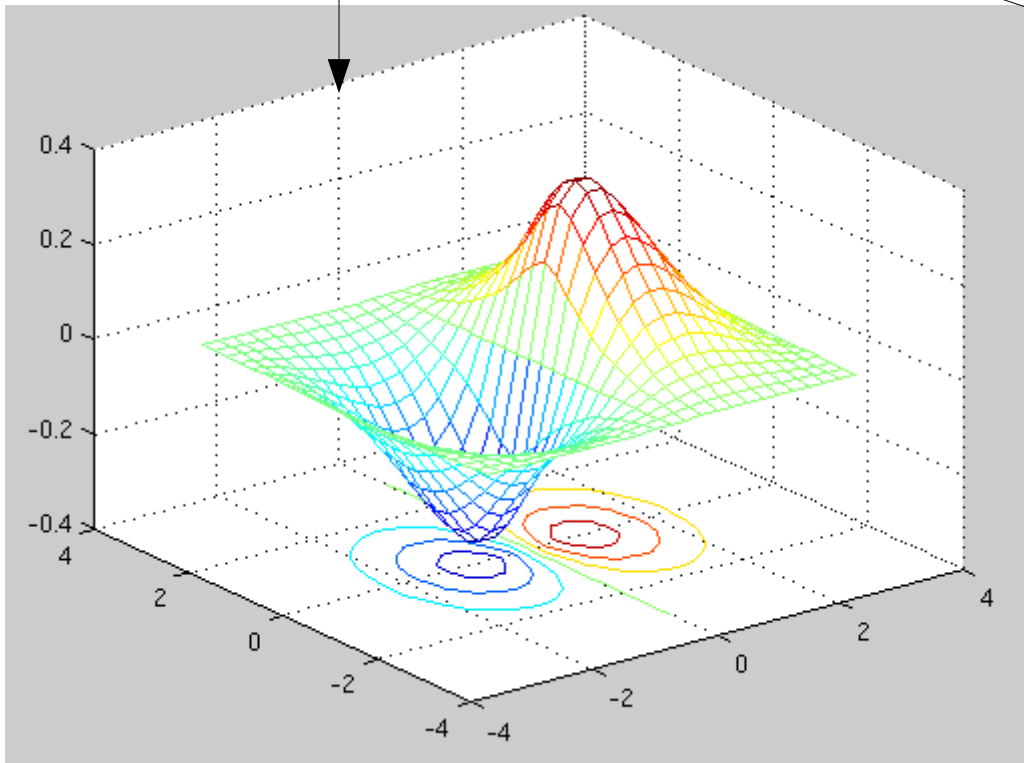
- Tamén se pode emprega-la función *surf(X,Y,Z)*, que rechea a superficie
- Contorno: *contour(X,Y,Z,n)*
contorno da superficie 3D sobre o plano XY; $n=n^{\circ}$ niveis do contorno (opcional)
- Mapa de calor: *contourf(Z,n)*

