# 无约束优化测试问题

这里列出的六个无约束优化测试问题,是我的学生周斌由CUTEr测试集的问题推广而来. 前五个问题的原型问题分别为BARD($n = 3$), CUBE($n = 2$), Powell singular($n = 4$), SINEVAL($n = 2$)和WOOD($n = 4$). 第六个问题来自K. Schittkowski的问题.

(1) **GENBARD** (Generalized BARD function):

$$f(x) = \sum_{j=1}^{n-2}\sum_{i=1}^{15}\left(y_i - x_j - \frac{u_i}{v_i x_{j+1} + w_i x_{j+2}}\right)^2,$$

其中$u_i = i$, $v_i = 16 - i$, $w_i = \min(u_i, v_i)$, 且

| $i$ | $y_i$ | $i$ | $y_i$ | $i$ | $y_i$ |
|---|---|---|---|---|---|
| 1 | 0.14 | 6 | 0.32 | 11 | 0.73 |
| 2 | 0.18 | 7 | 0.35 | 12 | 0.96 |
| 3 | 0.22 | 8 | 0.39 | 13 | 1.34 |
| 4 | 0.25 | 9 | 0.37 | 14 | 2.10 |
| 5 | 0.29 | 10 | 0.58 | 15 | 4.39 |

$n$至少取为3,初始点取为$x_0 = (1, 1, ..., 1)^T$.

(2) **GENCUBE** (Generalized CUBE function):

$$f(x) = (x_1 - 1)^2 + 100\sum_{i=2}^{n}(x_i - x_{i-1}^3)^2,$$

其中$n$至少取为2,初始点取为$x_0 = (1, 1, ..., 1)^T$.

(3) **GENPOWSG** (Generalized Powell singular function):

$$\begin{aligned} f(x) = \sum_{j=1}^{n/2-1} \Big[&(x_{2j-1} + 10x_{2j})^2 + 5(x_{2j+1} - x_{2j+2})^2 \\ &+ (x_{2j} - 2x_{2j+1})^4 + 10(x_{2j-1} - x_{2j+2})^4\Big], \end{aligned} \tag{1}$$

其中$n$为不小于4的偶数,初始点取为$x_0 = (3, -1, ..., 3, -1)^T$.

(4) **GENSINEV** (Generalized SINEVAL function):

$$f(x) = \sum_{i=1}^{n-1} \Big[ (x_{i+1} - \sin x_i)^2 / c_1 + x_i^2 / c_2 \Big],$$

其中$c_1 = 10^{-4}$, $c_2 = 4$, $n$至少取为2, 初始点取为$x_0 = (4.712389, -1, -1, ..., -1)$.

(5) **GENWOOD** (Generalized WOOD function):

$$\begin{aligned} f(x) = \sum_{j=1}^{n/2-1} \Big[ & 100(x_{2j} - x_{2j-1}^2)^2 + (1 - x_{2j-1})^2 + 90(x_{2j+2} - x_{2j+1}^2)^2 \\ & + (1 - x_{2j+1})^2 + 10(x_{2j} + x_{2j+2} - 2)^2 + (x_{2j} - x_{2j+2})^2 / 10 \Big], \end{aligned} \tag{2}$$

其中$n$为不小于4的偶数,初始点取为$x_0 = (-3, -1, ..., -3, -1)$.

(6) **S303-305**:

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

其中$n$为任何正整数,初始点取为$x_0 = (0.1, ..., 0.1)^T$.