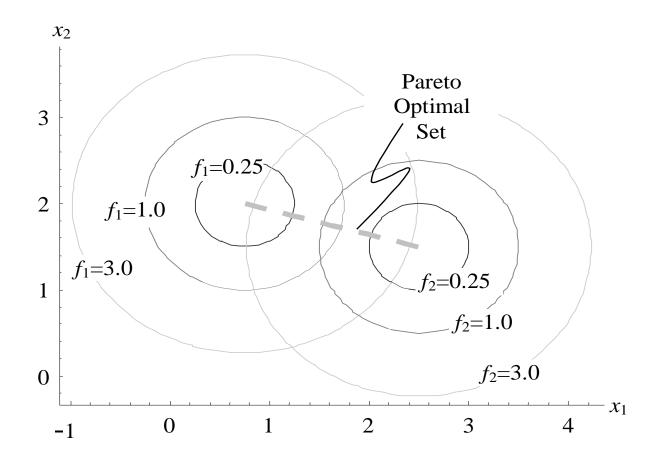
CHAPTER

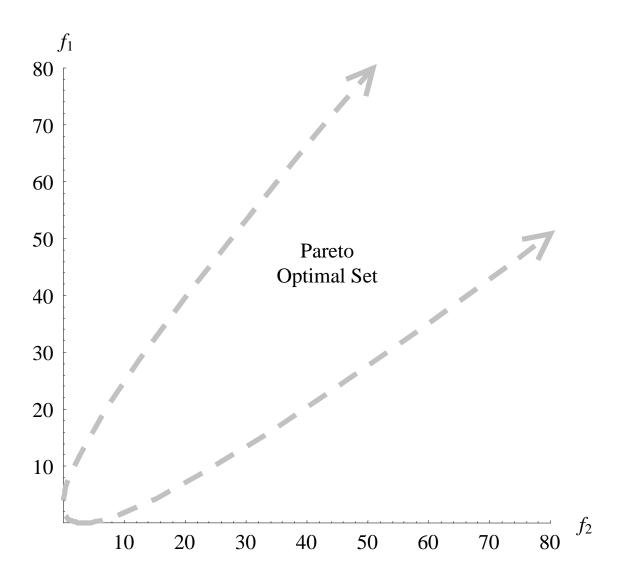
18

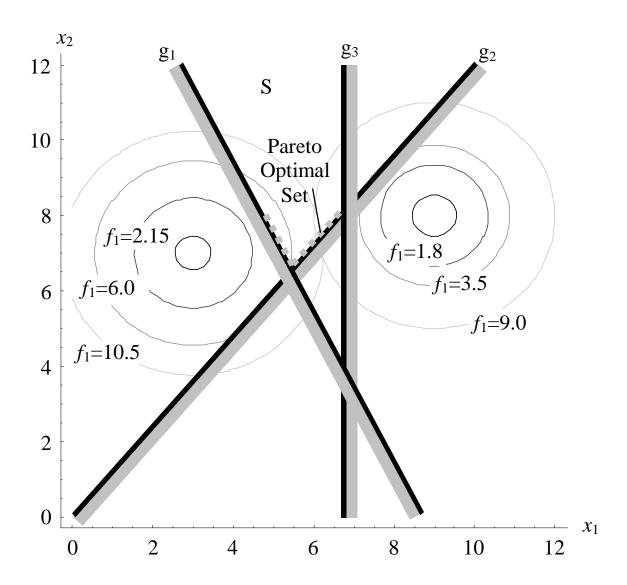
Multi-objective Optimum Design Concepts and Methods

