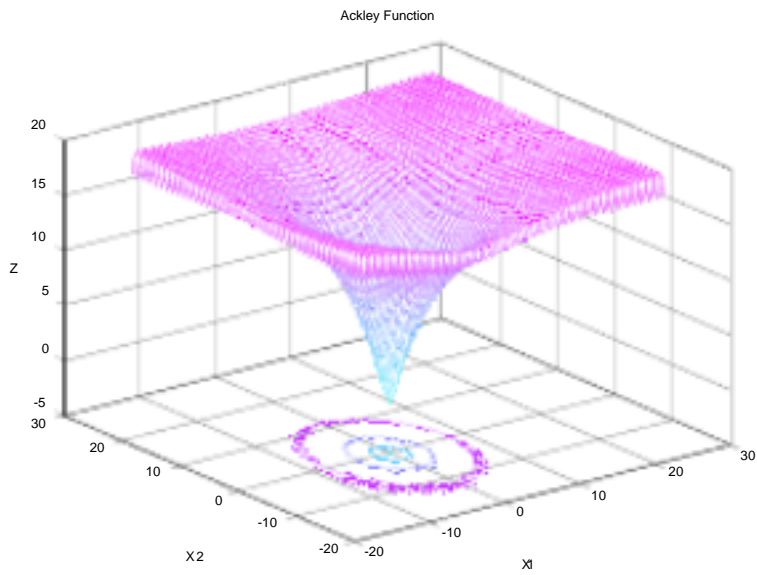


F₁
Ackley
Function

$$F_1(\mathbf{X}) = -20 e^{-\frac{1}{5} \sqrt{\frac{1}{D} \sum_{i=1}^D x_i^2}} - e^{\frac{1}{D} \sum_{i=1}^D \cos(2\pi x_i)} + 20 + e$$



```
x1=linspace(-15,25,300);
x2=x1;
[X1,X2]=meshgrid(x1,x2);
A=sqrt(X1.^2+0.5*X2.^2);
B=cos(2*pi*X1)+cos(2*pi*X2);
Z=-20*exp(-0.2*A)-exp(0.5*B)+20;

% subplot(2,1,1)
meshc(X1,X2,Z)

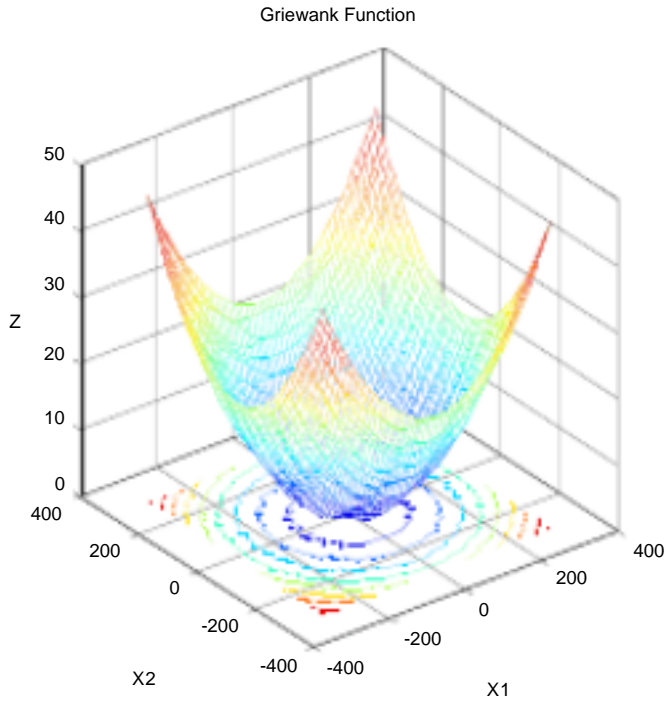
colormap('cool')

xlabel('X1')
ylabel('X2')
zlabel('Z')
title('Ackley Function')
% subplot(2,1,2)
% [c,h]=contour(X1,X2,Z);
% clabel(c,h);
```

F₂
Griewank
Function

$$F_2(\mathbf{X}) = \frac{1}{4000} \sum_{i=1}^D x_i^2 - \prod_{i=1}^D \left(\cos\left(\frac{x_i}{\sqrt{i}}\right) \right) + 1$$

