Some more comparisons of DESCON with different values for the parameter „maxls” versus CG-DESCENT

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In this paper we present some more comparisons between DESCON package with different numbers of line searches in subroutine LINESEARCH, which implements the Wolfe line search conditions [4], and CG-DESCENT by Hager and Zhang [6].

1) DESCON (maxls = 5)

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Performance Profile:   September 11, 2012.
  Results descon5  versus hzw     , valeps=  .1000000000000E-02
  nexptot= 750    nexp= 733
  Total Number of iterations for descon5 =   246545
  Total Number of iterations for hzw     =   424251

  Total Number of function evaluations for descon5 =   578252
  Total Number of function evaluations for hzw     =   865260

  Total Time (centeseconds)  for descon5 =    23336
  Total Time (centeseconds)  for hzw     =    30728

          descon5  achieved minimum # of iter in    548   problems
          hzw      achieved minimum # of iter in    100   problems
          descon5  and hzw      achieved the same # of iter in     85   problems

   Iterations Performance Profile for descon5

   descon5 =[ .86, .98, .98,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

   Iterations Performance Profile for hzw

   hzw     =[ .25, .81, .88, .92, .94, .95, .95, .96, .96, .97, .97, .97, .98, .98, .98, .99];

          descon5  achieved minimum # of fg in    330   problems
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hzw achieved minimum # of fg in 387 problems
descon5 and hzw achieved the same # of fg in 16 problems

Function Evaluations Performance Profile for descon5

descon5 =[.47, .97, .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];

Function Evaluations Performance Profile for hzw

hzw =[.55, .81, .88, .90, .92, .93, .95, .95, .96, .97, .98, .98, .98, .98, .98, .98];

descon5 achieved minimum time in 232 problems
hzw achieved minimum time in 204 problems
descon5 and hzw achieved the same time in 297 problems

Time Performance Profile for descon5

descon5 =[.72, .97, .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 hzw

hzw =[.68, .87, .91, .93, .94, .96, .96, .97, .97, .98, .98, .98, .99, .99, .99, .99];

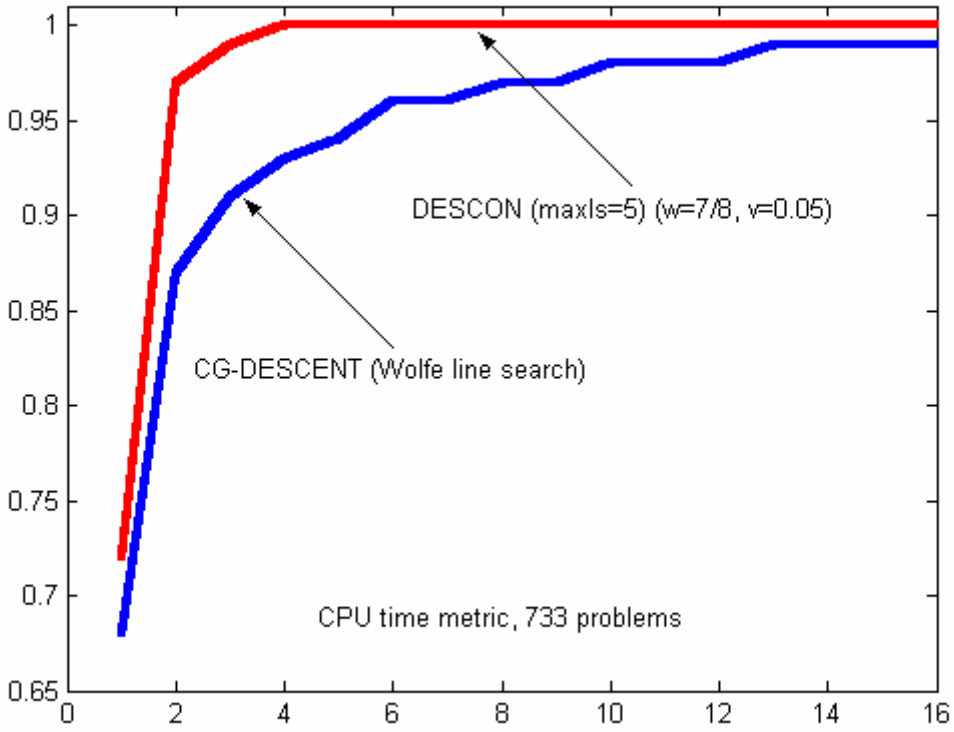

Fig. 1. DESCON (maxls=5) versus CG-DESCENT.

