Liste de problèmes avec variables mixtes

6 avril 2017

1 Barnes

Minimize

$$\begin{aligned} f(x) &= 75.196 + 3.81x_1 - 0.126x_1^2 + 2.5056 * 10^{-3}x_1^3 - 1.034 * 10^{-5}x_1^4 6.83x_2 - 0.0302x_1x_2 \\ &\quad +1.281 * 10^{-3}x_2x_1^2 - 3.525 * 10^{-5}x_2x_1^3 + 2.266 * 10^{-}7x_2x_1^4 - 0.256x_2^2 3.46 * 10^{-}3x_2^3 \\ &\quad -1.35 * 10^{-}5x_2^4 + \frac{28.106}{x_2+1} + 5.237 * 10^{-}6x_1^2x_2^2 + 6.3 * 10^{-}8x_1^3x_2^2 + 1.663 * 10^{-}6x_1x_2^3 \\ &\quad +2.867e^{0.0005x_1x_2} \end{aligned}$$

Subject to

$$\begin{aligned} g_1(x) &= -\left(\frac{x_1x_2}{700} - 1\right) \leq 0 \\ g_2(x) &= -\left(\frac{x_2}{5} - \frac{x_1^2}{625}\right) \leq 0 \\ g_3(x) &= -\left(\frac{x_2}{50} - 1\right)^2 - \left(\frac{x_1}{500} - 0.11\right) \leq 0 \end{aligned}$$

Bound constraints and variables types for

Case1 $x_1 \in \{3, 9, 26, 49, 60, 78\},\ 0.0 \leq x_2 \leq 60.0,\ x_1$ discrete, $x_2 \in \mathbb{R}$
Case2 $0 \leq x_1 \leq 80,\ 0.0 \leq x_2 \leq 60.0,\ x_1 \in \mathbb{N},\ x_2 \in \mathbb{R}$
Case3 $x_1 \in \{0, 10, 20, 30, 40, 50, 60, 70, 80\},\ 0.0 \leq x_2 \leq 60.0,\ x_1$ categorical, $x_2 \in \mathbb{R}$

2 CarSideImpact

Minimize

$$f(x) = 1.98 + 4.90x_1 + 6.67x_2 + 6.98x_3 + 4.01x_4 + 1.78x_5 + 2.73x_7$$

Subject to

$$
\begin{aligned}
g_1(x) &= 1.16 - 0.3717x_2x_4 - 0.00931x_2x_{10} - 0.484x_3x_9 + 0.01343x_6x_{10} - 1 \leq 0 \\
g_2(x) &= 0.261 - 0.0159x_1x_2 - 0.188x_1x_8 - 0.019x_2x_7 + 0.0144x_3x_5 + 0.0008757x_5x_{10} \\
&\quad +0.08045x_6x_9 + 0.00139x_8x_{11} + 0.00001575x_{10}x_{11} - 0.32 \leq 0 \\
g_3(x) &= 0.214 + 0.00817x_5 - 0.131x_1x_8 - 0.0704x_1x_9 + 0.03099x_2x_6 - 0.018x_2x_7 + 0.0208x_3x_8 \\
&\quad +0.121x_3x_9 - 0.00364x_5x_6 + 0.0007715x_5x_{10} - 0.0005354x_6x_{10} + 0.00121x_8x_{11} - 0.32 \leq 0 \\
g_4(x) &= 0.74 - 0.061x_2 - 0.163x_3x_8 + 0.001232x_3x_{10} - 0.166x_7x_9 + 0.227x_2^2 - 0.32 \leq 0 \\
g_5(x) &= 28.98 + 3.818x_3 - 4.2x_1x_2 + 0.0207x_5x_{10} + 6.63x_6x_9 - 7.7x_7x_8 + 0.32x_9x_{10} - 32 \leq 0 \\
g_6(x) &= 33.86 + 2.95x_3 + 0.1792x_{10} - 5.057x_1x_2 - 11.0x_2x_8 - 0.0215x_5x_{10} - 9.98x_7x_8 + 22.0x_8x_9 - 32 \leq \\
g_7(x) &= 46.36 - 9.9x_2 - 12.9x_1x_8 + 0.1107x_3x_{10} - 32 \leq 0 \\
g_8(x) &= 4.72 - 0.5x_4 - 0.19x_2x_3 - 0.0122x_4x_{10} + 0.009325x_6x_{10} + 0.000191x_{11}^2 - 4 \leq 0 \\
g_9(x) &= 10.58 - 0.674x_1x_2 - 1.95x_2x_8 + 0.02054x_3x_{10} - 0.0198x_4x_{10} + 0.028x_6x_{10} - 9.9 \leq 0 \\
g_{10}(x) &= 16.45 - 0.489x_3x_7 - 0.843x_5x_6 + 0.0432x_9x_{10} - 0.0556x_9x_{11} - 0.000786x_{11}^2 - 15.7 \leq 0
\end{aligned}
$$

