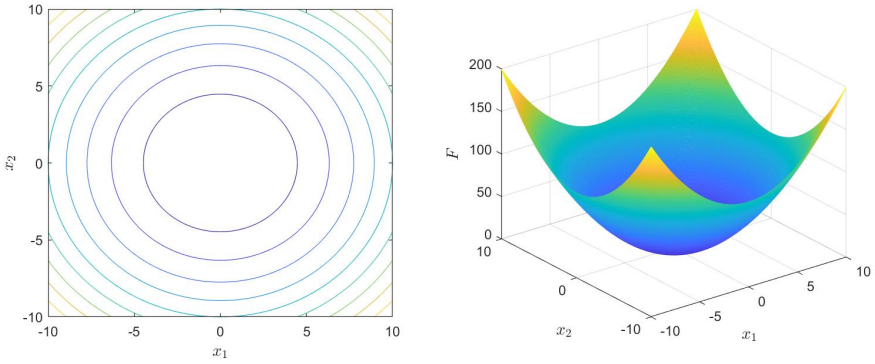
**Optimization Methods for Engineers - FS 2021 (ETH Zurich)**

# Benchmark Functions

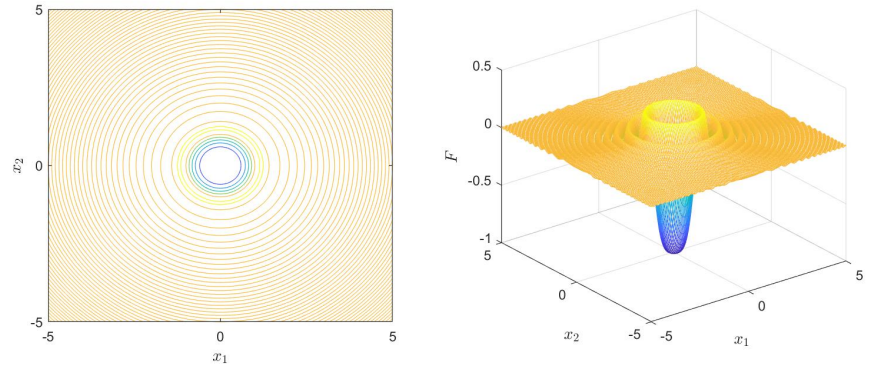
**Sphere Function**

$F = x_1^2 + x_2^2$



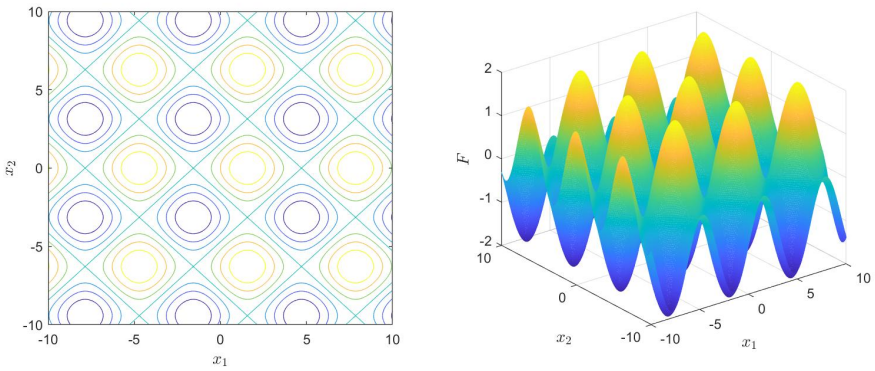

**Sinc Function**

$F = -\text{sinc}(x_1^2 + x_2^2)$



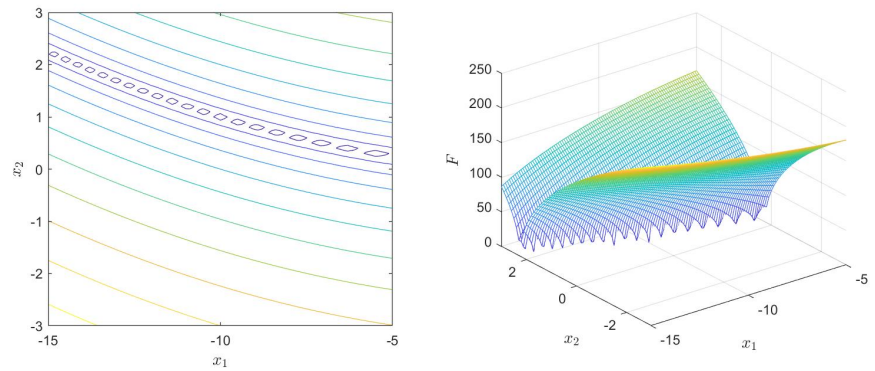

**Cos-Sin Function**

$F = \sin(x_1) + \cos(x_2)$



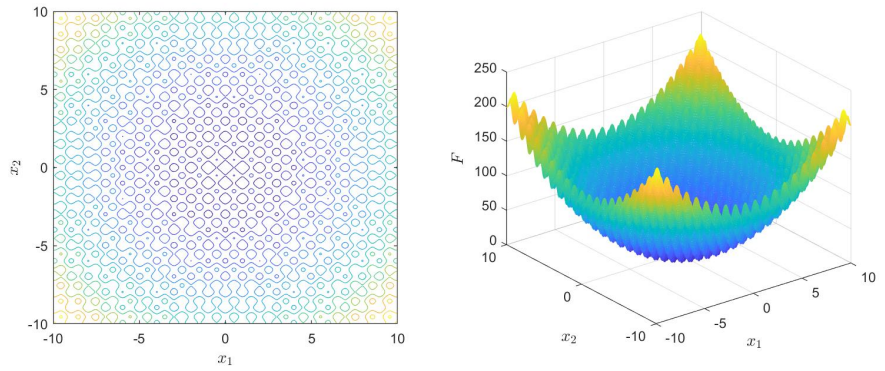