2) DESCON (maxls=6)

Performance Profile: September 11, 2012.
Results descon6 versus hzw , valeps= .1000000000000E-02
nexptot= 750 nexp= 734
Total Number of iterations for descon6 = 244984
Total Number of iterations for hzw = 424595
Total Number of function evaluations for descon6 = 569813
Total Number of function evaluations for hzw = 865875
Total Time (centeseconds) for descon6 = 22315
Total Time (centeseconds) for hzw = 30771

descon6 achieved minimum # of iter in 551 problems
hzw achieved minimum # of iter in 98 problems
descon6 and hzw achieved the same # of iter in 85 problems

Iterations Performance Profile for descon6

descon6 =[.87, .98, .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];

Iterations Performance Profile for hzw

hzw =[.25, .80, .88, .92, .94, .95, .95, .96, .96, .97, .97, .98, .98, .98, .99, .99];

descon6 achieved minimum # of fg in 323 problems
hzw achieved minimum # of fg in 392 problems
descon6 and hzw achieved the same # of fg in 19 problems

Function Evaluations Performance Profile for descon6

descon6 =[.47, .97,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

Function Evaluations Performance Profile for hzw

hzw =[.56, .81, .88, .90, .92, .94, .95, .96, .96, .97, .98, .98, .98, .98, .98, .99];

descon6 achieved minimum time in 248 problems
hzw achieved minimum time in 219 problems
descon6 and hzw achieved the same time in 267 problems

Time Performance Profile for descon6

descon6 =[.70, .96, .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];

Time Performance Profile for hzw

hzw =[.66, .87, .91, .93, .94, .96, .96, .97, .97, .98, .98, .99, .99, .99, .99, .99];

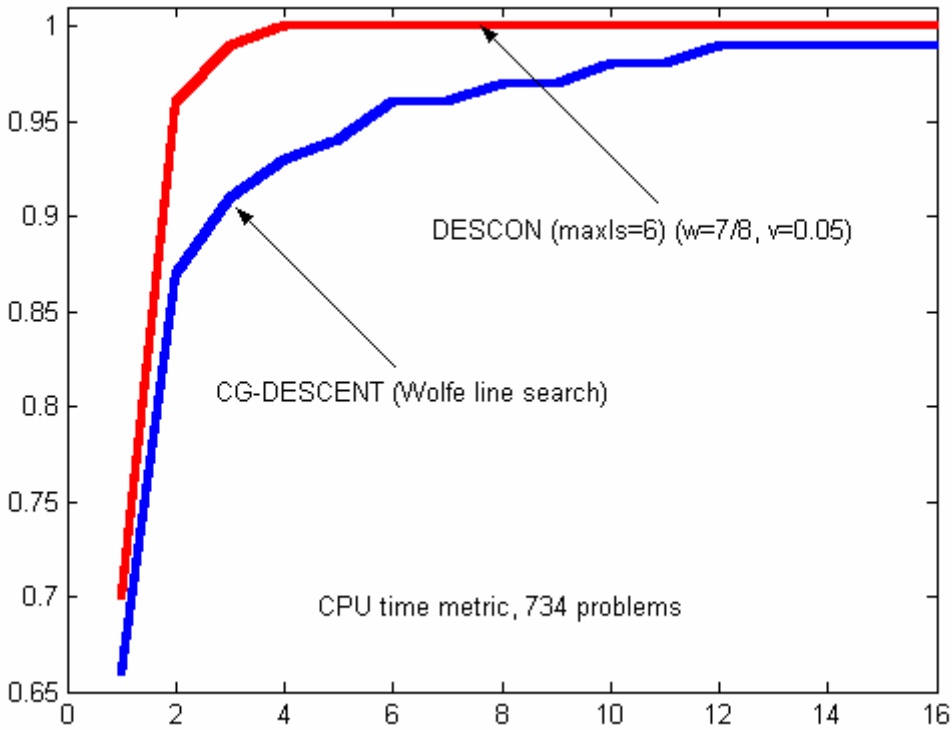

Fig. 2. DESCON (maxls=6) versus CG-DESCENT.