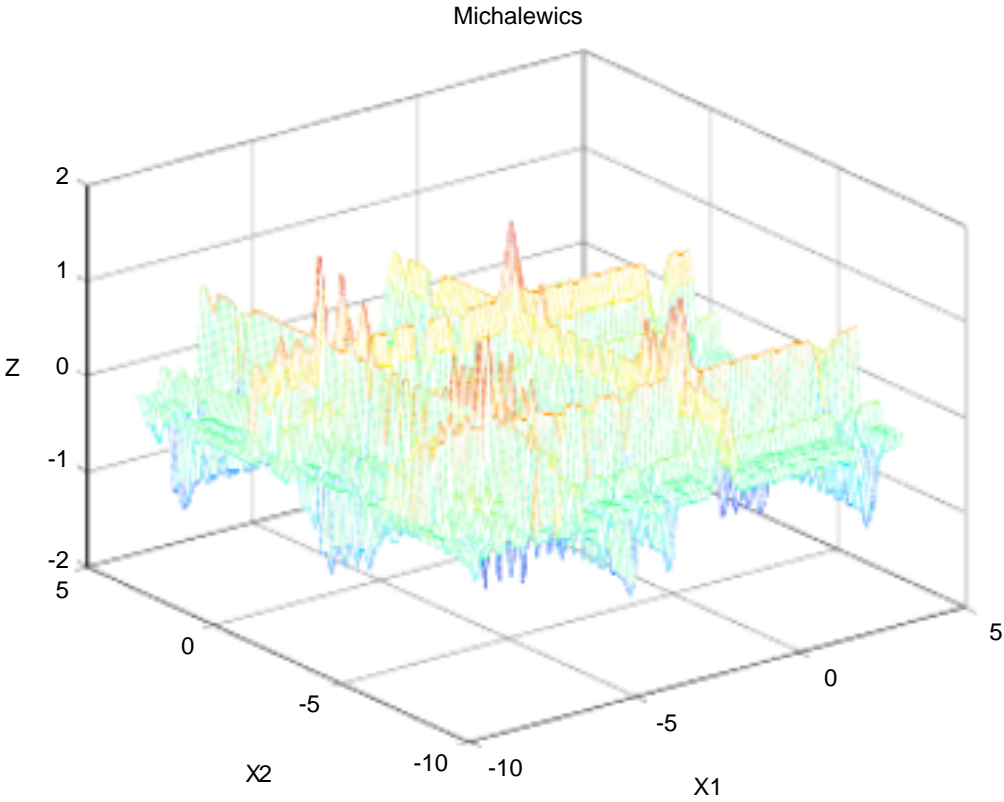
```
x1=linspace(-300,300,50);
x2=x1;
[X1,X2]=meshgrid(x1,x2);
A=X1.^2+X2.^2;
B=cos(X1).*cos(X2/sqrt(2));
Z=(1/4000)*A-B+1;
meshc(X1,X2,Z)
xlabel('X1')
ylabel('X2')
zlabel('Z')
title('Griewank Function')
axis square
```



F₃
Michalewics
Function

$$F_3(\mathbf{X}) = -\sum_{i=1}^D \sin(x_i) \left(\sin\left(\frac{x_i^2}{\pi}\right) \right)^{2m}; m=10$$

```
x1=linspace(-10,pi,80);
x2=x1;
m=10;
[X1,X2]=meshgrid(x1,x2);
X=[X1,X2];
A=sin(X1).*(sin(X1.^2/pi)).^(2*m);
B=sin(X2).*(sin(2*(X2.^2)/pi)).^(2*m);
Z=-(A+B);
mesh(X1,X2,Z)
xlabel('X1')
ylabel('X2')
zlabel('Z')
title('Michalewics')
```

