

Supplementary materials for

Xiao-qing Zhang, Zheng-feng Ming, 2017. An optimized grey wolf optimizer based on a mutation operator and eliminating-reconstructing mechanism and its application. *Front. Inform. Technol. Electron. Eng.*, **18**(11):1705–1719. <https://doi.org/10.1631/FITEE.1601555>

Table S1 Benchmark functions

Function No.	Name	Function expression
1	Sphere	$f_1(x) = \sum_{i=1}^n x_i^2$
2	Schwefel 2.22	$f_2(x) = \sum_{i=1}^n x_i + \prod_{i=1}^n x_i $
3	Schwefel 1.2	$f_3(x) = \sum_{i=1}^n \left(\sum_{j=1}^i x_j \right)^2$
4	Schwefel 2.21	$f_4(x) = \max_i \{ x_i , 1 \leq i \leq n\}$
5	Rosebrock	$f_5(x) = \sum_{i=1}^{n-1} [100(x_{i+1} - x_i^2)^2 + (x_i - 1)^2]$
6	Step	$f_6(0.5x) = \sum_{i=1}^n (x_i + 0.5)^2$
7	Quartic	$f_7(x) = \sum_{i=1}^n i x_i^4 + \text{random}[0,1)$
8	Schwefel 2.26	$f_8(x) = -\sum_{i=1}^n \left(x_i \sin \sqrt{ x_i } \right)$
9	Rastrigin	$f_9(x) = \sum_{i=1}^n [x_i^2 - 10 \cos(2\pi x_i) + 10]$
10	Shifted Ackley	$f_{10}(x) = -20 \exp \left(-0.2 \sqrt{\frac{1}{n} \sum_{i=1}^n x_i^2} \right) - \exp \left(\frac{1}{n} \sum_{i=1}^n \cos(2\pi x_i) \right) + 20 + e$
11	Griewank	$f_{11}(x) = \frac{1}{4000} \sum_{i=1}^n x_i^2 - \prod_{i=1}^n \cos \left(\frac{x_i}{\sqrt{i}} \right) + 1$ $f_{12}(x) = \frac{\pi}{n} \left\{ 10 \sin^2(\pi y_1) + \sum_{i=1}^{n-1} (y_i - 1)^2 [1 + 10 \sin^2(\pi y_{i+1})] + (y_n - 1)^2 \right\} + \sum_{i=1}^n u(x_i, 10, 100, 4),$
12	Penalized1	$y_i = 1 + (x_i + 1) / 4, u(x_i, a, k, m) = \begin{cases} k(x_i - a)^m, & x_i > a, \\ 0, & -a < x_i < a, \\ k(-x_i - a)^m, & x_i < -a. \end{cases}$
13	Penalized2	$f_{13}(x) = 0.1 \left\{ \sin^2(3\pi x_1) + \sum_{i=1}^{n-1} (x_i - 1)^2 [1 + \sin^2(3\pi x_{i+1})] + (x_n - 1)^2 [1 + \sin^2(2\pi x_{i+1})] \right\} + \sum_{i=1}^n u(x_i, 5, 100, 4)$

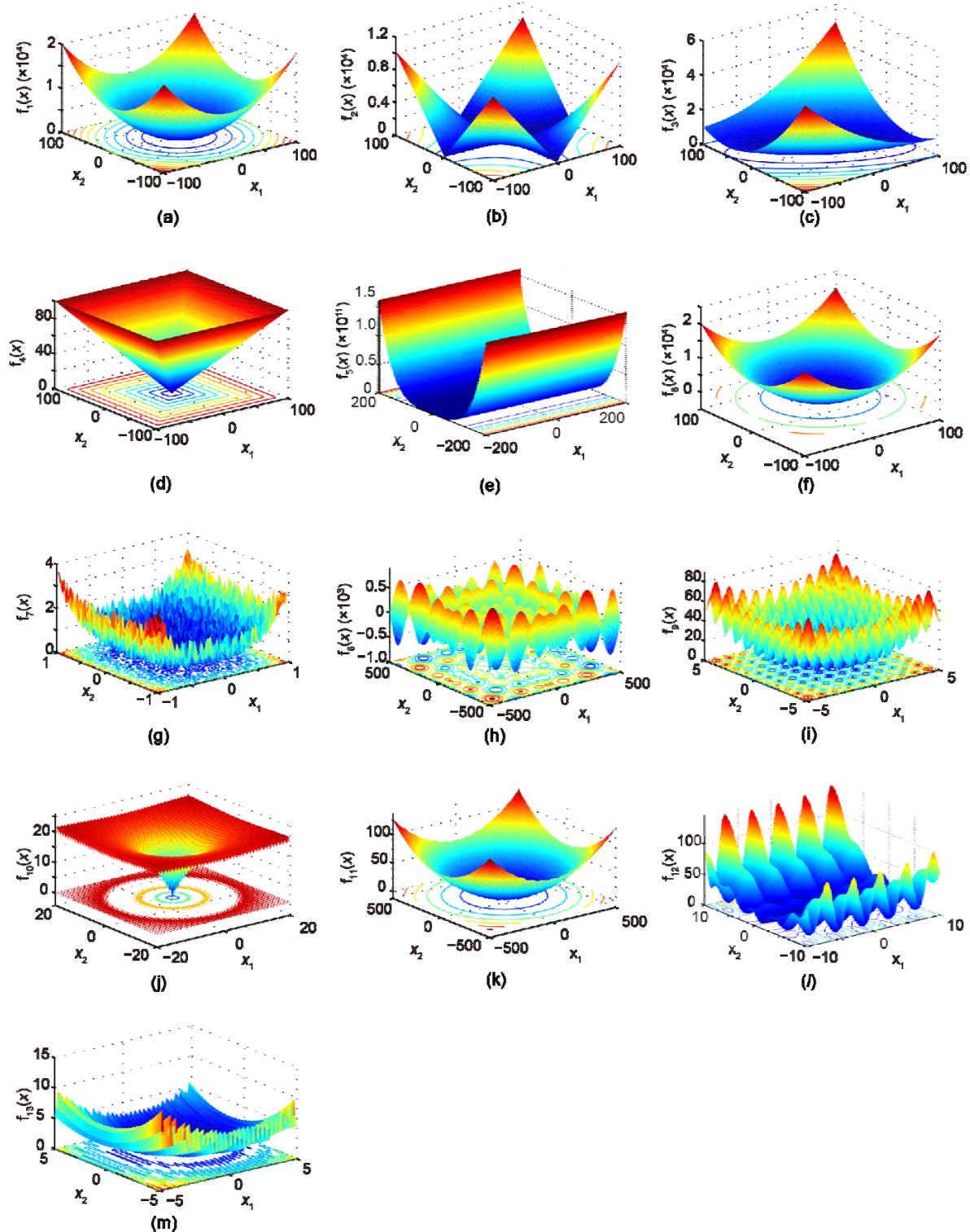


Fig. S1 Graphs of benchmark functions: Sphere (a); Schwefel 2.22 (b); Schwefel 1.2 (c); Schwefel 2.21 (d); Rosebrock (e); Step (f); Quartic (g); Schwefel 2.26 (h); Rastrigin (i); Shifted Ackley (j); Griewank (k); Penalized1 (l); and Penalized2 (m) (Dim=2)