3) DESCON (maxls=7)

Performance Profile: September 11, 2012.
Results descon7 versus hzw , valeps= .1000000000000E-02
nexptot= 750 nexp= 734
Total Number of iterations for descon7 = 245196
Total Number of iterations for hzw = 424595
Total Number of function evaluations for descon7 = 571470
Total Number of function evaluations for hzw = 865875
Total Time (centeseconds) for descon7 = 22611
Total Time (centeseconds) for hzw = 30771

descon7 achieved minimum # of iter in 554 problems
hzw achieved minimum # of iter in 98 problems
descon7 and hzw achieved the same # of iter in 82 problems

Iterations Performance Profile for descon7

descon7 =[.87, .99, .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];

Iterations Performance Profile for hzw

hzw =[.25, .80, .88, .92, .94, .95, .95, .96, .97, .97, .97, .98, .98, .98, .98, .99];

descon7 achieved minimum # of fg in 323 problems
hzw achieved minimum # of fg in 395 problems
descon7 and hzw achieved the same # of fg in 16 problems

Function Evaluations Performance Profile for descon7

descon7 =[.46, .97,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

Function Evaluations Performance Profile for hzw

hzw =[.56, .81, .88, .90, .92, .95, .95, .95, .96, .97, .98, .98, .98, .98, .98, .99];

descon7 achieved minimum time in 245 problems
hzw achieved minimum time in 217 problems
descon7 and hzw achieved the same time in 272 problems

Time Performance Profile for descon7

descon7 =[.70, .96, .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 hzw

hzw =[.67, .87, .92, .93, .94, .95, .96, .96, .97, .98, .98, .99, .99, .99, .99, .99];

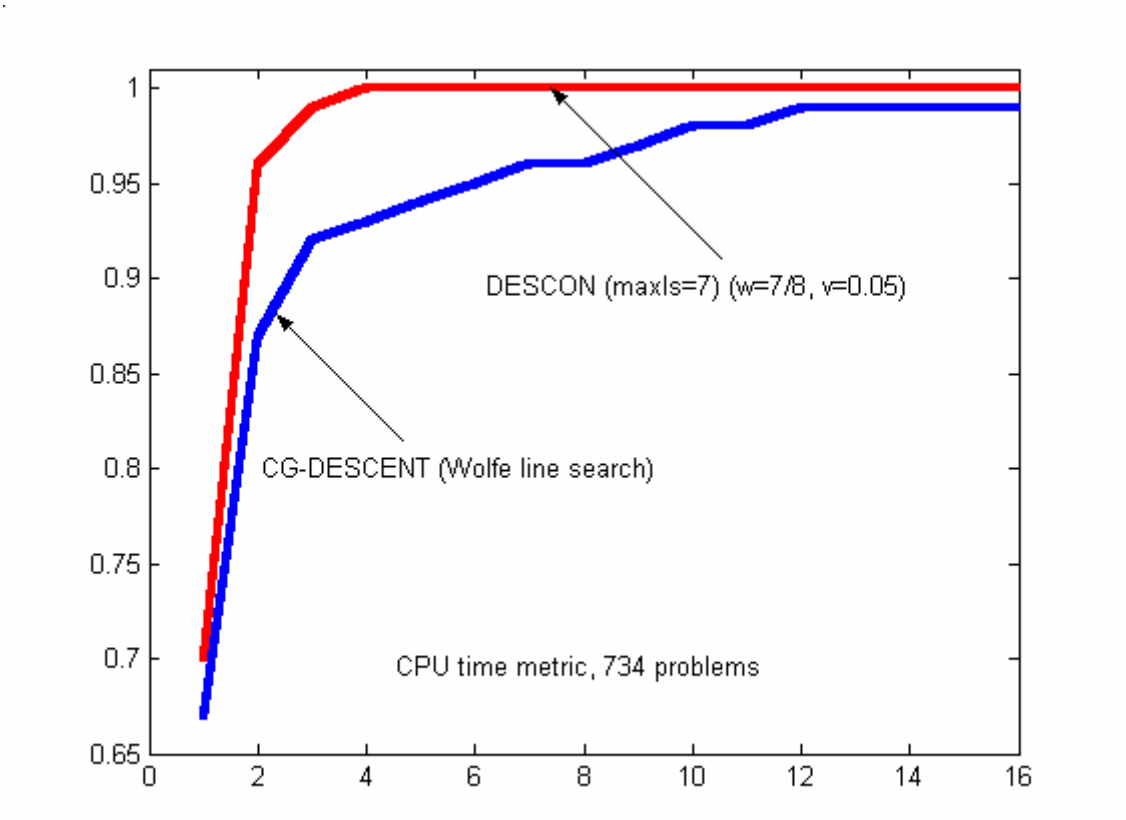

Fig. 3. DESCON (maxls=7) versus CG-DESCENT.

