Comparison between DLDC and CG_DESCENT conjugate gradient algorithms

Neculai Andrei
Research Institute for Informatics,
Center for Advanced Modeling and Optimization,
8-10, Averescu Avenue, Bucharest 1, Romania,
Academy of Romanian Scientists, 54,
Splaiul Independentei, Bucharest 5, Romania.
E-mail: nandrei@ici.ro

DLDC Package (Andrei)

($v = 0.05,\ w = 0.6,$ Powell=.true., $\|\nabla f(x_k)\|_\infty \le 10^{-6},\ \rho = 10^{-4}$)

A1. Elastic-Plastic Torsion

```
   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Elastic-Plastic Torsion Problem
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
  40000    241     0    510    27       595 -.4392678188056E+00  .3175798147507E-04
--------------------------------------------------------------------------------
  TOTAL    241     0    510    27      5.95 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Elastic-Plastic Torsion Problem
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 160000    476     0    982    29      5179 -.4392942848677E+00  .4717215899501E-04
--------------------------------------------------------------------------------
  TOTAL    476     0    982    29     51.79 (seconds)    proc=    .00%
```

```
   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Elastic-Plastic Torsion Problem
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 360000    705     0   1439    28     17742 -.4392992067811E+00  .5991292282222E-04
--------------------------------------------------------------------------------
  TOTAL    705     0   1439    28    177.42 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Elastic-Plastic Torsion Problem
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 640000    911     0   1853    30     41037 -.4393009097431E+00  .5942611590252E-04
--------------------------------------------------------------------------------
  TOTAL    911     0   1853    30    410.37 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Elastic-Plastic Torsion Problem
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
1000000   1111     0   2253    30     78709 -.4393016840057E+00  .6698929721647E-04
--------------------------------------------------------------------------------
  TOTAL   1111     0   2253    30    787.09 (seconds)    proc=    .00%
```

A2. Pressure Distribution in a Journal Bearing

```
   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Pressure Distribution in a Journal Bearing
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
  40000    631     0   1297    34      1560 -.2828929485496E+00  .2445970728835E-04
--------------------------------------------------------------------------------
  TOTAL    631     0   1297    34     15.60 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Pressure Distribution in a Journal Bearing
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 160000   1223     0   2477    30     14216 -.2829064007793E+00  .3999154908118E-04
--------------------------------------------------------------------------------
  TOTAL   1223     0   2477    30    142.16 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Pressure Distribution in a Journal Bearing
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 360000   1783     0   3594    27     48289 -.2829088979228E+00  .5453108009269E-04
--------------------------------------------------------------------------------
  TOTAL   1783     0   3594    27    482.89 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
```

```
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Pressure Distribution in a Journal Bearing
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 640000   2335     0   4698    27    112406 -.2829097592472E+00  .7281252418388E-04
-------------------------------------------------------------------------------
  TOTAL   2335     0   4698    27   1124.06 (seconds)    proc=    .00%

   ****************************************************
   * DLDC                             Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Pressure Distribution in a Journal Bearing
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
1000000   2833     0   5694    27    215186 -.2829101117321E+00  .8163124591989E-04
-------------------------------------------------------------------------------
  TOTAL   2833     0   5694    27   2151.86 (seconds)    proc=    .00%
```

A3. Optimal Design with Composite Materials

```
   ****************************************************
   * DLDC                             Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 6, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:Optimal Design with Composite Materials
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
  40000   1023     0   2076    29      4342 -.1138128744588E-01  .3922131897477E-04
-------------------------------------------------------------------------------
TOTAL   1023     0   2076    29     43.42 (seconds)    proc=    .00%

   ****************************************************
```

```
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 6, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:Optimal Design with Composite Materials
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 160000   1909     0   3853    34     35435 -.1138240111429E-01  .6465920397985E-04
--------------------------------------------------------------------------------
TOTAL   1909     0   3853    34    354.35 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 6, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:Optimal Design with Composite Materials
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 360000   2761     0   5560    37    117451 -.1138247919820E-01  .8720137808329E-04
--------------------------------------------------------------------------------
TOTAL   2761     0   5560    37   1174.51 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 6, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:Optimal Design with Composite Materials
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 640000   3674     0   7395    46    280264 -.1138233181316E-01  .1128649949874E-03
--------------------------------------------------------------------------------
TOTAL   3674     0   7395    46   2802.64 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm       **
   ***************************************************
```

```
   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 6, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:Optimal Design with Composite Materials
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
1000000   4777     0   9595    40    569539 -.1138211462583E-01  .1465217214474E-03
--------------------------------------------------------------------------------
TOTAL   4777     0   9595    40   5695.39 (seconds)    proc=    .00%
```