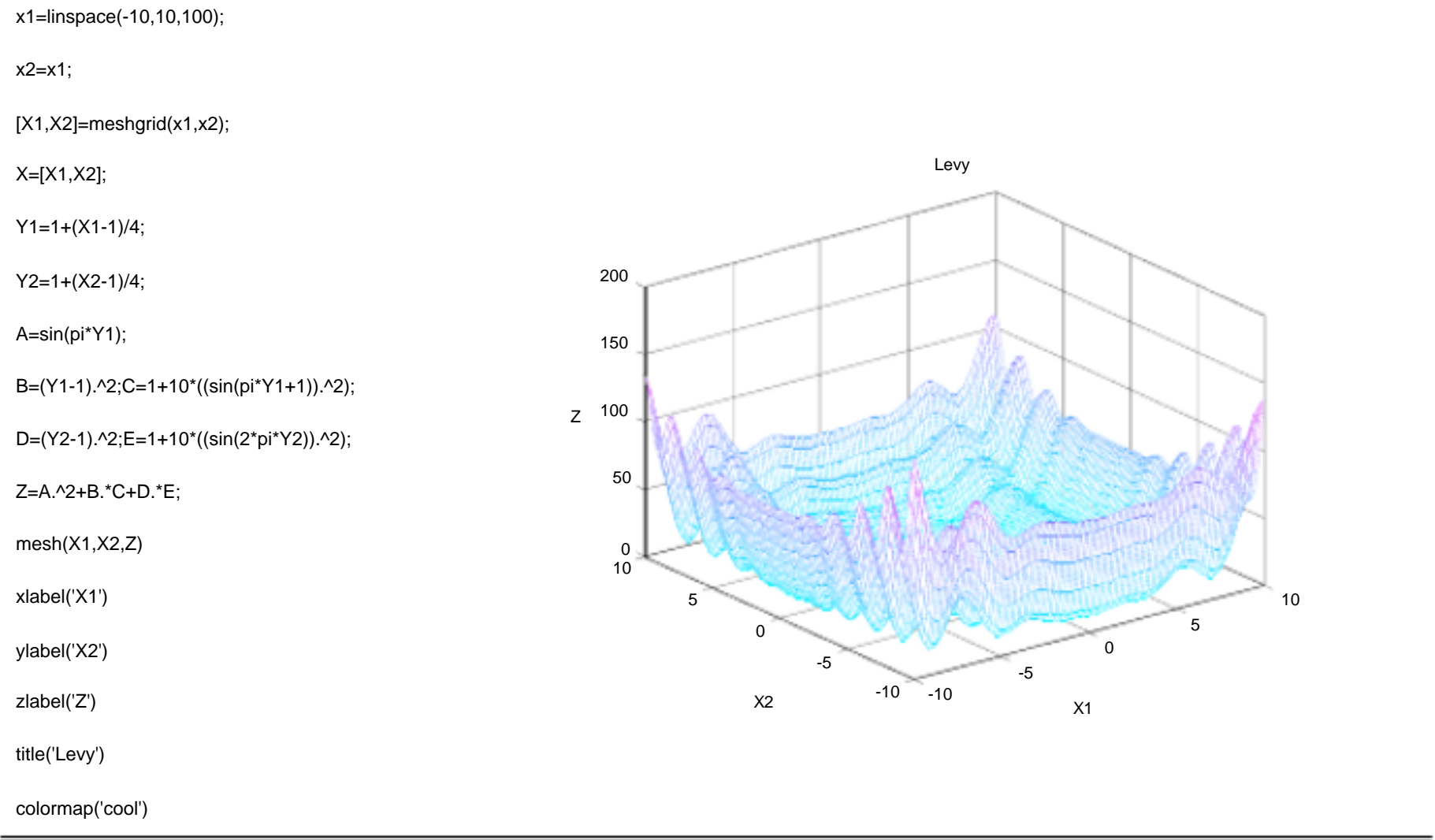


F₄

Levy Function

$$F_4(\mathbf{X}) = \sin^2(\pi y_1) + \sum_{i=1}^{D-1} \left[(y_i - 1)^2 (1 + 10 \sin^2(\pi y_i + 1)) \right] + (y_D - 1)^2 (1 + 10 \sin^2(2\pi y_D))$$