4) DESCON (maxls=8)

Performance Profile: September 11, 2012.
Results descon8 versus hzw , valeps= .1000000000000E-02
nexptot= 750 nexp= 734
Total Number of iterations for descon8 = 245081
Total Number of iterations for hzw = 424595
Total Number of function evaluations for descon8 = 572718
Total Number of function evaluations for hzw = 865875
Total Time (centeseconds) for descon8 = 22534
Total Time (centeseconds) for hzw = 30771

descon8 achieved minimum # of iter in 552 problems
hzw achieved minimum # of iter in 99 problems
descon8 and hzw achieved the same # of iter in 83 problems

Iterations Performance Profile for descon8

descon8 =[.87, .99, .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];

Iterations Performance Profile for hzw

hzw =[.25, .80, .88, .92, .94, .95, .95, .96, .96, .97, .97, .98, .98, .98, .99, .99];

descon8 achieved minimum # of fg in 325 problems
hzw achieved minimum # of fg in 391 problems
descon8 and hzw achieved the same # of fg in 18 problems

Function Evaluations Performance Profile for descon8

descon8 =[.47, .97, .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];

Function Evaluations Performance Profile for hzw

hzw =[.56, .82, .88, .90, .92, .95, .95, .96, .96, .98, .98, .98, .98, .98, .98, .99];

descon8 achieved minimum time in 243 problems
hzw achieved minimum time in 217 problems
descon8 and hzw achieved the same time in 274 problems

Time Performance Profile for descon8

descon8 =[.70, .97, .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 hzw

hzw =[.67, .87, .91, .93, .95, .96, .96, .97, .98, .98, .98, .98, .99, .99, .99, .99];

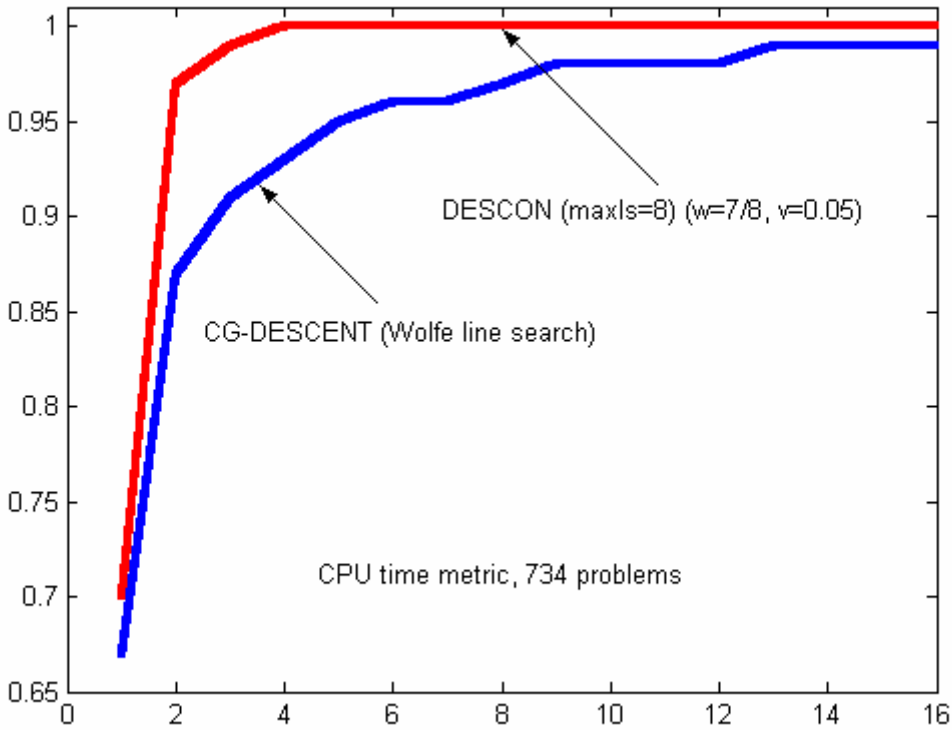

Fig. 4. DESCON (maxls=8) versus CG-DESCENT.

