Real Valued Test Functions

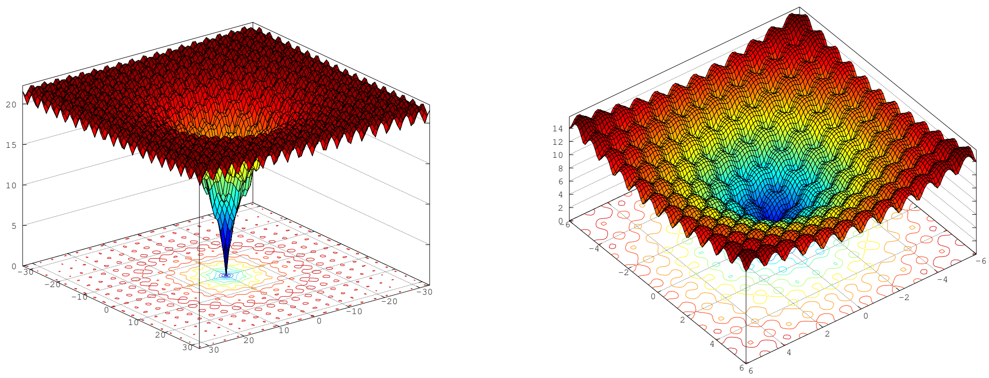
Heuristic and Evolutionary Algorithms Laboratory (HEAL)

August 20, 2013

Ackley Function

$$f(x) = 20 + e - 20e^{-\frac{1}{5}\sqrt{\frac{1}{n}\sum_{i=1}^{n} x_i^2}} - e^{\frac{1}{n}\sum_{i=1}^{n}\cos(2\pi x_i)}$$

Dimensions:	n
Domain:	$-32.768 \leq x_i \leq 32.768$
Global Optimum:	$f(x) = 0.0$ at $x = (0.0, 0.0, \ldots, 0.0)$
Operator:	AckleyEvaluator
Charts:	



(a) [-32.768, 32.768] (b) [-6.0, 6.0]

Figure 1: Ackley function plots.

Beale Function

$$f(x) = (1.5 - x_1 + x_1 x_2)^2 + (2.25 - x_1 + x_1 x_2^2)^2 + (2.625 - x_1 + x_1 x_2^3)^2$$

Dimensions:	2
Domain:	$-4.5 \leq x_i \leq 4.5$
Global Optimum:	$f(x) = 0.0$ at $x = (3.0, 0.5)$
Operator:	BealeEvaluator
Charts:	

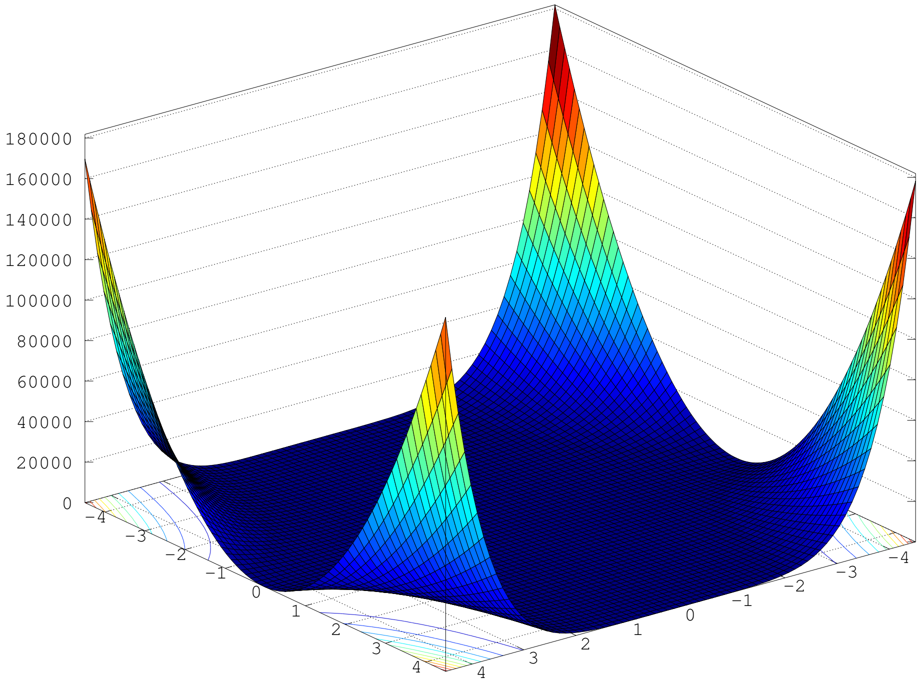


Figure 2: Beale function [-4.5, 4.5].

