Department of Mechanical Engineering, IIT Bombay

ME 782 Design Optimization, Assignment #5, August 30, 2024

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1. Determine the value of the variables that will obtain an unconstrained local minimum of the following functions using the Marquardt's method

   (a) $f(x_1, x_2) = \left(3x_1^2 + 12x_2^2 + 10x_1\right)^2 + \left(24x_1x_2 + 4x_2 + 3\right)^2$

   (b) $f(x_1, x_2) = \left(10x_1^3 - 10x_1 - x_2 - 2\right)^2 + \left(2x_2^3 - 10x_2 - x_1 - 3\right)^2$

   (c) $f(x_1, x_2) = \left(x_1^2 + x_2^2 - 2\right)^2 + \left(10x_1^2 - 10x_2 - 5x_1 + 1\right)^2$

   (d) $f(x_1, x_2) = \left(x_1^2 + x_2 - 11\right)^2 + \left(x_1 + x_2^2 - 7\right)^2$

   (e) $f(x_1, x_2) = -\left(x_1^3 + 12x_1x_2^2 + 2x_2^2 + 5x_1^2 + 3x_2\right)$

2. Determine the value of the variables that will obtain an unconstrained local minimum of the following functions using the analytical method by using the relevant MATLAB programs.

   (a) $f(x_1, x_2) = \left(3x_1^2 + 12x_2^2 + 10x_1\right)^2 + \left(24x_1x_2 + 4x_2 + 3\right)^2$

   (b) $f(x_1, x_2) = \left(10x_1^3 - 10x_1 - x_2 - 2\right)^2 + \left(2x_2^3 - 10x_2 - x_1 - 3\right)^2$

   (c) $f(x_1, x_2) = \left(x_1^2 + x_2^2 - 2\right)^2 + \left(10x_1^2 - 10x_2 - 5x_1 + 1\right)^2$

   (d) $f(x_1, x_2) = \left(x_1^2 + x_2 - 11\right)^2 + \left(x_1 + x_2^2 - 7\right)^2$

   (e) $f(x_1, x_2) = -\left(x_1^3 + 12x_1x_2^2 + 2x_2^2 + 5x_1^2 + 3x_2\right)$