5) DESCON (maxls=9)

Performance Profile: September 12, 2012.
Results descon9 versus hzw , valeps= .1000000000000E-02
nexptot= 750 nexp= 734
Total Number of iterations for descon9 = 244817
Total Number of iterations for hzw = 424595
Total Number of function evaluations for descon9 = 573831
Total Number of function evaluations for hzw = 865875
Total Time (centeseconds) for descon9 = 22726
Total Time (centeseconds) for hzw = 30771

descon9 achieved minimum # of iter in 552 problems
hzw achieved minimum # of iter in 99 problems
descon9 and hzw achieved the same # of iter in 83 problems

Iterations Performance Profile for descon9
descon9 =[.87, .98, .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];

Iterations Performance Profile for hzw
hzw =[.25, .80, .88, .92, .94, .95, .95, .96, .96, .97, .97, .98, .98, .98, .99, .99];

descon9 achieved minimum # of fg in 324 problems
hzw achieved minimum # of fg in 392 problems

descon9 and hzw achieved the same # of fg in 18 problems

Function Evaluations Performance Profile for descon9

descon9 =[.47, .97, .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];

Function Evaluations Performance Profile for hzw

hzw =[.56, .82, .88, .90, .93, .94, .95, .96, .96, .98, .98, .98, .98, .98, .98, .98];

descon9 achieved minimum time in 242 problems
hzw achieved minimum time in 224 problems
descon9 and hzw achieved the same time in 268 problems

Time Performance Profile for descon9

descon9 =[.69, .96, .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 hzw

hzw =[.67, .87, .91, .93, .95, .96, .96, .97, .98, .98, .98, .99, .99, .99, .99, .99];

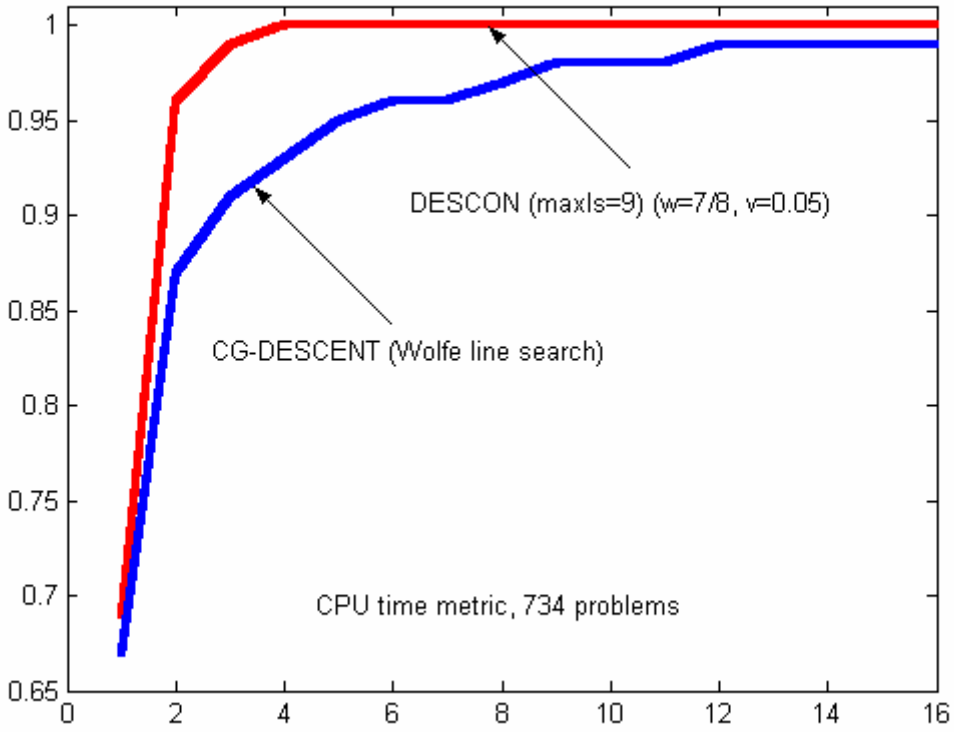

Fig. 5. DESCON (maxls=9) versus CG-DESCENT.

