

# Spectral projected gradient approach in Powell's method for derivative free optimization

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Derivative free optimization methods are designed for solving nonlinear optimization problem where the derivatives of the objective function are not available. Formally, we consider the problem of minimize a smooth nonlinear objective function  $f(x)$  without constraints and we assume that the gradient and Hessian of the function cannot be computed for any  $x$ .

The main motivation for examining algorithmic solutions to this problem is the high demand from users and practitioners for such tools. For those problems,  $f(x)$  is very expensive to compute, and its derivatives are not available because  $f(x)$  results from physical, chemical or industrial measure or is the result of large computer simulation.

One of the research directions for dealing with this problem is based on a trust region framework with quadratic interpolation of the objective function. Powell proposed a method, named NEWUOA, in [6] that worked very well. Moreover, the benchmarking derivative free optimization article by Moré and Wild [5], indicate that NEWUOA has turned out the most successful algorithm for smooth functions.

The trust region strategy requires to solve successively box quadratic subproblems. Our proposal consists in the combination of NEWUOA with the spectral projected gradient method (SPG) for solving the subproblem. SPG is an algorithm developed for large-scale convex constrained mathematical programming problems, which has showed to be succesful when the projections on the feasible set are easy to compute [1].

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We present two different strategies. In the first one we use SPG for solving each box quadratic subproblem [2]. For the second one we divide the box constrained in open faces. An iterative method is used for solving a quadratic subproblem in each face and the SPG method is used to quit the face [3].

We perform numerical experiments by using a set of test problems [4] and we compare NEWUOA against our two implementation.

## References

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