Bound constraints and variables types for

Default	$0.5 \leq x_1, x_3, x_4 \leq 1.5,\ 0.45 \leq x_2 \leq 1.35,\ 0.875 \leq x_5 \leq 2.625,\ 0.4 \leq x_6, x_7 \leq 1.2,$ $x_8, x_9 \in \{0.192, 0.345\}$ (discrete), $0.5 \leq x_{10}, x_{11} \leq 1.5$
DC	$0.5 \leq x_1, x_3, x_4 \leq 1.5,\ 0.45 \leq x_2 \leq 1.35,\ 0.875 \leq x_5 \leq 2.625,\ 0.4 \leq x_6, x_7 \leq 1.2,$ $x_8, x_9 \in \{0.192, 0.345\}$ (categorical), $0.5 \leq x_{10}, x_{11} \leq 1.5$

3 G07

Minimize

$$
\begin{aligned}
f(x) &= x_1^2 + x_2^2 + x_1x_2 - 14x_1 - 16x_2 + (x_3 - 10)^2 + 4(x_4 - 5)^2 + (x_5 - 3)^2 + 2(x_6 - 1)^2 \\
&\quad +5x_7^2 + 7(x_8 - 11)^2 + 2(x_9 - 10)^2 + (x_{10} - 7)^2 + 45
\end{aligned}
$$

Subject to

$$
\begin{aligned}
g_1(x) &= -105 + 4x_1 + 5x_2 - 3x_7 + 9x_8 \leq 0 \\
g_2(x) &= 10x_1 - 8x_2 - 17x_7 + 2x_8 \leq 0 \\
g_3(x) &= -8x_1 + 2x_2 + 5x_9 - 2x_{10} - 12 \leq 0 \\
g_4(x) &= 3(x_1 - 2)^2 + 4(x_2 - 3)^2 + 2x_3^2 - 7x_4 - 120 \leq 0 \\
g_5(x) &= 5x_1^2 + 8x_2 + (x_3 - 6)^2 - 2x_4 - 40 \leq 0 \\
g_6(x) &= x_1^2 + 2(x_2 - 2)^2 - 2x_1x_2 + 14x_5 - 6x_6 \leq 0 \\
g_7(x) &= 0.5(x_1 - 8)^2 + 2(x_2 - 4)^2 + 3x_5^2 - x_6 - 30 \leq 0 \\
g_8(x) &= -3x_1 + 6x_2 + 12(x_9 - 8)^2 - 7x_{10} \leq 0
\end{aligned}
$$

Bound constraints and variables types for

Case3	$x_i \in \{-10, -5, 0, 1.3, 2.2, 5, 8.2, 8.7, 9.5, 10\}\ \forall i = 1:6,$ $-10.0 \leq x_7$ and $x_8 \leq 10.0,\ -10 \leq x_9$ and $x_{10} \leq 10,$ x_1 to x_6 discrete, $x_7, x_8 \in \mathbb{R},\ x_9, x_{10} \in \mathbb{N}$
Case4	$x_i \in \{-10, -5, 0, 1.3, 2.2, 5, 8.2, 8.7, 9.5, 10\}\ \forall i = 1:6,$ $-10.0 \leq x_7$ and $x_8 \leq 10.0,\ -10 \leq x_9$ and $x_{10} \leq 10,$ x_1 to x_6 categorical, $x_7, x_8 \in \mathbb{R},\ x_9, x_{10} \in \mathbb{N}$