Booth Function

$$f(x) = (x_1 + 2x_2 - 7)^2 + (2x_1 + x_2 - 5)^2$$

Dimensions:	2
Domain:	$-10.0 \leq x_i \leq 10.0$
Global Optimum:	$f(x) = 0.0$ at $x = (1.0, 3.0)$
Operator:	BoothEvaluator
Charts:	

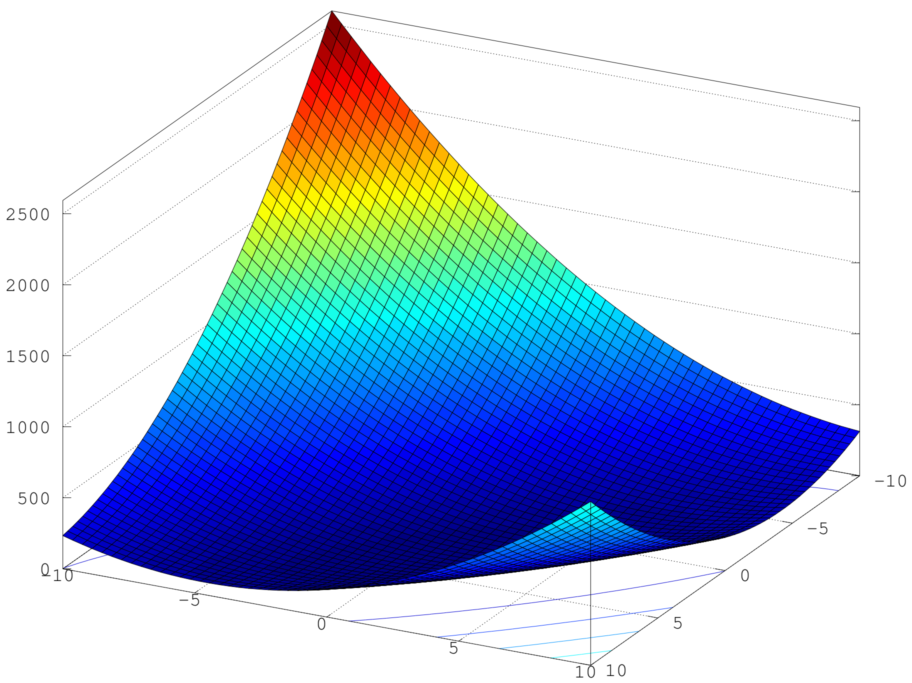
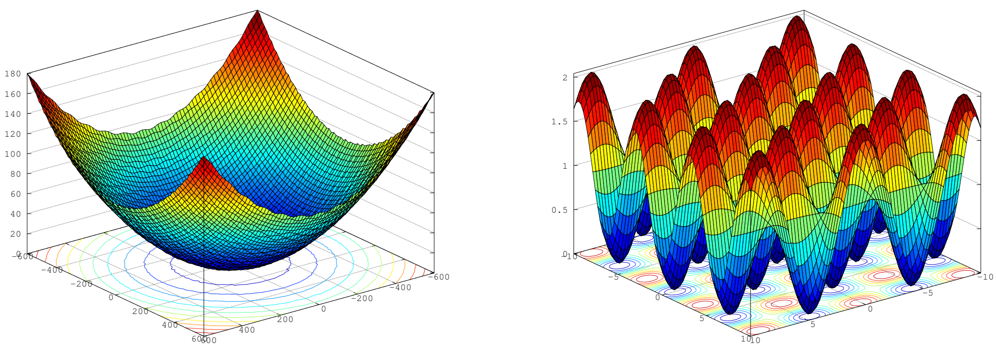


Figure 3: Booth function [-10.0, 10.0].