6) DESCON (maxls=10)

Performance Profile: September 12, 2012.
Results descon10 versus hzw , valeps= .1000000000000E-02
nexptot= 750 nexp= 734
Total Number of iterations for descon10= 245278
Total Number of iterations for hzw = 424595
Total Number of function evaluations for descon10= 576111
Total Number of function evaluations for hzw = 865875
Total Time (centeseconds) for descon10= 23012
Total Time (centeseconds) for hzw = 30771

descon10 achieved minimum # of iter in 554 problems
hzw achieved minimum # of iter in 97 problems
descon10 and hzw achieved the same # of iter in 83 problems

Iterations Performance Profile for descon10

descon10=[.87, .99, .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];

Iterations Performance Profile for hzw

hzw =[.25, .80, .88, .93, .94, .95, .95, .96, .96, .97, .97, .98, .98, .98, .98, .99];

descon10 achieved minimum # of fg in 322 problems
hzw achieved minimum # of fg in 394 problems
descon10 and hzw achieved the same # of fg in 18 problems

Function Evaluations Performance Profile for descon10

descon10=[.46, .96, .98, .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 hzw

hzw =[.56, .82, .88, .91, .93, .94, .95, .96, .96, .98, .98, .98, .98, .98, .98, .98];

descon10 achieved minimum time in 244 problems
hzw achieved minimum time in 219 problems
descon10 and hzw achieved the same time in 271 problems

Time Performance Profile for descon10

descon10=[.70, .96, .99, .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];

Time Performance Profile for hzw

hzw =[.67, .88, .91, .93, .95, .96, .96, .97, .97, .98, .98, .99, .99, .99, .99, .99];

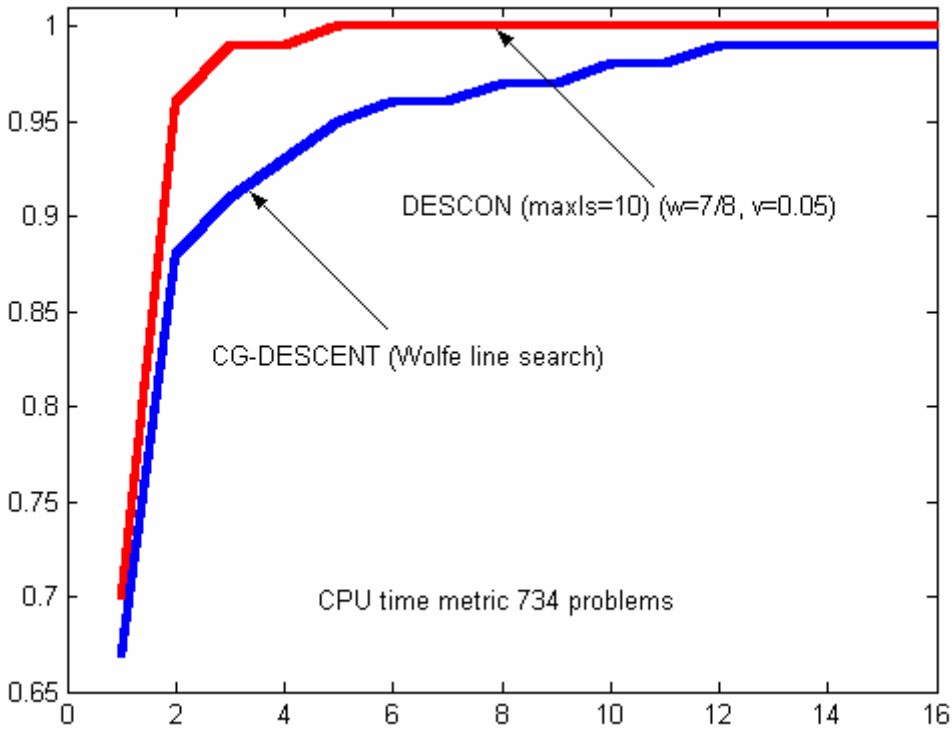

Fig. 6. DESCON (maxls=10) versus CG-DESCENT.