4 G09

Minimize

$$f(x) = (x_1 - 10)^2 + 5(x_2 - 12)^2 + x_3^4 + 3(x_4 - 11)^2 + 10x_5^6 + 7x_6^2 + x_7^4 - 4x_6x_7 - 10x_6 - 8x_7$$

Subject to

$$\begin{aligned} g_1(x) &= 2x_1^2 + 3x_2^4 + x_3 + 4x_4^2 + 5x_5 - 127 \leq 0 \\ g_2(x) &= 7x_1 + 3x_2 + 10x_3^2 + x_4 - x_5 - 282 \leq 0 \\ g_3(x) &= 23x_1 + x_2^2 + 6x_6^2 - 8x_7 - 196 \leq 0 \\ g_4(x) &= 4x_1^2 + x_2^2 - 3x_1x_2 + 2x_3^2 + 5x_6 - 11x_7 \leq 0 \end{aligned}$$

Bound constraints and variables type for

Default	$-10 \leq x_i \leq 10\ \forall i = 1:7$ and $x_i \in \mathbb{N}\ \forall i = 1:3$ and $x_i \in \mathbb{R}\ \forall i = 4:7.$
IC	$-10 \leq x_i \leq 10\ \forall i = 1:7,$ $x_i \in \mathbb{N}$ treated as categorical variable $\forall i = 1:3,\ x_i \in \mathbb{R}, \forall i = 4:7.$

5 Mystery

Minimize

$$f(x) = 2 + 0.1(x_2 - x_1^2)^2 + (1 - x_1)^2 + 2(2 - x_2)^2 + 7\sin(0.5x_1)\sin(0.7x_1x_2)$$

Bound constraints and variables type for

Case1	$x_1 \in \{-0.5, 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5\},\ -0.5 \leq x_2 \leq 5.0,\ x_1$ discrete, $x_2 \in \mathbb{R}$
Case2	$0 \leq x_1 \leq 5,\ -0.5 \leq x_2 \leq 5.0,\ x_1 \in \mathbb{N},\ x_2 \in \mathbb{R}$
Case3	$x_1 \in \{1, 2, 3\},\ -0.5 \leq x_2 \leq 5.0,\ x_1$ categorical, $x_2 \in \mathbb{R}$
Case6	$x_1 \in \{1, 2, 3\},\ -0.5 \leq x_2 \leq 5.0,\ x_1$ discrete, $x_2 \in \mathbb{R}$

6 PressureVessel

Minimize

$$f(x) = 0.6224x_1x_3x_4 + 1.7781x_2x_3^2 + 3.1661x_1^2x_4 + 19.84x_1^2x_3$$

0.2	0.8	1.4	2	2.64	3.41	4.03	4.84	6.16	8	11.06
0.31	0.88	1.55	2.17	2.79	3.52	4.2	5	6.32	8.4	11.85
0.4	0.93	1.58	2.2	2.8	3.6	4.34	5.28	6.6	8.69	12
0.44	1	1.6	2.37	3	3.72	4.4	5.4	7.11	9	13
0.6	1.2	1.76	2.4	2.08	3.95	4.65	5.53	7.2	9.48	14
0.62	1.24	1.8	2.48	2.1	3.96	4.74	5.72	7.8	10.27	15
0.79	1.32	1.86	2.6	3.16	4	4.8	6	7.9	11	

TABLE 1 – Possible values for variable A in ReinforcedConcreteBeam problem

Subject to

$$\begin{aligned} g_1(x) &= -x_1 + 0.0193x_3 \leq 0 \\ g_2(x) &= -x_2 + 0.00954x_3 \leq 0 \\ g_3(x) &= -\pi x_3^2 x_4 - \frac{4}{3}\pi x_3^3 + 1296000 \leq 0 \end{aligned}$$

