Performances of SPG for solving MINPACK-2 applications

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In this work I present the performances of SPG package [1] for solving some applications from MINPACK-2 collection of Averick, Carter, Moré and Xue [2].

1. Elastic-Plastic Problem

Experiment Nr. 1: $10^{-6} \leq x \leq 1$

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day: 3 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation
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Elastic-Plastic Torsion problem n= 40000

F= -4.3926782010D-01
CGINFNORM= 1.1156588486D-08
CGTWNORM= 9.9701713719D-07
FLAG= 1

ITER= 3311
FCNT= 5433
GCNT= 3312
TIME(csec.)= 11325
Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 3  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
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Elastic-Plastic Torsion problem  n= 40000

F= -4.3926782073D-01
CGINFNORM= 2.517419382D-08
CGTWNORM= 8.0189862450D-07
FLAG= 1

ITER= 2663
FCNT= 3600
GCNT= 2664
TIME(csec.)= 8321

Fig. 1. Elastic-Plastic-Torsion Problem (quadratic).
Fig. 2. Elastic-Plastic-Torsion Problem (cubic).

**Experiment Nr. 2**: $10^{-6} \leq x \leq 0.01$

**Project**: Simple Bounded Optimization


Date: --- Month: 9 Day: 3 Year: 2010

Termination criteria:
- cgfn is the gradient infinite-norm, and eps = 0.0000000000000E+00
- cgtn is the gradient 2-norm, and eps2 = 1.0000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation

Elastic-Plastic Torsion problem    n= 40000

F= -4.1913749027D-02
CGINFNORM= 4.9814688135D-08
CGTWONORM= 9.5751878157D-07
FLAG= 1

ITER= 152
FCNT= 190
GCNT= 153
TIME(csec.)= 293
Elastic-Plastic Torsion problem    n= 40000

F= -4.1913749029D-02
CGINFNORM= 4.3749634771D-08
CGTWONORM= 8.5000284860D-07
FLAG= 1
ITER= 118
FCNT= 132
GCNT= 119
TIME(csec.)= 233

Fig. 3. Elastic-Plastic-Torsion Problem (quadratic).
2. Pressure Distribution in a Journal Bearing

Experiment Nr. 1: $-1 \leq x \leq 1$

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
cginfn .ie. eps
cgtwon .ie. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation
==================================================================
Pressure Distribution in a Journal Bearing Problem    n=  40000

F= -2.8289294907D-01
CGINFNORM= 1.1427951653D-08
CGTWONORM= 9.9341353557D-07
FLAG= 1

ITER= 4179
FCNT= 7071
GCNT= 4180
TIME(csec.)= 14973

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= .00000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .10000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
==================================================================

Pressure Distribution in a Journal Bearing Problem    n=  40000

F= -2.8289294954D-01
CGINFNORM= 1.7258658877D-08
CGTWONORM= 5.4390730011D-07
FLAG= 1

ITER= 2663
FCNT= 3553
GCNT= 2664
TIME(csec.)= 8396
Fig. 5. Pressure Distribution in a Journal Bearing (quadratic)

Fig. 6. Pressure Distribution in a Journal Bearing (cubic)
Project: Simple Bounded Optimization
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Date: --- Month: 9 Day: 7 Year: 2010
Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05
Line search interpolation:
Line search with safeguarded quadratic interpolation
==================================================================
Pressure Distribution in a Journal Bearing Problem n= 40000
F= -1.8059754456D-01
CGINFNORM= 1.7536325350D-08
CGTWNORM= 9.9307582671D-07
FLAG= 1
ITER= 4964
FCNT= 7796
GCNT= 4965
TIME(csec.)= 15202

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day: 7 Year: 2010
Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05
Line search interpolation:
Line search with safeguarded cubic interpolation
==================================================================
Pressure Distribution in a Journal Bearing Problem n= 40000
F= -1.8059754456D-01
CGINFNORM= 3.2455560570D-08
Fig. 7. Pressure Distribution in a Journal Bearing (quadratic)

Fig. 8. Pressure Distribution in a Journal Bearing (cubic)
Experiment Nr. 3 \(-1 \leq x \leq 0\)

Project: Simple Bounded Optimization


Date: --- Month: 9 Day: 7 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded \textbf{quadratic} interpolation

Pressure Distribution in a Journal Bearing Problem \( n = 40000 \)

