FEDERAL STATE AUTONOMOUS EDUCATIONAL INSTITUTION

OF HIGHER EDUCATION

ITMO UNIVERSITY

Report

on the practical task No. 4

"Algorithms for unconstrained nonlinear optimization. Stochastic and metaheuristic algorithms"

Performed by

Pakulev Aleksandr

J4133c

Accepted by

Dr Petr Chunaev

St. Petersburg
2020

Brief theoretical part:

In this task need to do less things, than in previous tasks.

1) Implement Simulated Annealing algorithm and Differential Evolution, bellow brief theoretical part:

   a. Simulated Annealing is a metaheuristic algorithm that solves the optimization problem like the process of annealing.

   b. Differential Evolution is an metaheuristic algorithm that solves the optimization problem by maintaining a population of agents, i.e. candidate solutions, creating new agents by combining existing ones and further keeping the best one.

2) Approximate dataset:

$$y_k = \begin{cases} -100 + \delta_k, & f(x_k) < -100, \\ f(x_k) + \delta_k, & -100 \le f(x_k) \le 100, \\ 100 + \delta_k, & f(x_k) > 100, \end{cases} \qquad x_k = \frac{3k}{1000},$$

$$f(x) = \frac{1}{x^2 - 3x + 2},$$

$$F(x, a, b, c, d) = \frac{ax + b}{x^2 + cx + d}$$

For minimization use least square method:

$$D(a, b, c, d) = \sum_{k=0}^{1000} (F(x_k, a, b, c, d) - y_k)^2.$$

Result:

Bellow achieved results:

Name	Answer point	LSE	Iteration count
Nelder-Mead	[-1.00084, 1.00135987, -2.00096991, 1.000986]	137253.96638679053	439
levenberg_marquardt	[-0.88005, 0.88055863, -2.001184, 1.00119823]	138278.80072506782	Value don't report
differential_evolution	[-0.999053, 0.99931713, -2., 1.00001608]	137801.88492003008	4
simultaneous_anneal	[-0.99907, 0.99933215, -1.99998, 0.99999913]	137821.28675832704	1000

As you may notice best result give nelder-mead and levenberg_marquardt methods, I suppose it's occurred because these methods are determined while other methods not determined and use in some way randomized methods.

Below is image with all
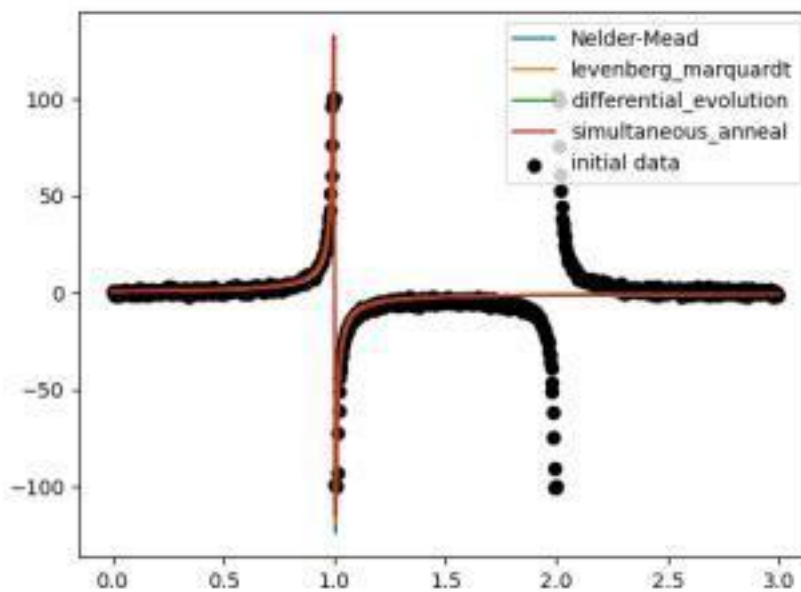
methods plots. And as you can see all methods approximate this dataset similarly.

Conclusion:

First two methods use strong determine algorithms, while other two methods use not determined methods and use in some way randomized methods. And as result you may be notice that determine algorithms give better result than two other.