1. *Ackley's Problem (ACK)* (Storn and Price, 1997)

$$\min_x f(x) = -20\exp\left(-0.02\sqrt{n^{-1}\sum_{i=1}^{n} x_i^2}\right) - \exp\left(n^{-1}\sum_{i=1}^{n}\cos(2\pi x_i)\right) + 20 + e$$

subject to $-30 \leqslant x_i \leqslant 30$, $i \in \{1, 2, \ldots, n\}$. The number of local minima is not known. The global minimum is located at the origin with $f(x^*) = 0$. Tests were performed for $n = 10$.

2. *Aluffi-Pentini's Problem (AP)* (Aluffi-Pentini et al., 1985)

$$\min_x f(x) = 0.25x_1^4 - 0.5x_1^2 + 0.1x_1 + 0.5x_2^2$$

subject to $-10 \leqslant x_1, x_2 \leqslant 10$. The function has two local minima, one of them is global with $f(x^*) \approx -0.3523$ located at $(-1.0465, 0)$.

4. *Bohachevsky 1 Problem (BF1)* (Bohachevsky et al., 1986)

$$\min_x f(x) = x_1^2 + 2x_2^2 - 0.3\cos(3\pi x_1) - 0.4\cos(4\pi x_2) + 0.7$$

subject to $-50 \leqslant x_1, x_2 \leqslant 50$. The number of local minima is unknown but the global minimizer is located at $x^* = (0, 0)$ with $f(x^*) = 0$.

5. *Bohachevsky 2 Problem (BF2)* (Bohachevsky et al., 1986)

$$\min_x f(x) = x_1^2 + 2x_2^2 - 0.3\cos(3\pi x_1)\cos(4\pi x_2) + 0.3$$

subject to $-50 \leqslant x_1, x_2 \leqslant 50$. The number of local minima is unknown but the global minimizer is located at $x^* = (0, 0)$ with $f(x^*) = 0$.

15. *Griewank Problem (GW)* (Griewank, 1981; Jansson and Knüppel, 1995)

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

subject to $-600 \leqslant x_i \leqslant 600$, $i \in \{1, 2, \ldots, n\}$. The function has a global minimum located at $x^* = (0, 0, \ldots, 0)$ with $f(x^*) = 0$. Number of local minima for arbitrary n is unknown, but in the two dimensional case there are some 500 local minima. Tests were performed for $n = 10$.

7. *Camel Back – 3 Three Hump Problem (CB3)* (Dixon and Szegö, 1975)

$$\min_x f(x) = 2x_1^2 - 1.05x_1^4 + \frac{1}{6}x_1^6 + x_1x_2 + x_2^2$$

subject to $-5 \leqslant x_1,\ x_2 \leqslant 5$. The function has three local minima, one of them is global located at $x^* = (0, 0)$ with $f(x^*) = 0$.

8. *Camel Back – 6 Six Hump Problem (CB6)* (Dixon and Szegö, 1978; Michalewicz, 1996)

$$\min_x f(x) = 4x_1^2 - 2.1x_1^4 + \frac{1}{3}x_1^6 + x_1x_2 - 4x_2^2 + 4x_2^4$$

subject to $-5 \leqslant x_1,\ x_2 \leqslant 5$. This function is symmetric about the origin and has three conjugate pairs of local minima with values $f \approx -1.0316$, -0.2154, 2.1042. The function has two global minima at $x^* \approx (0.089842, -0.712656)$ and $(-0.089842, 0.712656)$ with $f(x^*) \approx -1.0316$.

9. *Cosine Mixture Problem (CM)* (Breiman and Cutler, 1993)

$$\max_x f(x) = 0.1\sum_{i=1}^{n}\cos(5\pi x_i) - \sum_{i=1}^{n} x_i^2$$

subject to $-1 \leqslant x_i \leqslant 1,\ i \in \{1, 2, \ldots, n\}$. The global maxima are located at the origin with the function values 0.20 and 0.40 for $n = 2$ and $n = 4$, respectively.

48. *Sinusoidal Problem (SIN)* (Zabinsky et al., 1992)

$$\min_x f(x) = -\left[A\prod_{i=1}^{n}\sin(x_i - z) + \prod_{i=1}^{n}\sin(B(x_i - z))\right]$$

subject to $0 \leqslant x_i \leqslant 180,\ i \in \{1, 2, \ldots, n\}$. The variable x is in degrees. Parameter A affects the amplitude of the global optimum; B affects the periodicity and hence the number of local minima; z shifts the location of the global minimum; and n indicates the dimension. Our tests were performed with $A = 2.5, B = 5, z = 30$, and $n = 10$, and 20. The location of the global solution is at $x^* = (90 + z, 90 + z, \ldots, 90 + z)$ with the global optimum value of $f(x^*) = -(A + 1)$. The number of local minima increases dramatically in dimension, and when $B = 5$ the number of local minima is equal to:

$$\sum_{i=0}^{\lfloor n/2 \rfloor}\left(\frac{n!}{(n-2i)!(2i)!}3^{n-2i}2^{2i}\right).$$