18. 1 -

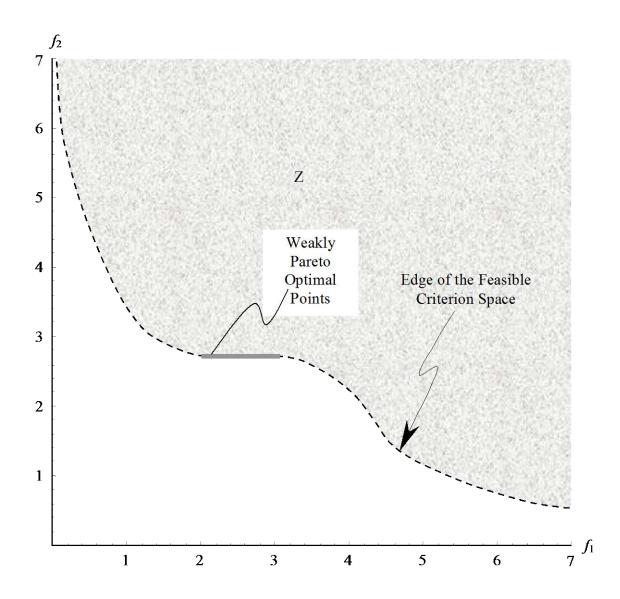


18. 2 -

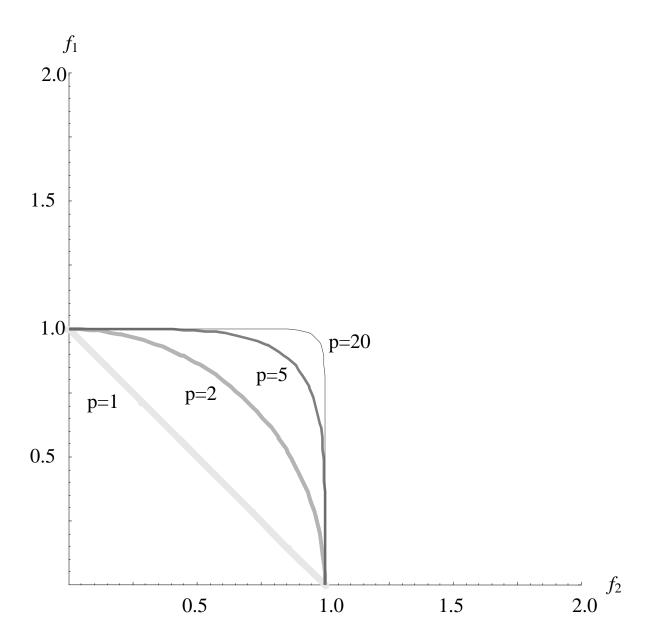




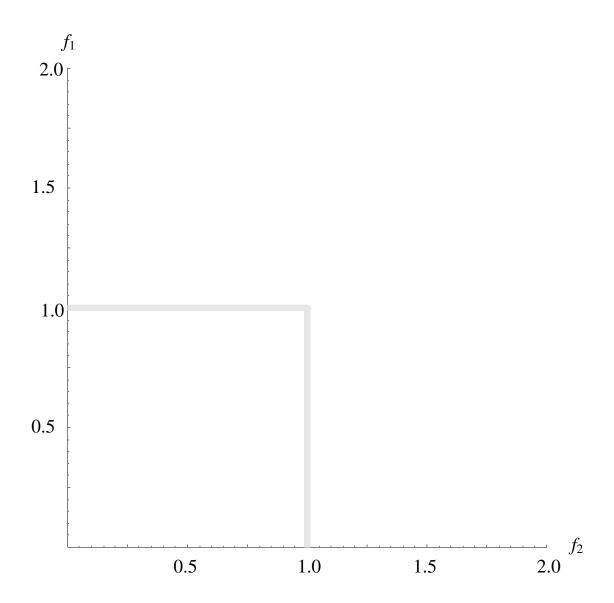
18.4-



18.5 -



18.6



18.7-

$$f(x) = w_1 \left[(x_1 - 3)^2 + (x_2 - 7)^2 \right] + w_2 \left[(x_1 - 9)^2 + (x_2 - 8)^2 \right]$$

$$\frac{\partial f}{\partial x_1} = 2w_1 (x_1 - 3) + 2w_2 (x_1 - 9) = 0$$

$$\frac{\partial f}{\partial x_2} = 2w_1 (x_2 - 7) + 2w_2 (x_1 - 8) = 0$$

$$x_1 = \frac{3w_1 + 9w_2}{w_1 + w_2}$$

$$x_2 = \frac{7w_1 + 8w_2}{w_1 + w_2}$$

18.8-

$$L = w_1 \left[20(x_1 - 0.75)^2 + (2x_2 - 2)^2 \right] + w_2 \left[5(x_1 - 1.6)^2 + 2x_2 \right] + u_1 \left(-x_2 + s_1^2 \right)$$

$$\frac{\partial L}{\partial x_1} = 10w_2(x_1 - 1.6) + 40w_1(x_1 - 0.75) = 0$$

$$\frac{\partial L}{\partial x_2} = 2w_2 - u_1 + 4w_1(2x_2 - 2) = 0$$

$$-x_2 + s_1^2 = 0$$

$$s_1 u_1 = 0$$

$$w_1 = 0.1, w_2 = 0.9 \Rightarrow x_1 = 1.33846, x_2 = 0.0, u_1 = 1.0, s_1 = 0.0$$

$$w_1 = 0.9, w_2 = 0.1 \Rightarrow x_1 = 0.772973, x_2 = 0.972222, u_1 = 0.0, s_1 = \pm 0.986013$$

18. 9 ———

Find: *h*, *r*; to:

Minimize: $-Volume = -\pi r^2 h$

Surface Area: $SA = 2\pi rh + 2\pi r^2$

subject to: $g_1 \Rightarrow 0.1 - h \le 0$

$$g_2 \Rightarrow h - 2 \le 0$$

$$g_3 \Rightarrow r - 2 \le 0$$

$$g_4 \Rightarrow 0.5h - r \le 0$$

$$\mathbf{w} = (1.0, 0.0) \ \ \mathbf{p} \ \ r^* = 2.0, h^* = 2.0, V^* = 25.132742, SA = 50.265483$$

$$\mathbf{w} = (0.75, 0.25) \ \ \mathbf{P} \ \ r^* = 2.0, h^* = 2.0, V^* = 25.132742, SA = 50.265483$$

$$\mathbf{w} = (0.5, 0.5) \ \ \ \ \ r^* = 0.05, \ h^* = 0.1, \ V^* = 0.000785, \ SA = 0.047124$$

$$\mathbf{w} = (0.25, 0.75) \ \ \ \ \ r^* = 0.05, \ h^* = 0.1, \ V^* = 0.000785, \ \mathrm{SA} = 0.047124$$

$$\mathbf{w} = (0.0, 1.0) \ \mathbf{P} \ r^* = 0.05, h^* = 0.1, V^* = 0.000785, SA = 0.047124$$

18. 10 **–**

 $\mathbf{w} = (0.5, 0.5), p = 2 \ \mathbf{p} \ r^* = 0.63, h^* = 1.26, V^* = 1.564643, SA = 7.460904$

18. 11 —

