Optimization Methods for Mechanical Design - ME7223

Assignment 6

Max marks 10 **Due Date:** 15 Oct 2020

Instructions

- Answer all questions.
- Write a Matlab program for all the methods mentioned.
- Use symbolic computation in Matlab for direction exploitation (i.e., to find λ^*)
- Assume any missing data appropriately and **mention** the values of those parameters wherever applicable.
- Submit the assignment as a *pdf* file with all the graphs included. Caption the graphs appropriately.
- Contact the TA (Sri Datta Rapaka) if you have any questions

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1. Minimize the function

$$f(x_1, x_2) = 100\left(x_2 - x_1^2\right)^2 + (1 - x_1)^2$$

using the following:

(a) Random walk method with direction exploitation, using an intial guess of your choice. **(1.5)**

(b) Univariate method. **(2)**

(c) Conjugate directions (Powell's) method. **(2.5)**

Use an initial guess $\mathbf{X_1} = \begin{Bmatrix} -0.5 \\ 0.5 \end{Bmatrix}$ for the Univariate and Powell's methods. Plot the contour lines of the objective function and superimpose the directions along which algorithm progresses for all the methods. Repeat the exercise using 2 additional initial guess points of your choice for both the Univariate and Powell's methods.

Note: You are encouraged to try out various initial guess points, and based on your experience, present the ones which you find interesting. You are also encouraged to comment on the differences (if you find any) in which the algorithm progresses based on the choice of your initial guess points.

2. Minimize the function

$$f(x_1, x_2) = (x_1 + 2x_2 - 7)^2 + (2x_1 + x_2 - 5)^2$$

using the following:

(a) Random walk method with direction exploitation. **(1)**

(b) Univariate method. **(1)**

(c) Conjugate directions (Powell's) method. **(1)**

Use an initial guess $\mathbf{X_1} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$ for all the methods. Plot the contour lines of the objective function and superimpose the directions along which algorithm progresses.

3. (a) Compare the number of steps taken by the Univariate and the Powell's methods in Q.1 and Q.2, for the choice of parameters you've taken (initial step length etc.). **(0.5)**

   (b) Comment on the differences in which the Powell's method progresses for the two objective functions given (in Q.1 and Q.2). **(0.5)**