Weld Beam design

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | H5N1 | SSA[8] | CPSO [7] | Coello and Montes [6] | WOA[9] | CDE[4] | Coello [5] | Coello[1] | Siddall [1] | Ragsdell [3] | Deb [2] |
| x1 | 0.20573 | 0.20570 | 0.20237 | 0.20599 | 0.20540 | 0.20314 | 0.20880 | 0.18290 | 0.24440 | 0.24550 | 0.24890 |
| x2 | 3.47049 | 3.47140 | 3.54421 | 3.47133 | 3.48429 | 3.54300 | 3.42050 | 4.04830 | 6.21890 | 6.19600 | 6.17300 |
| x3 | 9.03662 | 9.03660 | 9.04821 | 9.02022 | 9.03743 | 9.03350 | 8.99750 | 9.36660 | 8.29150 | 8.27300 | 8.17890 |
| x4 | 0.20573 | 0.20570 | 0.20572 | 0.20648 | 0.20628 | 0.20618 | 0.21000 | 0.20590 | 0.24440 | 0.24550 | -0.25330 |
| g1 | 0.00000 | N/A | -12.83980 | -0.07409 | N/A | -44.57857 | -0.33781 | -408.73277 | -5743.50200 | -5743.82650 | -5758.60380 |
| g2 | 0.00000 | N/A | -1.24747 | -0.26623 | N/A | -44.66353 | -353.90260 | -2105.91421 | -4.01521 | -4.71510 | -255.57690 |
| g3 | 0.00000 | N/A | -0.00150 | -0.00050 | N/A | -0.00304 | -0.00120 | -0.02306 | 0.00000 | 0.00000 | -0.00440 |
| g4 | -3.43298 | N/A | -3.42935 | -3.43004 | N/A | -3.42373 | -3.41187 | -3.32153 | -3.02256 | -3.02029 | -2.98287 |
| g5 | -0.08073 | N/A | -0.07938 | -0.08099 | N/A | -0.07814 | -0.08380 | -0.05788 | -0.11940 | -0.12050 | -0.12390 |
| g6 | -0.23554 | N/A | -0.23554 | -0.23551 | N/A | -0.23556 | -0.23565 | -0.23703 | -0.23424 | -0.23421 | -0.23416 |
| g7 | 0.00000 | N/A | -11.68136 | -58.66644 | N/A | -38.02827 | -363.23238 | -160.58645 | -3490.46940 | -3604.27500 | -4465.27090 |
| f(x) | 1.72485 | 1.72491 | 1.72802 | 1.72823 | 1.73050 | 1.73346 | 1.74831 | 1.82455 | 2.38154 | 2.38594 | 2.43312 |

[1] C. A. Coello Coello, “CONSTRAINT-HANDLING USING AN EVOLUTIONARY MULTIOBJECTIVE OPTIMIZATION TECHNIQUE,” *Civ. Eng. Environ. Syst.*, vol. 17, no. 4, pp. 319–346, Oct. 2000, doi: 10.1080/02630250008970288.

[2] K. Deb, “Optimal design of a welded beam via genetic algorithms,” *AIAA J.*, vol. 29, no. 11, pp. 2013–2015, Nov. 1991, doi: 10.2514/3.10834.

[3] K. M. Ragsdell and D. T. Phillips, “Optimal Design of a Class of Welded Structures Using Geometric Programming,” *J. Eng. Ind.*, vol. 98, no. 3, pp. 1021–1025, Aug. 1976, doi: 10.1115/1.3438995.

[4] F. Huang, L. Wang, and Q. He, “An effective co-evolutionary differential evolution for constrained optimization,” *Appl. Math. Comput.*, vol. 186, no. 1, pp. 340–356, Mar. 2007, doi: 10.1016/j.amc.2006.07.105.

[5] C. A. Coello Coello, “Use of a self-adaptive penalty approach for engineering optimization problems,” *Comput. Ind.*, vol. 41, no. 2, pp. 113–127, Mar. 2000, doi: 10.1016/S0166-3615(99)00046-9.

[6] C. A. Coello Coello and E. Mezura Montes, “Constraint-handling in genetic algorithms through the use of dominance-based tournament selection,” *Adv. Eng. Inform.*, vol. 16, no. 3, pp. 193–203, Jul. 2002, doi: 10.1016/S1474-0346(02)00011-3.

[7] Q. He and L. Wang, “An effective co-evolutionary particle swarm optimization for constrained engineering design problems,” *Eng. Appl. Artif. Intell.*, vol. 20, no. 1, pp. 89–99, Feb. 2007, doi: 10.1016/j.engappai.2006.03.003.

[8] S. Mirjalili, A. H. Gandomi, S. Z. Mirjalili, S. Saremi, H. Faris, and S. M. Mirjalili, “Salp Swarm Algorithm: A bio-inspired optimizer for engineering design problems,” *Adv. Eng. Softw.*, vol. 114, pp. 163–191, Dec. 2017, doi: 10.1016/j.advengsoft.2017.07.002.

[9] S. Mirjalili and A. Lewis, “The whale optimization algorithm,” *Adv. Eng. Softw.*, vol. 95, pp. 51–67, 2016, doi: 10.1016/j.advengsoft.2017.07.002.