Bound constraints and variables types for

Default	$x_1 = 0.0625n_1,\ x_2 = 0.0625n_2$ where n_1 and $n_2 \in \mathbb{N},\ x_3$ and $x_4 \in \mathbb{R}$ and where $1 \leq n_1 \leq 99, 1 \leq n_2 \leq 99, 10.0 \leq x_3 \leq 200.0,\ 10.00 \leq x_4 \leq 200.0$
IC	$x_1 = 0.0625n_1,\ x_2 = 0.0625n_2$ where n_1 and $n_2 \in \mathbb{N}$ treated as categorical variables, x_3 and $x_4 \in \mathbb{R}$ and where $1 \leq n_1 \leq 99, 1 \leq n_2 \leq 99, 10.0 \leq x_3 \leq 200.0,\ 10.00 \leq x_4 \leq 200.0$

7 Rastrigin

Minimize

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

Bound constraints and variables types for

Case1	$x_1 \in \{-5, -3, -1, 0, 1, 3, 5\},\ -5.0 \leq x_2 \leq 5.0,\ x_1$ discrete, $x_2 \in \mathbb{R}$
Case2	$-5 \leq x_1 \leq 5,\ -5.0 \leq x_2 \leq 5.0,\ x_1 \in \mathbb{N},\ x_2 \in \mathbb{R}$
Case3	$x_1 \in \{-5, -3, -1, 0, 1, 3, 5\},\ -5.0 \leq x_2 \leq 5.0,\ x_1$ categorical, $x_2 \in \mathbb{R}$
Case12	$x_1,\ x_2 \in \{-5, -3, -1, 0, 1, 3, 5\},\ x_3 \in \{-5, 0, 2, 5\},\ x_4,\ x_5 \in \{-5, -3, -1, 0, 1, 3, 5\}$, $x_6 \in \{0, 1, 2, 3\},\ -5.0 \leq x_7,\ x_8 \leq 5.0,\ -5 \leq x_9,\ x_{10} \leq 5$, x_1 to x_3 discrete, x_4 to x_6 categorical, $x_7, x_8 \in \mathbb{R},\ x_9, x_{10} \in \mathbb{N}$
Case22	$x_i \in \{-5, -3, -1, 0, 1, 3, 5\}\ \forall i = 1:8,\ x_9,\ x_{10} \in \{0, 1, 2, 3\},\ -5 \leq x_i \leq 5\ \forall i = 11:20$, x_1 to x_4 discrete, x_5 to x_{10} categorical, $x_{11}, x_{12} \in \mathbb{N},\ x_{13}$ to $x_{20} \in \mathbb{R}$

8 ReinforcedConcreteBeam

Minimize

$$f(A, b, h) = 29.4A + 0.6bh$$

Subject to

$$\begin{aligned} g_1(A,b,h) &= h - 4b \leq 0 \\ g_2(A,b,h) &= 180b + 7.375A^2 - Abh \leq 0 \end{aligned}$$

Bound constraints and variables types for

Default	A chosen among discrete values from Table 1, $28 \leq b \leq 40,\ 5.0 \leq h \leq 10.0$, $b \in \mathbb{N}$ and $h \in \mathbb{R}$
DC	A chosen among categorical values from Table 1, $28 \leq b \leq 40,\ 5.0 \leq h \leq 10.0$, $b \in \mathbb{N}$ and $h \in \mathbb{R}$
IC	A chosen among discrete values from Table 1, $28 \leq b \leq 40,\ 5.0 \leq h \leq 10.0$, $b \in \mathbb{N}$ treated as a categorical variable and $h \in \mathbb{R}$
IDC	A chosen among categorical values from Table 1, $28 \leq b \leq 40,\ 5.0 \leq h \leq 10.0$, $b \in \mathbb{N}$ treated as a categorical variable and $h \in \mathbb{R}$