Griewank Function

$$f(x) = 1 + \sum_{i=1}^{n} \frac{x_i^2}{4000} - \prod_{i=1}^{n} \cos\left(\frac{x_i}{\sqrt{i}}\right)$$

Dimensions: n
Domain: $-600.0 \leq x_i \leq 600.0$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0, \ldots, 0.0)$
Operator: GriewankEvaluator
Charts:



(a) [-600.0, 600.0]

(b) [-10.0, 10.0]

Figure 4: Griewank function plots.

Levy Function

$$f(x) = \sin^2(\pi w_1) + \sum_{i=1}^{n-1}(w_i - 1)^2[1 + 10\sin^2(\pi w_i + 1)] + (w_n - 1)^2[1 + \sin^2(2\pi w_n)]$$

$$w_i = 1 + \frac{x_i - 1}{4}, i = 1, \ldots, n$$

Dimensions: n
Domain: $-10.0 \leq x_i \leq 10.0$
Global Optimum: $f(x) = 0.0$ at $x = (1.0, 1.0)$
Operator: LevyEvaluator
Charts:

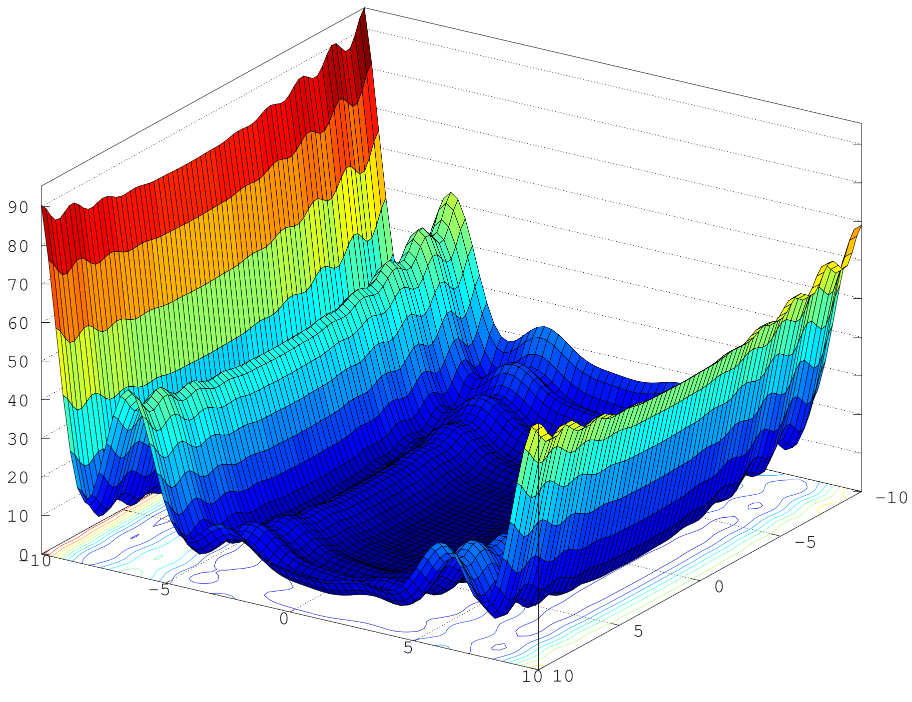


Figure 5: Levy function [-10.0, 10.0].