A4. Steady State Combustion

```
   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Steady State Combustion
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
  40000    299     0    632    33      1904 -.5611448493596E+01  .2374434426176E-04
--------------------------------------------------------------------------------
TOTAL    299     0    632    33     19.04 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
--------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Steady State Combustion
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
--------------------------------------------------------------------------------
 160000    585     0   1200    29     15318 -.5611479470976E+01  .2906018829500E-04
--------------------------------------------------------------------------------
TOTAL    585     0   1200    29    153.18 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
```

```
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Steady State Combustion
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 360000    863     0   1759    32     51239 -.5611485235586E+01  .3388100471173E-04
-------------------------------------------------------------------------------
TOTAL    863     0   1759    32    512.39 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Steady State Combustion
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 640000   1134     0   2304    35    120323 -.5611487252906E+01  .3908395280998E-04
-------------------------------------------------------------------------------
TOTAL   1134     0   2304    35   1203.23 (seconds)    proc=    .00%

   ***************************************************
   * DLDC                            Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ***************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Steady State Combustion
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
1000000   1413     0   2864    37    234041 -.5611488188408E+01  .4244605566031E-04
-------------------------------------------------------------------------------
TOTAL   1413     0   2864    37   2340.41 (seconds)    proc=    .00%
```

A5. Minimal Surface Area

```
   ****************************************************
   * DLDC                              Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm        **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Minimal Surface Area
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
  40000    279     1    578    19      1063  .1000000005826E+01  .3810120709289E-04
-------------------------------------------------------------------------------
TOTAL    279     1    578    19     10.63 (seconds)    proc=    .36%

   ****************************************************
   * DLDC                              Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm        **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Minimal Surface Area
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 160000    519     1   1057    18      8516  .1000000037732E+01  .6467301226858E-04
-------------------------------------------------------------------------------
TOTAL    519     1   1057    18     85.16 (seconds)    proc=    .19%

   ****************************************************
   * DLDC                              Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                   **
   * The fastest conjugate gradient algorithm        **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Minimal Surface Area
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 360000    778     2   1577    20     29608  .1000000073870E+01  .8439657553616E-04
-------------------------------------------------------------------------------
TOTAL    778     2   1577    20    296.08 (seconds)    proc=    .26%
```

```
   ****************************************************
   * DLDC                             Neculai Andrei **
   * Accelerated Dai – Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ****************************************************

   Parameters: descent=  .6000000000000E+00    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Minimal Surface Area
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time©        fxnew              gnorm
-------------------------------------------------------------------------------
 640000   1025     3   2074    23     69663  .1000000162338E+01  .1187918990706E-03
-------------------------------------------------------------------------------
TOTAL   1025     3   2074    23    696.63 (seconds)    proc=    .29%


   ****************************************************
   * DLDC                             Neculai Andrei **
   * Accelerated Dai - Liao Conjugate Gradient with **
   * Guaranteed Descent and Conjugacy conditions.   **
   * ---------------------------------------------- **
   * Project: FCGA                                  **
   * The fastest conjugate gradient algorithm       **
   ****************************************************

   Parameters: descent=  .1000000000000E-01    conjugacy=  .5000000000000E-01

   Dai-Liao DC. Powell restart.     July 3, 2009
-------------------------------------------------------------------------------

     1    DLDC Algorithm. Function:    Minimal Surface Area
          stoptest= 1

    n   iter   irs  fgcnt lscnt   time(c)        fxnew              gnorm
-------------------------------------------------------------------------------
1000000   1219     2   2462    23    128291  .1000000298851E+01  .1476781639642E-03
-------------------------------------------------------------------------------
TOTAL   1219     2   2462    23   1282.91 (seconds)    proc=    .16%
```