9 Rosenbrock

Minimize

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

Bound constraints and variables types for

Case1	$x_1 \in \{-2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2\},\ -2.0 \leq x_2 \leq 2.0,\ x_1$ discrete, $x_2 \in \mathbb{R}$
Case2	$-2 \leq x_1 \leq 2,\ -2.0 \leq x_2 \leq 2.0,\ x_1 \in \mathbb{N},\ x_2 \in \mathbb{R}$
Case3	$x_1 \in \{0, 1, 2\},\ -2.0 \leq x_2 \leq 2.0,\ x_1$ categorical, $x_2 \in \mathbb{R}$
Case12	$x_1, x_2 \in \{-2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2\},\ x_3 \in \{-1.8, 0, 1, 0.6, 1.6\},$ $-2.0 \leq x_4, x_5 \leq 2.0,\ x_6 \in \{-2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2\},\ x_7 \in \{2, 0, 1\},$ $x_8 \in \{0.5, 1, -1, 0.5, -2, 2, -0.5, 0\},\ -2 \leq x_9, x_{10} \leq 2,$ x_1 to x_3 discrete, $x_4, x_5 \in \mathbb{R},\ x_6$ to x_8 categorical, $x_9, x_{10} \in \mathbb{N}$
Case22	$x_i \in \{-2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2\},\ \forall i = 1:8,\ x_9, x_{10} \in \{2, 0, 1\},$ $-2 \leq x_i \leq 2,\ \forall i = 11:20,$ x_1 to x_4 discrete, x_5 to x_{10} categorical, $x_{11}, x_{12} \in \mathbb{N},\ x_{13}$ to $x_{20} \in \mathbb{R}$

10 SpeedReducer

Minimize

$$\begin{aligned} f(x) &= 0.7854x_1x_2^2(3.3333x_3^2 + 14.9334x_3 - 43.0934) - 1.508x_1(x_6^2 + x_7^2) \\ &\quad +7.477(x_6^3 + x_7^3) + 0.7854(x_4x_6^2 + x_5x_7^2) \end{aligned}$$

Subject to

$$\begin{aligned}
g_1(x) &= 27 - x_1 x_2^2 x_3 \leq 0 \\
g_2(x) &= 397.5 - x_1 x_2^2 x_3^2 \leq 0 \\
g_3(x) &= 1.93 x_4^3 - x_2 x_3 x_6^4 \leq 0 \\
g_4(x) &= 1.93 x_5^3 - x_2 x_3 x_7^4 \leq 0 \\
g_5(x) &= \sqrt{(745.0 x_4)^2 + 16.9 \times 10^6 x_2^2 x_3^2} - 110 x_2 x_3 x_6^3 \leq 0 \\
g_6(x) &= \sqrt{(745.0 x_5)^2 + 157.5 \times 10^6 x_2^2 x_3^2} - 85 x_2 x_3 x_7^3 \leq 0 \\
g_7(x) &= x_2 x_3 - 40 \leq 0 \\
g_8(x) &= 5 x_2 - x_1 \leq 0 \\
g_9(x) &= x_1 - 12 x_2 \leq 0 \\
g_{10}(x) &= 1.9 + 1.5 x_6 - x_4 \leq 0 \\
g_{11}(x) &= 1.9 + 1.1 x_7 - x_5 \leq 0
\end{aligned}$$

Bound constraints and variables types for

Default	$2.6 \leq x_1 \leq 3.6,\ 0.7 \leq x_2 \leq 0.8,\ 17 \leq x_3 \leq 28,\ 7.3 \leq x_4$ and $x_5 \leq 8.3$, $2.6 \leq x_6 \leq 3.9,\ 5 \leq x_7 \leq 5.5$, $x_3 \in \mathbb{N}$, x_1, x_2 and x_4 to $x_7 \in \mathbb{R}$
IC	$2.6 \leq x_1 \leq 3.6,\ 0.7 \leq x_2 \leq 0.8,\ 17 \leq x_3 \leq 28,\ 7.3 \leq x_4$ and $x_5 \leq 8.3$, $2.6 \leq x_6 \leq 3.9,\ 5 \leq x_7 \leq 5.5$, $x_3 \in \mathbb{N}$ treated as categorical, x_1, x_2 and x_4 to $x_7 \in \mathbb{R}$

11 Spring

Minimize

$$f(x) = (x_3 + 2) x_1 x_2^2$$

Subject to

$$\begin{aligned}
g_1(x) &= 71785 x_2^4 - x_1^3 x_3 \leq 0 \\
g_2(x) &= 5108 x_2^2 (4 x_1^2 - x_1 x_2) + 12566 (x_1 x_2^3 - x_2^4) - 64187128 x_2^5 (x_1 - x_2) \leq 0 \\
g_3(x) &= x_1^2 x_3 - 140.45 x_2 \leq 0 \\
g_4(x) &= x_1 + x_2 - 1.5 \leq 0
\end{aligned}$$