7) DESCON (maxls=5) versus DESCON (maxls=10)

Performance Profile: September 12, 2012.
Results descon5 versus descon10, valeps= .1000000000000E-02
nexptot= 750 nexp= 749
Total Number of iterations for descon5 = 248953
Total Number of iterations for descon10= 247310
Total Number of function evaluations for descon5 = 586055
Total Number of function evaluations for descon10= 583133
Total Time (centeseconds) for descon5 = 23979
Total Time (centeseconds) for descon10= 23607

descon5 achieved minimum # of iter in 49 problems
descon10 achieved minimum # of iter in 73 problems
descon5 and descon10 achieved the same # of iter in 627 problems

Iterations Performance Profile for descon5

descon5 =[.90,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

Iterations Performance Profile for descon10

descon10=[.93,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

descon5 achieved minimum # of fg in 147 problems
descon10 achieved minimum # of fg in 59 problems
descon5 and descon10 achieved the same # of fg in 543 problems

Function Evaluations Performance Profile for descon5

descon5 =[.92,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

Function Evaluations Performance Profile for descon10

descon10=[.80,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00,1.00];

descon5 achieved minimum time in 186 problems
descon10 achieved minimum time in 141 problems
descon5 and descon10 achieved the same time in 422 problems

Time Performance Profile for descon5
descon5 =[.81, .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];

Time Performance Profile for descon10
descon10=[.75, .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];

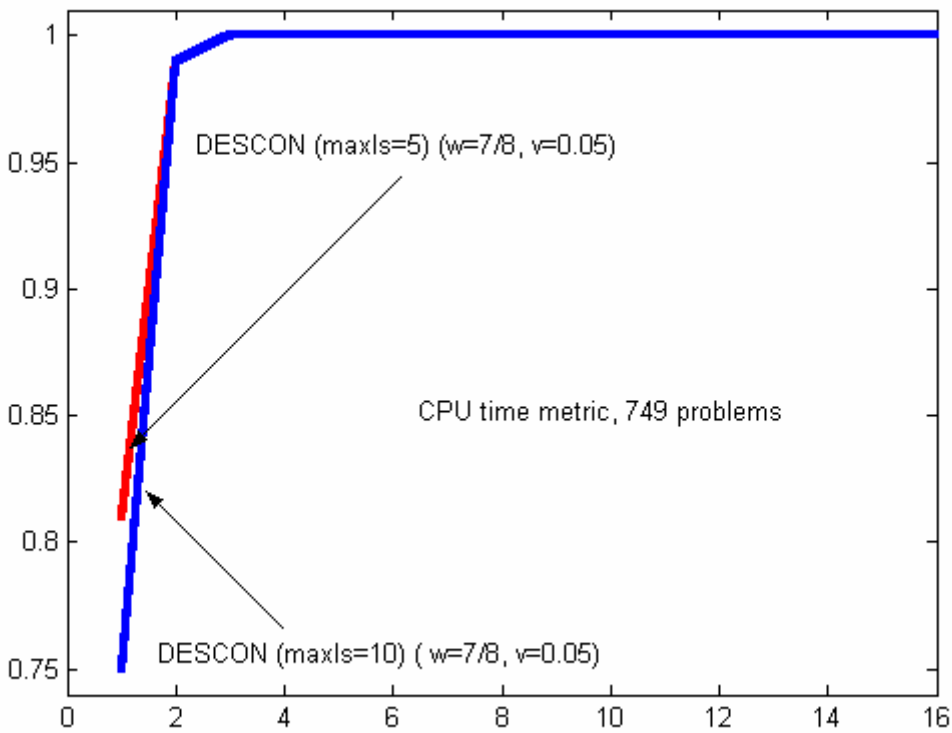

Fig. 7. DESCON (maxls=5) versus DESCON (maxls=10).

Observe that DESCON with maxls=5 is top performer. In LINESEARCH subroutine, which implements the Wolfe line search conditions, it is not necessary to compute the value of the step length with a high accuracy. Just a few iterations, let say 5 or 6, are sufficient to get a value for the step length. The acceleration procedure, included in DESCON, will modify this value of the step length in order to decrease the value of the minimizing function.

Conclusion

DESCON is one of the fastest and robust conjugate gradient algorithm (and Fortran program). It implements a conjugate gradient algorithm with guaranteed sufficient descent and conjugacy conditions. It uses an efficient acceleration procedure, and the Beale-Powell restart procedure.

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