Matyas Function

$$f(x) = 0.26(x_1^2 + x_2^2) - 0.48x_1x_2$$

Dimensions: 2
Domain: $-10.0 \le x_i \le 10.0$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0)$
Operator: MatyasEvaluator
Charts:

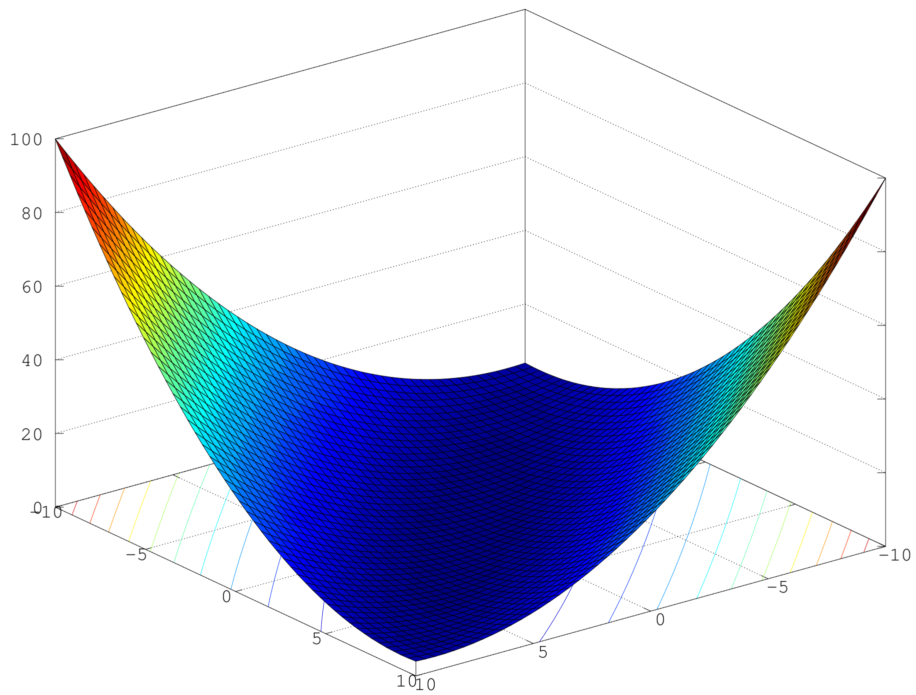
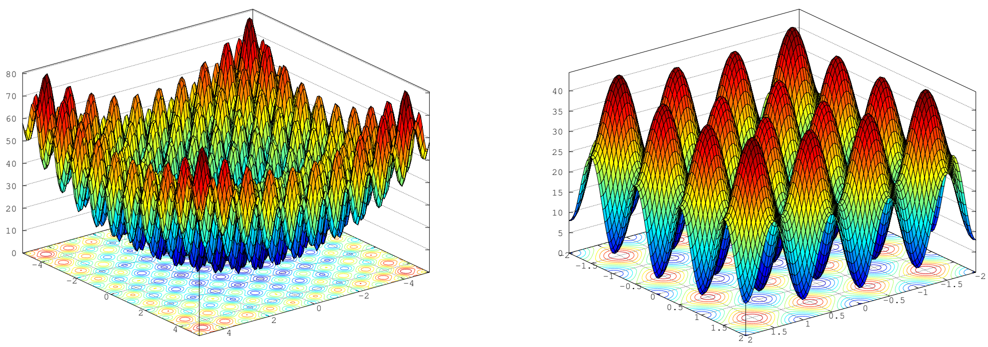


Figure 6: Matyas function [-10.0, 10.0].

Rastrigin Function

$$f(x) = 10n + \sum_{i=1}^{n} [x_i^2 - 10\cos(2\pi x_i)]$$

Dimensions: n
Domain: $-5.12 \leq x_i \leq 5.12$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0, \dots, 0.0)$
Operator: RastriginEvaluator
Charts:



(a) [-5.12, 5.12] (b) [-2.0, 2.0]

Figure 7: Rastrigin function plots.