Bound constraints and variables types for

Default	$0.25 \leq x_1 \leq 1.3,\ 0.05 \leq x_2 \leq 2.0,\ 2 \leq x_3 \leq 15,\ x_1,\ x_2 \in \mathbb{R}$ and $x_3 \in \mathbb{N}$
IC	$0.25 \leq x_1 \leq 1.3,\ 0.05 \leq x_2 \leq 2.0,\ 2 \leq x_3 \leq 15,\ x_1,\ x_2 \in \mathbb{R}$ and $x_3 \in \mathbb{N}$ treated as categorical

12 SteppedCantileverBeam

Minimize

$$f(x) = l(x_1 x_2 + x_3 x_4 + x_5 x_6 + x_7 x_8 + x_9 x_{10})$$

Subject to

$$
\begin{aligned}
g_1(x) &= 6Pl - \sigma_{max} x_9 x_{10}^2 \leq 0 \\
g_2(x) &= 6P(2l) - \sigma_{max} x_7 x_8^2 \leq 0 \\
g_3(x) &= 6P(3l) - \sigma_{max} x_5 x_6^2 \leq 0 \\
g_4(x) &= 6P(4l) - \sigma_{max} x_3 x_4^2 \leq 0 \\
g_5(x) &= 6P(5l) - \sigma_{max} x_1 x_2^2 \leq 0 \\
g_6(x) &= \frac{Pl^3}{E}\left(244 x_3 x_4^3 x_5 x_6^3 x_7 x_8^3 x_9 x_{10}^3 + 148 x_1 x_2^3 x_5 x_6^3 x_7 x_8^3 x_9 x_{10}^3 + 76 x_1 x_2^3 x_3 x_4^3 x_7 x_8^3 x_9 x_{10}^3\right. \\
&\quad \left. + 28 x_1 x_2^3 x_3 x_4^3 x_5 x_6^3 x_9 x_{10}^3 + 4 x_1 x_2^3 x_3 x_4^3 x_5 x_6^3 x_7 x_8^3\right) - \delta_{max} x_1 x_2^3 x_3 x_4^3 x_5 x_6^3 x_7 x_8^3 x_9 x_{10}^3 \leq 0 \\
g_7(x) &= x_2 - 20 x_1 \leq 0 \\
g_8(x) &= x_4 - 20 x_3 \leq 0 \\
g_9(x) &= x_6 - 20 x_5 \leq 0 \\
g_{10}(x) &= x_8 - 20 x_7 \leq 0 \\
g_{11}(x) &= x_{10} - 20 x_9 \leq 0
\end{aligned}
$$

Bound constraints and variables types for

Default	$x_1 \in \{1,2,3,4,5\},\ x_2$ and $x_4 \in \{45.0, 50.0, 55.0, 60.0\},\ x_3$ and $x_5 \in \{2.4, 2.6, 2.8, 3.1\},$ $x_6 \in \{30, 31, ..., 65\},\ 1 \leq x_7 \leq 5,\ 30 \leq x_8 \leq 65,\ 1 \leq x_9 \leq 5,\ 30 \leq x_{10} \leq 65$ x_1 and $x_6 \in \mathbb{N},\ x_2$ to x_5 discrete and x_7 to $x_{10} \in \mathbb{R}$
DC	$x_1 \in \{1,2,3,4,5\},\ x_2$ and $x_4 \in \{45.0, 50.0, 55.0, 60.0\},\ x_3$ and $x_5 \in \{2.4, 2.6, 2.8, 3.1\},$ $x_6 \in \{30, 31, ..., 65\},\ 1 \leq x_7 \leq 5,\ 30 \leq x_8 \leq 65,\ 1 \leq x_9 \leq 5,\ 30 \leq x_{10} \leq 65$ x_1 and $x_6 \in \mathbb{N},\ x_2$ to x_5 categorical and x_7 to $x_{10} \in \mathbb{R}$
IC	$x_1 \in \{1,2,3,4,5\},\ x_2$ and $x_4 \in \{45.0, 50.0, 55.0, 60.0\},\ x_3$ and $x_5 \in \{2.4, 2.6, 2.8, 3.1\},$ $x_6 \in \{30, 31, ..., 65\},\ 1 \leq x_7 \leq 5,\ 30 \leq x_8 \leq 65,\ 1 \leq x_9 \leq 5,\ 30 \leq x_{10} \leq 65$ x_1 and $x_6 \in \mathbb{N}$ treated as categorical variables , x_2 to x_5 discrete and x_7 to $x_{10} \in \mathbb{R}$
IDC	$x_1 \in \{1,2,3,4,5\},\ x_2$ and $x_4 \in \{45.0, 50.0, 55.0, 60.0\},\ x_3$ and $x_5 \in \{2.4, 2.6, 2.8, 3.1\},$ $x_6 \in \{30, 31, ..., 65\},\ 1 \leq x_7 \leq 5,\ 30 \leq x_8 \leq 65,\ 1 \leq x_9 \leq 5,\ 30 \leq x_{10} \leq 65$ x_1 and $x_6 \in \mathbb{N}$ treated as categorical variables, x_2 to x_5 categorical and x_7 to $x_{10} \in \mathbb{R}$