**Bukin Function Nr. 6**

$F = 100 \cdot \sqrt{|x_2 - 0.01 \cdot (x_1^2)|} + 0.01 \cdot |x1 + 10|$



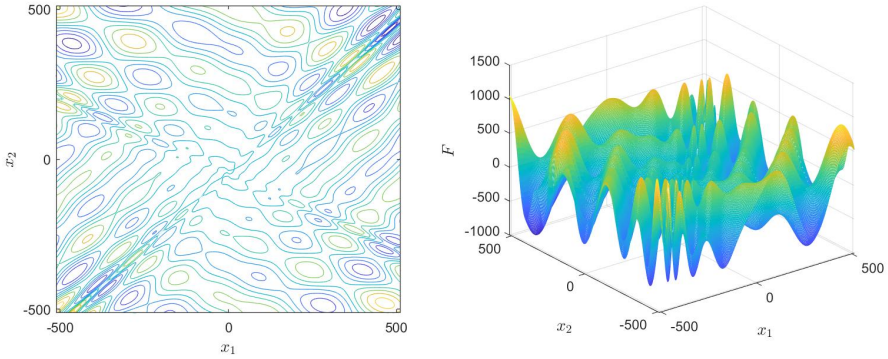
**Rastrigin Function**

$$F = 10 \cdot 2 + (x_1^2 - 10 \cdot \cos(2\pi \cdot x_1)) + (x_2^2 - 10 \cdot \cos(2\pi \cdot x_2))$$



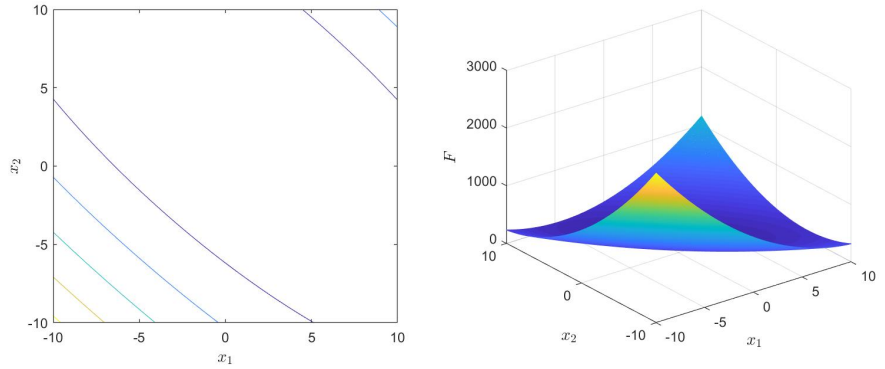

**Eggholder Function**

$$F = -(x_2 + 47) \cdot \sin\sqrt{\left|\frac{x_1}{2} + (x_2 + 47)\right|} - x_1 \cdot \sin\sqrt{|x_1 - (x_2 + 47)|}$$