Rosenbrock Function

$$f(x) = \sum_{i=1}^{n-1} [100(x_i^2 - x_{i+1})^2 + (x_i - 1)^2]$$

Dimensions: n
Domain: $-2.048 \leq x_i \leq 2.048$
Global Optimum: $f(x) = 0.0$ at $x = (1.0, 1.0, \ldots, 1.0)$
Operator: RosenbrockEvaluator
Charts:

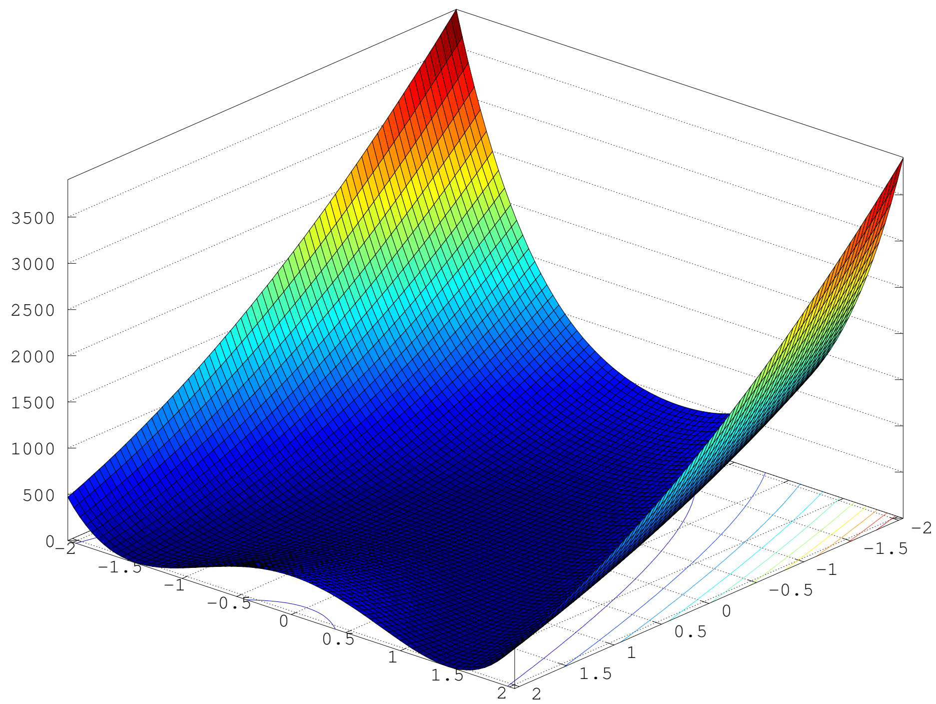


Figure 8: Rosenbrock function [-2.048, 2.048].

Schwefel Function

$$f(x) = 418.982887272433n - \sum_{i=1}^{n} x_i \sin(\sqrt{|x_i|})$$

Dimensions:	n
Domain:	$-500.0 \leq x_i \leq 500.0$
Global Optimum:	$f(x) \approx 0.0$ at $x = (420.9687, 420.9687, \ldots, 420.9687)$
Operator:	SchwefelEvaluator
Charts:	