Parameters

$P = 50000N,\ L = 500cm,\ l = 100cm,\ \delta_{max} = 2.7cm,\ \sigma_{max} = 14000N/cm^2,\ E = 2{\times}10^7 N/cm^2$

13 Synthèse

Type	Name	n_r	n_i	n_d	n_c	n	v	Reference
A	BarnesCase1	1	0	1	0	2	3	[5]
A	BarnesCase2	1	1	0	0	2	3	[5]
B	CarSideImpact	9	0	2	0	11	10	[2]
A	G07Case3	2	2	6	0	10	8	[4]
A	G09	4	3	0	0	7	4	[4]
A	MysteryCase1	1	0	1	0	2	0	[6]
A	MysteryCase2	1	1	0	0	2	0	[6]
A	MysteryCase6	1	0	1	0	2	0	[6]
B	PressureVessel	2	2	0	0	4	3	[1]
A	RastriginCase1	1	0	1	0	2	0	[7]
A	RastriginCase2	1	1	0	0	2	0	[7]
B	ReinforcedConcreteBeam	1	1	1	0	3	2	[2]
A	RosenbrockCase1	1	0	1	0	2	0	[7]
A	RosenbrockCase2	1	1	0	0	2	0	[7]
B	SpeedReducer	6	1	0	0	7	11	[1]
B	Spring	2	1	0	0	3	4	[3]
B	SteppedCantileverBeam	4	2	4	0	10	11	[2]

TABLE 2 – Test problems without categorical variables (Set I)

Type	Name	n_r	n_i	n_d	n_c	n	v	Reference
A	BarnesCase3	1	0	0	1	2	3	[5]
B	CarSideImpactDC	9	0	0	2	11	10	[2]
A	G07Case4	2	2	0	6	10	8	[4]
A	G09IC	4	0	0	3	7	4	[4]
A	MysteryCase3	1	0	0	1	2	0	[6]
B	PressureVesselIC	2	0	0	2	4	3	[1]
A	RastriginCase3	1	0	0	1	2	0	[7]
A	RastriginCase12	2	2	3	3	10	0	[7]
A	RastriginCase22	8	2	4	6	20	0	[7]
B	ReinforcedConcreteBeamDC	1	1	0	1	3	2	[2]
B	ReinforcedConcreteBeamIC	1	0	1	1	3	2	[2]
B	ReinforcedConcreteBeamIDC	1	0	0	2	3	2	[2]
A	RosenbrockCase3	1	0	0	1	2	0	[7]
A	RosenbrockCase12	2	2	3	3	10	0	[7]
A	RosenbrockCase22	8	2	4	6	20	0	[7]
B	SpeedReducerIC	6	0	0	1	7	11	[1]
B	SpringIC	2	0	0	1	3	4	[3]
B	SteppedCantileverBeamDC	4	2	0	4	10	11	[2]
B	SteppedCantileverBeamIC	4	0	4	2	10	11	[2]
B	SteppedCantileverBeamIDC	4	0	0	6	10	11	[2]

TABLE 3 – Test problems with categorical variables (Set II)

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