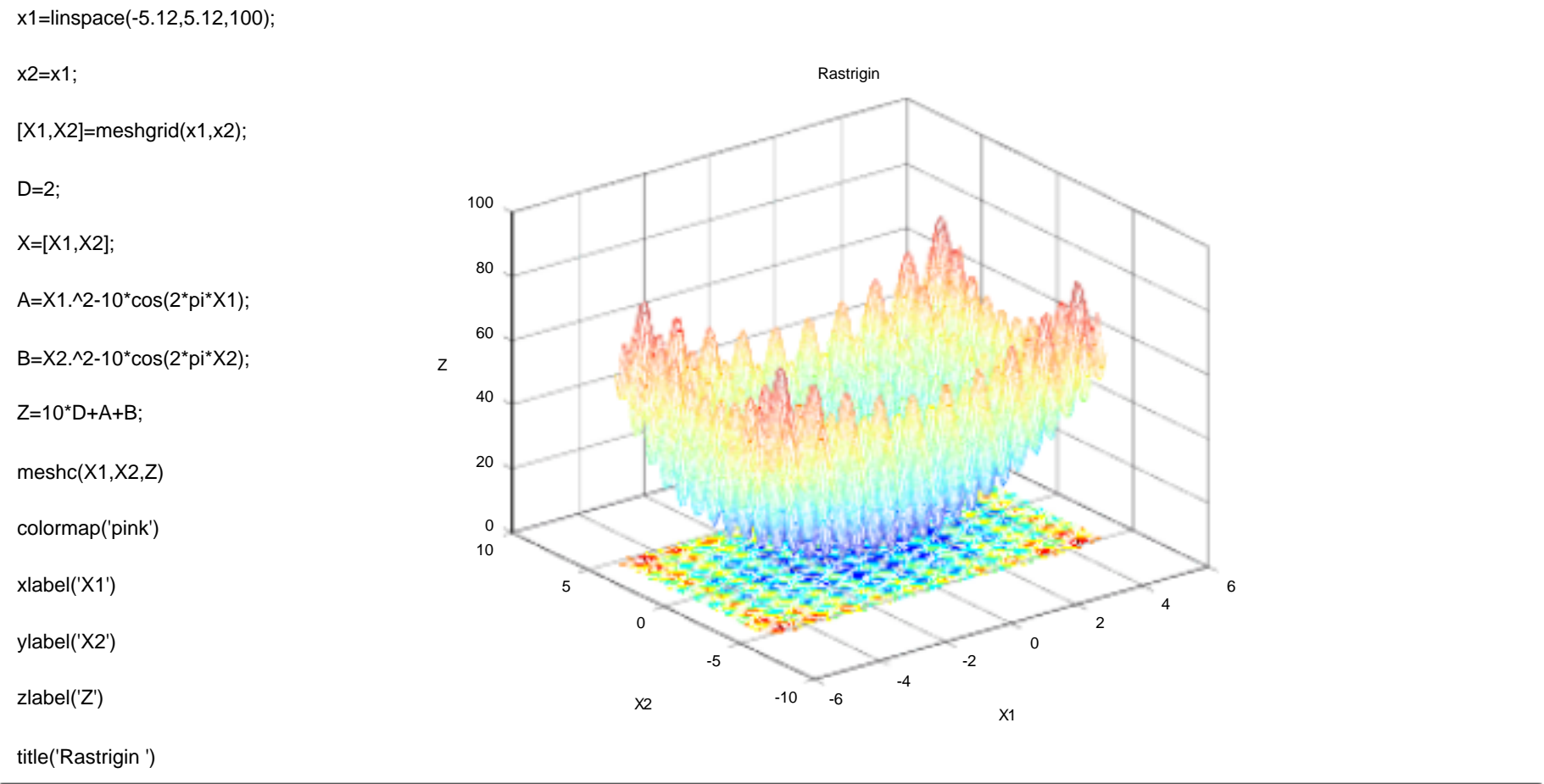
$$y_i = 1 + \frac{x_i - 1}{4}, i = 1, 2, \dots, D$$



F₅

Rastrigin Function

$$F_5(\mathbf{X}) = 10D + \sum_{i=1}^D (x_i^2 - 10 \cos(2\pi x_i))$$



F₆

Rosenbrock Function

$$F_6(\mathbf{X}) = \sum_{i=2}^D \left[(x_i^2 - x_{i-1})^2 + (x_i - 1)^2 \right]$$