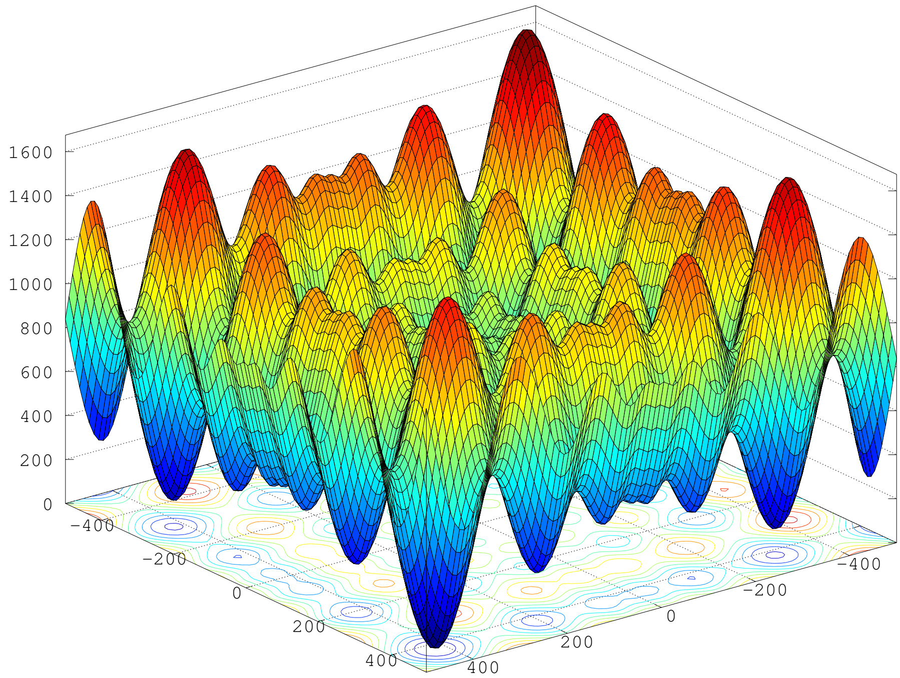


Figure 9: Schwefel function [-500.0, 500.0].

Sphere Function

$$f(x) = \sum_{i=1}^{n} x_i^2$$

Dimensions: n
Domain: $-5.12 \leq x_i \leq 5.12$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0, \ldots, 0.0)$
Operator: SphereEvaluator
Charts:

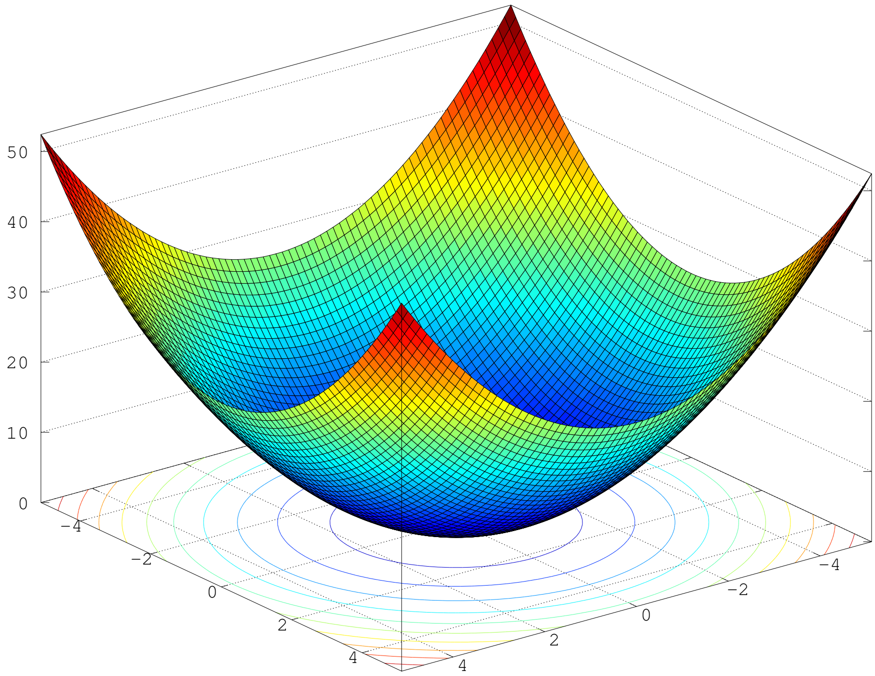


Figure 10: Sphere function [-5.12, 5.12].

Sum Squares Function

$$f(x) = \sum_{i=1}^{n} i x_i^2$$

Dimensions: n
Domain: $-10.0 \leq x_i \leq 10.0$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0, \ldots, 0.0)$
Operator: SumSquaresEvaluator
Charts:

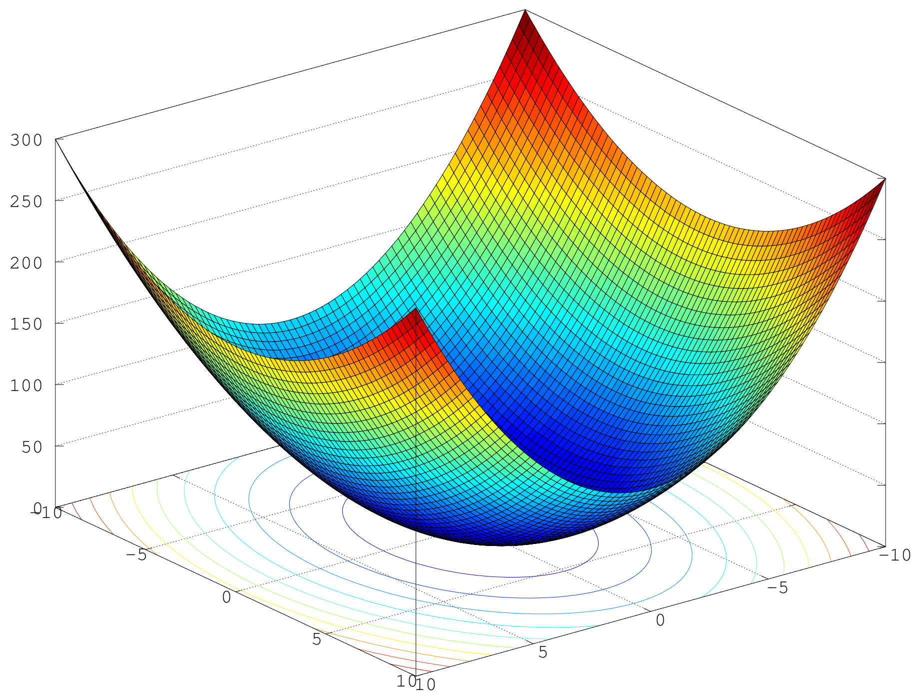


Figure 11: Sum squares function [-10.0, 10.0].

Zakharov Function

$$f(x) = \sum_{i=1}^{n} x_i^2 + \left(\sum_{i=1}^{n} 0.5ix_i\right)^2 + \left(\sum_{i=1}^{n} 0.5ix_i\right)^4$$

Dimensions: n
Domain: $-5.0 \leq x_i \leq 10.0$
Global Optimum: $f(x) = 0.0$ at $x = (0.0, 0.0, \ldots, 0.0)$
Operator: ZakharovEvaluator
Charts:

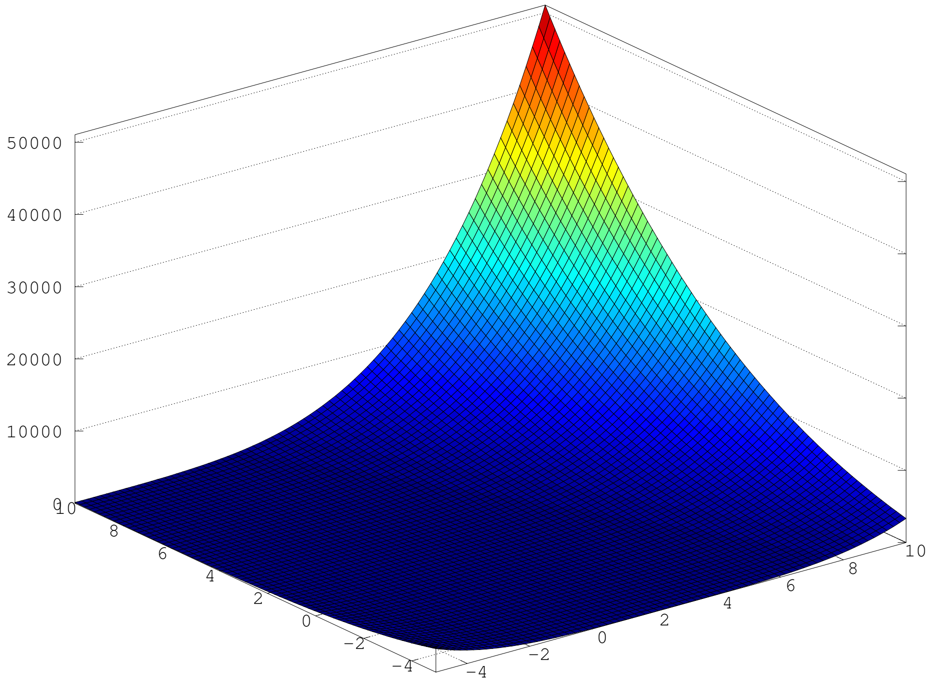


Figure 12: Zakharov function [-5.0, 10.0].