Comparison between SPG with quadratic interpolation and SPG with cubic interpolation

Neculai Andrei
Research Institute for Informatics,
Center for Advanced Modeling and Optimization,
8-10, Averescu Avenue, Bucharest 1, Romania,
Academy of Romanian Scientists
E-mail: nandrei@ici.ro

In this work I present the numerical comparisons of SPG with quadratic interpolation in line search versus SPG with cubic interpolation on a collection of 730 simple bounded optimization test problems.

Spectral Projected Gradient algorithm with quadratic interpolation in line search is implemented by Birgin, Martinez and Raydan. The variant with cubic interpolation in line search is implemented by Neculai Andrei. Both these variants of the algorithm are included in the package MSPG.FOR.

The comparison is considered in the following format. Let f_i^{ALG1} and f_i^{ALG2} be the optimal value found by ALG1 and ALG2, for problem $i=1,\ldots,730,$ respectively. We say that, in the particular problem $i,$ the performance of ALG1 was better than the performance of ALG2 if:

$$\left| f_i^{ALG1} - f_i^{ALG2} \right| < 10^{-3}$$

and the number of iterations, or the number of function-gradient evaluations, or the CPU time of ALG1 was less than the number of iterations, or the number of function-gradient evaluations, or the CPU time corresponding to ALG2, respectively. Out of 730 test simple bounded optimization problems only 658 problems satisfies the above comparison criteria.

```
  Performance Profile:   August 31, 2010

  Results mspgp (quadratic) versus mspgc (cubic), valeps= 0.1000000000000E-02

  nexptot= 730    nexp= 658
  Total Number of iterations for mspgp   =   141376
  Total Number of iterations for mspgc   =   146150

  Total Number of function evaluations for mspgp   =   252496
  Total Number of function evaluations for mspgc   =   211700

  Total Time (centeseconds)  for mspgp   =    24906
  Total Time (centeseconds)  for mspgc   =    26140

            mspgp    achieved minimum # of iter in    115   problems
            mspgc    achieved minimum # of iter in    150   problems
            mspgp    and mspgc    achieved the same # of iter in    393   problems

   Iterations Performance Profile for mspgp

   mspgp
=[0.77,0.99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

   Iterations Performance Profile for mspgc

   mspgc
=[0.83,0.96,0.99,0.99,0.99,0.99,0.99,0.99,0.99,0.99,0.99,0.99,1.00,1.00,1.00,1.00];

            mspgp    achieved minimum # of fg in     81   problems
            mspgc    achieved minimum # of fg in    274   problems
            mspgp    and mspgc    achieved the same # of fg in    303   problems
```

```
   Function Evaluations Performance Profile for mspgp

   mspgp
=[0.58,0.96,0.99,0.99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

   Function Evaluations Performance Profile for mspgc

   mspgc
=[0.88,0.97,0.99,0.99,0.99,0.99,0.99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

            mspgp    achieved minimum time in     97   problems
            mspgc    achieved minimum time in    185   problems
            mspgp    and mspgc    achieved the same time in    376   problems

   Time Performance Profile for mspgp

   mspgp
=[0.72,0.99,0.99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

   Time Performance Profile for mspgc

   mspgc
=[0.85,0.98,0.99,0.99,0.99,0.99,0.99,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];
```

The performance profile is illustrated in Figure 1.

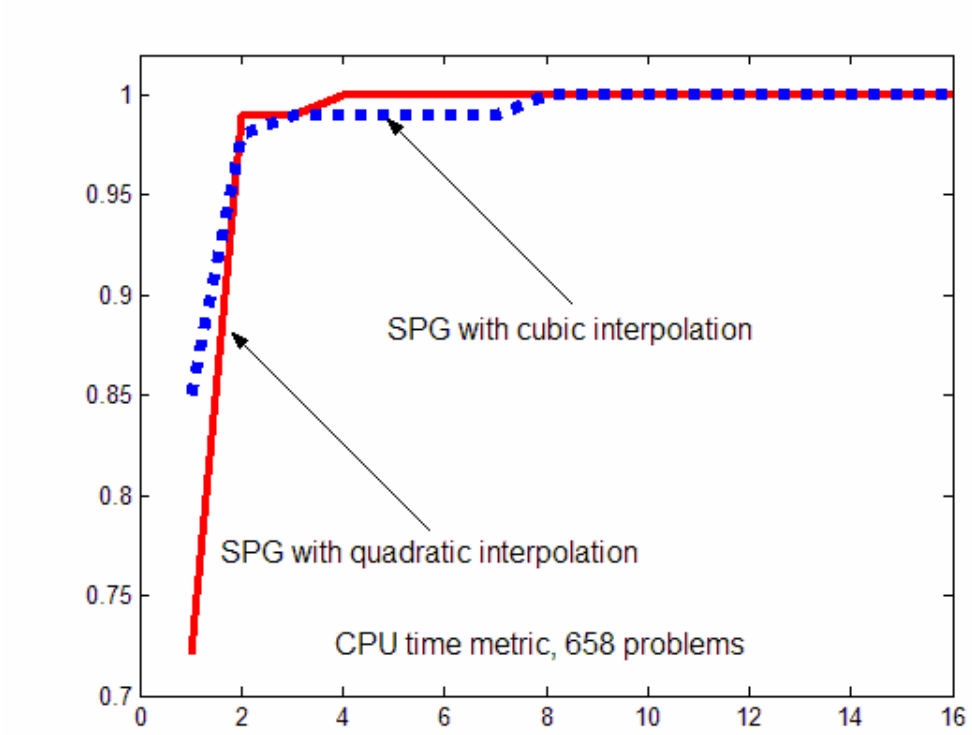

Fig.1. SPG versus LBFGS-B

References

N. Andrei, "An unconstrained optimization test functions collection". Advanced Modeling and Optimization. An Electronic International Journal, 10 (2008) 147-161.

R. H. Byrd, P. Lu, J. Nocedal and C. Zhu, „A limited memory algorithm for bound constrained optimization", SIAM J. Scientific Computing 16 (1995), no. 5, pp. 1190-1208.

C. Zhu, R.H. Byrd, P. Lu, J. Nocedal, „L-BFGS-B: FORTRAN Subroutines for Large Scale Bound Constrained Optimization" Tech. Report, NAM-11, EECS Department, Northwestern University, 1994.

E.G. Birgin, J.M., Martinez and M. Raydan, "Nonmonotone spectral projected gradient methods for convex sets", SIAM J. on Optimization 10(4), 1196-1211, 2000.

August 31, 2010