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

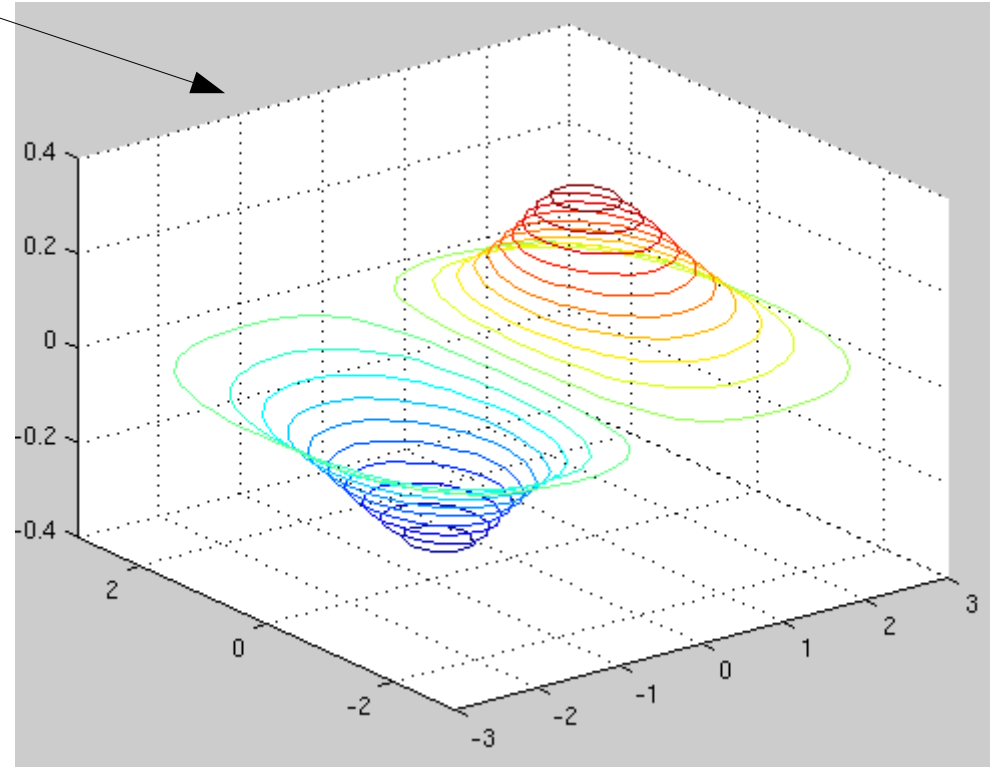


Superficies en 3D

```
x=-3:0.25:3   $z=f(x,y)=1.8^{-1.5\sqrt{x^2+y^2}} \cdot \sin x \cdot \cos y$   
[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)
```