CG_DESCENT Package (Hager & Zhang)

(Wolfe line search, Default settings, $\|\nabla f(x_k)\|_\infty \le 10^{-6}$)

A1. Elastic-Plastic Torsion

CG-DESCENT, standard Wolfe line search, January 19, 2009

1 CG_DESCENT Algorithm: Elastic-Plastic Torsion

n	iter	nfunc	ngrad	time(c)	f	gnorm	s
1000000	1145	2291	1147	108783	-.4393012991437E+00	.9703406971102E-06	0
TOTAL	1145	2291	1147	1087.83(seconds)			

A2. Pressure Distribution in a Journal Bearing

CG-DESCENT, standard Wolfe line search, January 19, 2009

1 CG_DESCENT Algorithm: Pressure Distribution in a Journal Bearing

n	iter	nfunc	ngrad	time(c)	f	gnorm	s
1000000	3368	6737	3369	336977	-.2829101441860E+00	.9571140068903E-06	0
TOTAL	3368	6737	3369	3369.77(seconds)			

A3. Optimal Design with Composite Materials

CG-DESCENT, standard Wolfe line search,January 19, 2009

1 CG_DESCENT Algorithm: Optimal Design with Composite Materials

n	iter	nfunc	ngrad	time(c)	f	gnorm	s
1000000	4841	9684	4843	805866	-.1138220375091E-01	.9988011843742E-06	0
TOTAL	4841	9684	4843	8058.66(seconds)			

A4. Steady State Combustion

CG-DESCENT, standard Wolfe line search, January 19, 2009

```
    1    CG_DESCENT Algorithm:    Steady State Combustion

      n          iter    nfunc    ngrad   time(c)              f                          gnorm          s
-------------------------------------------------------------------------------------------------------------------
  1000000    1806    3613    1807   421300     -.5611488039275E+01    .9690689195721E-06 0
-------------------------------------------------------------------------------------------------------------------
TOTAL        1806    3613    1807  4213.00(seconds)
```

A5. Minimal Surface Area

CG-DESCENT, standard Wolfe line search, January 19, 2009

```
    1    CG_DESCENT Algorithm:    Minimal Surface Area

      n          iter    nfunc    ngrad   time(c)              f                          gnorm          s
-------------------------------------------------------------------------------------------------------------------
  1000000    1226    2453    1227   177395      .1000000259829E+01    .9405265186902E-06 0
-------------------------------------------------------------------------------------------------------------------
TOTAL        1226    2453    1227  1773.95(seconds)
```

Table 1. Summary of performances.
1,000,000 variables. cpu seconds.

	DLDC				**CG_DESCENT**			
	#iter	#fg	cpu	f*	#iter	#fg	cpu	f*
A1	1111	2253	**787.09**	-0.439301684	1145	2291	1087.83	-0.439301299
A2	2833	5694	**2151.86**	-0.282910111	3368	6737	3369.77	-0.282910144
A3	4777	9595	**5695.39**	-0.011382114	4841	9684	8058.66	-0.011382203
A4	1413	2864	**2340.41**	-5.611488188	1806	3613	4213.00	-5.611488039
A5	1219	2462	**1282.91**	1	1226	2453	1773.95	1

References

Andrei, N., *An accelerated modified Dai-Liao conjugate gradient algorithm with guaranteed descent and conjugacy conditions for unconstrained optimization*. ICI Technical Report, July 2009. (n41a09.doc)

Hager, W.W., Zhang, H., (2005) *A new conjugate gradient method with guaranteed descent and an efficient line search*, SIAM Journal on Optimization **16**, 170-192 (2005)

July 7, 2009