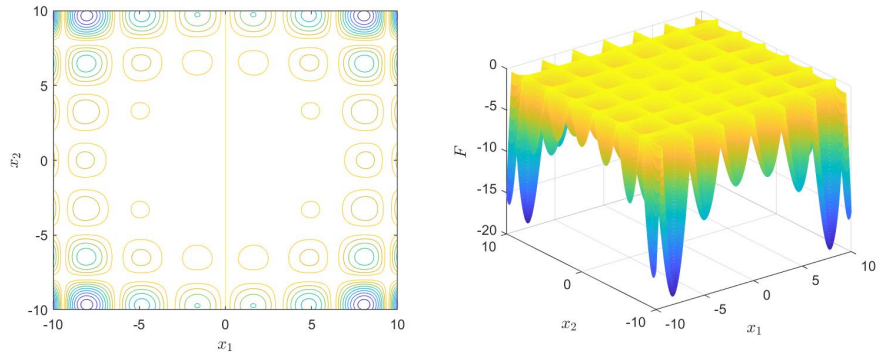

**Booth Function**

$$F = (x_1 + 2 \cdot x_2 - 7)^2 + (2 \cdot x_1 + x_2 - 5)^2$$



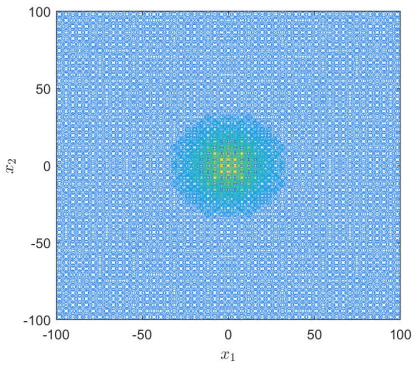

**Hoelder Table Function**

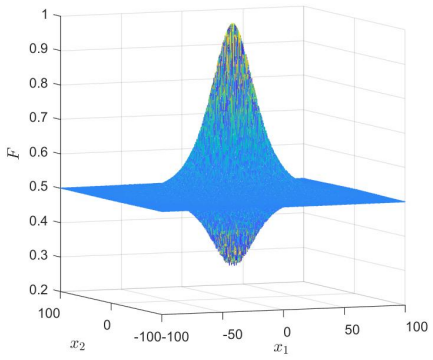
$$F = -\left|\sin(x_1) \cdot \cos(x_2) \cdot \exp\left(\left|1 - \frac{\sqrt{x_1^2 + x_2^2}}{\pi}\right|\right)\right|$$



**Schaffer Function Nr. 2**

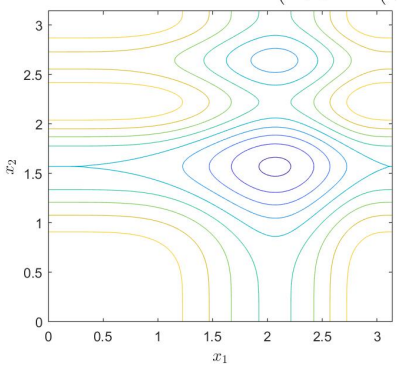
$$F = 0.5 + \frac{\cos(\sin|x_1^2 - x_2^2|)^2 - 0.5}{(1 + 0.001 \cdot (x_1^2 + x_2^2))^2}$$

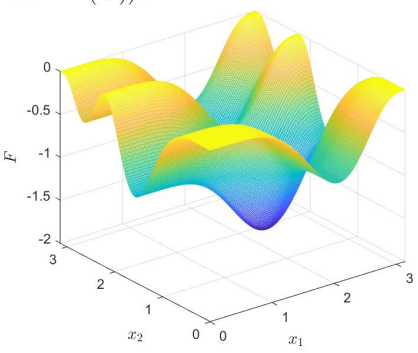



**Michalewicz Function (smooth)**

$$F = -\left(\sin(x_1) \cdot \sin^{2m}\left(\frac{1 \cdot x_1^2}{\pi}\right) + \sin(x_2) \cdot \sin^{2m}\left(\frac{2 \cdot x_2^2}{\pi}\right)\right), m = 1$$




**Michalewicz Function (steep)**

$$F = -\left(\sin(x_1) \cdot \sin^{2m}\left(\frac{1 \cdot x_1^2}{\pi}\right) + \sin(x_2) \cdot \sin^{2m}\left(\frac{2 \cdot x_2^2}{\pi}\right)\right), m = 10$$