Table 2: Article Benchmarks - Engineering problems with uncorrelated variables

LSF significance	**Case No.**	**Limit State function(s)**	**Stochastic variable(s)**	β	**Ref**
SDOF	(1)	$g(X) = 3X_4 - \frac{2X_5}{X_2+X_3} \times \sin\left(\frac{X_6}{2} \cdot \sqrt{\frac{X_2+X_3}{X_1}}\right)$	$X_1 : N(1, 0.05)$ $X_2 : N(1, 0.1)$ $X_3 : N(0.1, 0.01)$ $X_4 : N(0.5, 0.05)$ $X_5 : N(1, 0.2)$ $X_6 : N(1, 0.2)$	1.85	[1, 2]
Fatigue	(2)	$g(\mathbf{X}) = 2 - e^{\left(\frac{X_5 X_3}{X_1}\right)} + \frac{e^{X_5-2}}{e^{-X_6}-1}\left(e^{-\left(\frac{X_6 X_3}{X_1}\right)} - 1\right) - \frac{X_4}{X_2}$	$X_1 : LN(5490, 1098)$ $X_2 : LN(17100, 3420)$ $X_3 : LN(549, 109.8)$ $X_4 : LN(4.0 \times 10^3, 8.0 \times 10^2)$ $X_5 : N(0.42, 0.084)$ $X_6 : N(6.0, 1.2)$	3.633	[3]
Front Axle	(3)	$g(\mathbf{X}) = 460 - \sqrt{(Sb)^2 + 3(Ts)^2}$ $Sb = \frac{X_5}{\frac{X_1(X_4-2X_3)^3}{6X_4} + \frac{X_2}{6X_4}(X_4^3 - (X_4-2X_3)^3)}$ $Ts = \frac{X_6}{0.8X_2X_3^2 + 0.4\left(\frac{X_1^3(X_4-2X_3)}{X_3}\right)}$	$X_1 : N(12.0, 0.06)$ $X_2 : N(65.0, 0.325)$ $X_3 : N(14.0, 0.07)$ $X_4 : N(85.0, 0.425)$ $X_5 : N(3.5 \times 10^6, 1.75 \times 10^5)$ $X_6 : N(3.1 \times 10^6, 1.55 \times 10^5)$	2.05	[4]
Cantilever beam	(4)	$g(\mathbf{X}) = 18.461 - 7.477 \times 10^{10} \frac{X_1}{X_3^2}$	$X_1 : N(0.001, 0.00002)$ $X_2 : N(250.0, 37.5)$	2.41	[5]
Retaining wall/ Overturning	(5)	$g(\mathbf{X}) = 27.668X_1 + 18.595X_3 - 121.5X_1 \tan^2\left(45 - \frac{X_2}{2}\right)$	$X_1 : N(16.0, 1.12)$ $X_2 : N(30.0, 3.0)$ $X_3 : N(25.0, 1.0)$	2.74	[6]
Conical structure	(6)	$g(\mathbf{X}) = 1 - \frac{\sqrt{3(1-0.3^2)}}{\pi X_1 X_2^2 \cos^2 X_3} \times \left(\frac{X_6}{0.66} + \frac{X_5}{0.41X_4}\right)$	$X_1 : N(7.0 \times 10^{10}, 3.50 \times 10^9)$ $X_2 : N(2.50 \times 10^{-3}, 1.25 \times 10^{-4})$ $X_3 : N(0.524, 0.010480)$ $X_4 : N(0.90, 0.0225)$ $X_5 : N(8.0 \times 10^4, 6.4 \times 10^3)$ $X_6 : N(7.0 \times 10^4, 5.6 \times 10^3)$	4.78	[7]
Roof truss	(7)	$g(\mathbf{X}) = 0.03 - \left(\frac{X_1 X_2^2}{2}\right)\left(\frac{3.81}{X_4 X_6} + \frac{1.13}{X_3 X_5}\right)$	$X_1 : N(2.0 \times 10^4, 1.4 \times 10^3)$ $X_2 : N(12.0, 0.12)$ $X_3 : N(9.82 \times 10^{-4}, 5.9852 \times 10^{-5})$ $X_4 : N(0.04, 4.8 \times 10^{-3})$ $X_5 : N(1.0 \times 10^{11}, 1.0 \times 10^9)$ $X_6 : N(2.0 \times 10^{10}, 1.2 \times 10^9)$	2.59	[8, 9]
Tuned vibration absorber	(8)	$g(\mathbf{X}) = 27 - \frac{\left\lvert 1 - \left(\frac{1}{X_2}\right)^2 \right\rvert}{\sqrt{[a]^2 + 4(0.01)^2\left[\left(\frac{1}{X_1}\right)^2 - \frac{1}{X_1 X_2}\right]^2}}$, a = 1 - 0.01 $\left(\frac{1}{X_1}\right)^2 - \left(\frac{1}{X_1}\right)^2 - \left(\frac{1}{X_2}\right)^2 + \left(\frac{1}{X_1 X_2^2}\right)^2$	$X_1 : N(1.0, 0.025)$ $X_2 : N(1.0, 0.025)$	2.29	[10]

References

[1] GONG, J.; YI, P.; ZHAO, N. Non-gradient-based algorithm for structural reliability analysis. *Journal of Engineering Mechanics, ASCE*, v. 140, n. 6, p. 04014029, 2014.

[2] ECHARD, B.; GAYTON, N.; LEMAIRE, M. Ak-mcs: an active learning reliability method combining kriging and monte carlo simulation. *Structural Safety*, v. 33, p. 145–154, 2011.

[3] WEI, D.; RAHMAN, S. Structural reliability analysis by univariate decomposition and numerical integration. *Probabilistic Engineering Mechanics*, v. 22, n. 1, p. 27–38, 2007.

[4] XIAO, S.; LU, Z. Structural reliability analysis using combined space partition technique and unscented transformation. *ASCE Journal of Structural Engineering*, v. 142, p. 04001689, 2016.

[5] ELEGBEDE, C. Structural reliability assessment based on particles swarm optimization. *Structural Safety*, v. 27, p. 171–186, 2005.

[6] MANDALI, A. et al. Reliability analysis of counterfort retaining walls. *Electronic Journal of Structural Engineering*, v. 11, n. 1, p. 42–56, 2011.

[7] SHABAKHTY, N.; KAZEMI, N.; KIA, M. Structural reliability assessment using improved harmony search evolutionary algorithm. In: *Proceedings of the 2nd Iranian Conference on Reliability Engineering*. Tehran, Iran: Aerospace Research Institute. p. 1–9.

[8] KESHTEGAR, B.; MENG, Z. A hybrid relaxed first-order reliability method for efficient structural reliability analysis. *Structural Safety*, v. 66, p. 84–93, 2017.

[9] RASHKI, M.; MIRI, M.; AZHDARY-MOGHADDAM, M. A simulation-based method for reliability based design optimization problems with highly nonlinear constraints. *Automation in Construction*, v. 47, p. 24–36, 2014.

[10] GHOHANI-ARAB, H.; GHASEMI, M. A fast and robust method for estimating the failure probability of structures. *Proceedings of the Institution of Civil Engineers - Structures and Buildings*, v. 168, n. 4, p. 298–309, 2015.