Programación en Octave

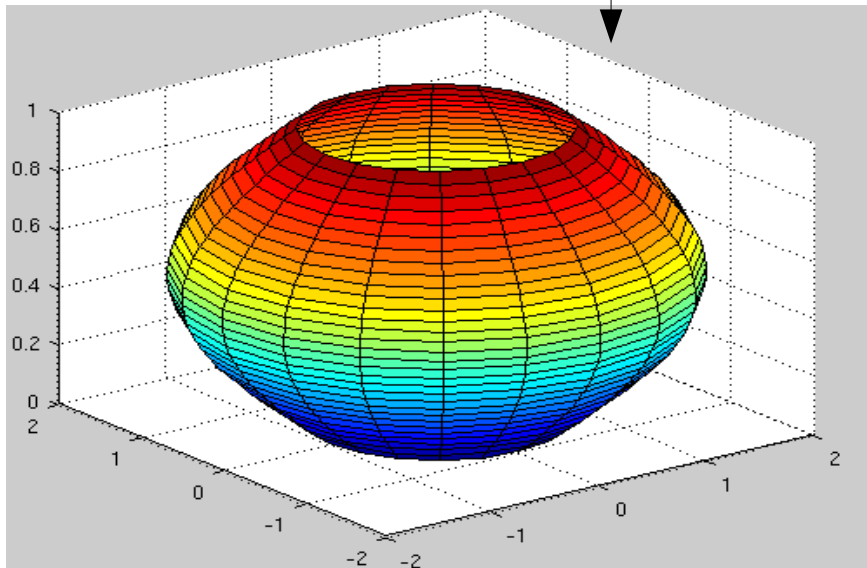


Gráficos tridimensionais

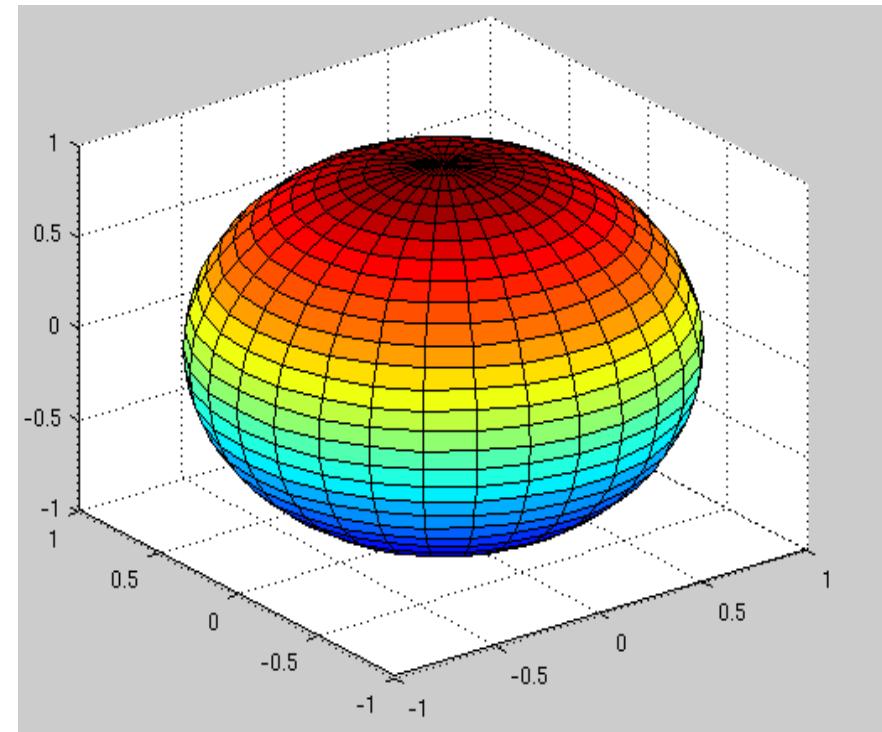
Otras gráficas

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

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



Programación en Octave



Gráficos tridimensionais

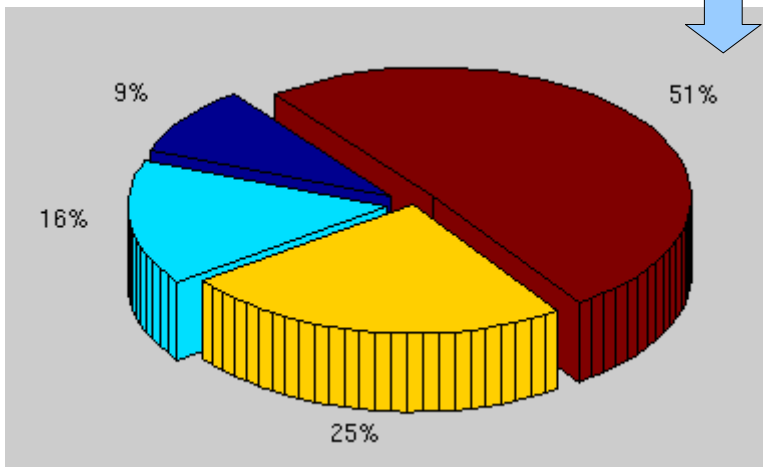
Outros diagramas 3D

- Diagrama de barras 3D

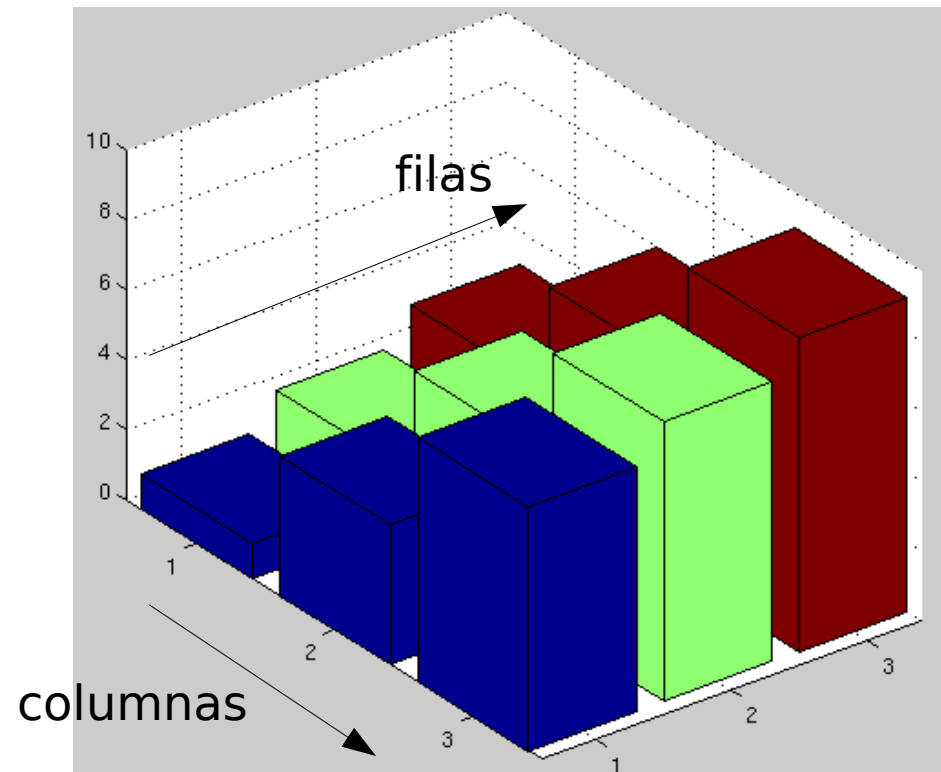
```
y=[1 2 3; 4 5 6; 7 8 9]; bar3(y)
```

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

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



Programación en Octave



Gráficos tridimensionais

Exercicios

Representa as seguintes curvas e superficies 3D:

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

$$2) x(t) = \cos t - t \sin t; y(t) = \sin t - t \cos t; z(t) = t^2$$

$$3) x(\theta) = 1 + \cos \theta; y(\theta) = 1 + \sin \theta; z(\theta) = 4\theta$$

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

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

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

$$7) x(t) = 2\cos(2\pi t), y(t) = 2\sin(2\pi t), z(t) = t$$

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

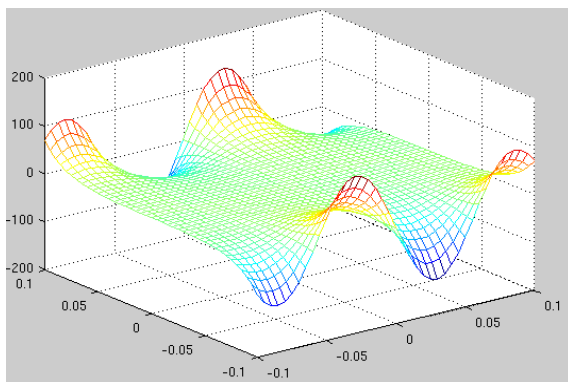
Soluciones aos exercicios (I)

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
```

Soluciones 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)`