Real-world engineering optimization problems Constraints

0.1 Car Side Impact

Car Side Impact Problem [2]

$$F = 4.72 - 0.5x_4 - 0.19x_2x_3$$
$$Vmbp = 10.58 - 0.674x_1x_2 - 0.67275x_2 \tag{1}$$
$$Vfd = 16.45 - 0.489x_3x_7 - 0.843x_5x_6$$

This problem has the following constraints:

$$g_1 = 1.16 - 0.3717x_2x_4 - 0.0092928x_3 \le 1.0$$
$$g_2 = 0.261 - 0.0159x_1x_2 - 0.06486x_1 - 0.019x_2x_7 + 0.0144x_3x_5$$
$$+ 0.0154464x_6 \le 0.32$$
$$g_3 = 0.214 + 0.00817x_5 - 0.045195x_1 - 0.0135168x_1 + 0.03099x_2x_6$$
$$- 0.018x_2x_7 + 0.007176x_3 + 0.023232x_3 - 0.00364x_5x_6$$
$$- 0.018x_2x_2 \le 0.32$$
$$g_4 = 0.74 - 0.61x_2 - 0.031296x_3 - 0.031872x_7 + 0.227x_2x_2 \le 0.32 \tag{2}$$
$$g_5 = 28.98 + 3.818x_3 - 4.2x_1x_2 + 1.27296x_6 - 2.68065x_7 \le 0.32$$
$$g_6 = 33.86 + 2.95x_3 - 5.057x_1x_2 - 3.795x_2 - 3.4431x_7 + 1.45728 \le 0.32$$
$$g_7 = 46.36 - 9.9x_2 - 4.4505x_1 \le 0.32$$
$$g_8 = F \le 4.0; g_9 = Vmbp \le 9.9; g_{10} = Vg_d \le 15.7$$
$$0.5 \le \{x_1, x_3, x_4\} \le 1.5; 0.4 \le \{x_6, x_7\} \le 1.2; 0.45 \le x_2 \le 1.35$$
$$0.875 \le x_5 \le 2.625$$

0.2 Machining

The Machining problem [1] has the following constraints:

$$g_1 = -0.44x_1 + 1.16x_2 - 0.61x_3 \le -3.17$$
$$g_2 = -0.92x_1 + 0.16x_2 - 0.43x_3 \le -8.04$$
$$g_3 = -1.94x_1 + 0.30x_2 + 1.04x_3 \le 18.50 \tag{3}$$
$$6.40 \le x_1 \le 7.09; 0.69 \le x_2 \le 2.89; 3.91 \le x_3 \le 4.61;$$

0.3   Water Resource Planning

Water Resource Planning [3] has the following constraints:

$$g_1 = \frac{0.00139}{x_1 x_2} + 4.94 x_3 - 0.08 \le 1.0$$

$$g_2 = \frac{0.000306}{x_1 x_2} + 1.082 x_3 - 0.0986 \le 1.0$$

$$g_3 = \frac{12.307}{x_1 x_2} + 49408.24 x_3 + 4051.02 \le 5000$$

$$g_4 = \frac{2.098}{x_1 x_2} + 8046.33 x_3 - 696.71 \le 16000 \tag{4}$$

$$g_5 = \frac{2.138}{x_1 x_2} + 7883.39 x_3 - 705.04 \le 10000$$

$$g_6 = \frac{0.417}{x_1 x_2} + 1721.26 x_3 - 136.54 \le 2000$$

$$g_7 = \frac{0.164}{x_1 x_2} + 631.13 * x_3 - 54.48 \le 550$$

$$0.01 \le x_1 \le 0.45; 0.01 \le x_2 \le 0.10; 0.01 \le x_3 \le 0.10$$

References

1. Ghiassi, M., DeVor, R., Dessouky, M., Kijowski, B.: An application of multiple criteria decision making principles for planning machining operations. IIE Transactions **16**(2), 106–114 (1984)
2. Jain, H., Deb, K.: An evolutionary many-objective optimization algorithm using reference-point based nondominated sorting approach, part ii: Handling constraints and extending to an adaptive approach. IEEE Trans. Evolutionary Computation **18**(4), 602–622 (2014)
3. Tapabrata, R., Kang, T., Seow, K.C.: Multiobjective design optimization by an evolutionary algorithm. Engineering Optimization **33**(4), 399–424 (2001). https://doi.org/10.1080/03052150108940926