\( F = -1.8059754455D-01 \)
\( \text{CGINFNORM} = 1.3853286775D-08 \)
\( \text{CGTWONORM} = 9.9760220449D-07 \)
\( \text{FLAG} = 1 \)
\( \text{ITER} = 3881 \)
\( \text{FCNT} = 6179 \)
\( \text{GCNT} = 3882 \)
\( \text{TIME (csec.)} = 11635 \)

Project: Simple Bounded Optimization


Date: --- Month: 9 Day: 7 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded \textbf{cubic} interpolation

Pressure Distribution in a Journal Bearing Problem \( n = 40000 \)

\( F = -1.8059754456D-01 \)
\( \text{CGINFNORM} = 3.7006498776D-08 \)
CGTWONORM = 9.9670674200D-07
FLAG = 1
ITER = 3154
FCNT = 4170
GCNT = 3155
TIME (csec.) = 8699

Fig. 8. Pressure Distribution in a Journal Bearing (quadratic)

Fig. 10. Pressure Distribution in a Journal Bearing (cubic)
Experiment Nr. 4 \(-0.5 \leq x \leq 0.5\)

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= \(.0000000000000E+00\)
cgtwon is the gradient 2-norm, and eps2= \(.1000000000000E-05\)

Line search interpolation:
Line search with safeguarded quadratic interpolation
==================================================================

Pressure Distribution in a Journal Bearing Problem  \(n= 40000\)

\(P= -2.8289294910D-01\)
CGINFNORM= 1.0195428499D-08
CGTWONORM= 9.9766551753D-07
FLAG= 1

ITER= 4054
FCNT= 6820
GCNT= 4055
TIME(csec.)= 14309

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= \(.0000000000000E+00\)
cgtwon is the gradient 2-norm, and eps2= \(.1000000000000E-05\)

Line search interpolation:
Line search with safeguarded cubic interpolation
==================================================================

Pressure Distribution in a Journal Bearing Problem  \(n= 40000\)

\(P= -2.8289294950D-01\)
CGINFNORM= 5.6516445827D-09
CGTWNORM = 4.8165804218D-07
FLAG = 1
ITER = 2969
FCNT = 4105
GCNT = 2970
TIME (csec.) = 9484

Fig. 11. Pressure Distribution in a Journal Bearing (quadratic)

Fig. 12. Pressure Distribution in a Journal Bearing (cubic)
3. Optimal Design with Composite Materials

Experiment Nr. 1: $-1 \leq x \leq 0$

Project: Simple Bounded Optimization


Date: --- Month: 9 Day: 7 Year: 2010

Termination criteria:
cglnfn .le. eps
cgtwon .le. eps2**2
where :
cglnfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation

Optimal Design with Composite Materials Problem    n=  40000

F= -1.1381297204D-02
CGINFNORM= 6.4141788970D-08
CGTWONORM= 9.9511281084D-07
FLAG= 1
ITER= 22515
FCNT= 34686
GCNT= 22516
TIME(csec.)= 125982

Project: Simple Bounded Optimization


Date: --- Month: 9 Day: 7 Year: 2010

Termination criteria:
cglnfn .le. eps
cgtwon .le. eps2**2
where :
cglnfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation

Optimal Design with Composite Materials Problem    n=  40000
F= -1.1381297098D-02
CGINFNORM= 9.0640360981D-09
CGTWONORM= 9.9757695281D-07
FLAG= 1
ITER= 20969
FCNT= 27964
GCNT= 20970
TIME(csec.)= 108320

Fig. 13. Optimal Design with Composite Materials (quadratic).

Fig. 14. Optimal Design with Composite Materials (cubic).
**Experiment Nr. 2: \(-0.02 \leq x \leq 0\)**

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
\[ \text{cginfn} \leq \text{eps} \]
\[ \text{cgtwon} \leq \text{eps}^2 \]
where:
\text{cginfn} is the gradient infinite-norm, and \text{eps} = \text{0.0000000000000E+00}
\text{cgtwon} is the gradient 2-norm, and \text{eps} = \text{0.1000000000000E-05}

Line search interpolation:
Line search with safeguarded quadratic interpolation
==================================================================

Optimal Design with Composite Materials Problem    \(n = 40000\)

\[F = -8.2074125873D-03\]
\[\text{CGINFNORM} = 5.9298561172D-08\]
\[\text{CGTWONORM} = 8.8942770602D-07\]
\[\text{FLAG} = 1\]
\[\text{ITER} = 1855\]
\[\text{FCNT} = 2769\]
\[\text{GCNT} = 1856\]
\[\text{TIME (csec.)} = 8621\]

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Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day: 7  Year: 2010

Termination criteria:
\[ \text{cginfn} \leq \text{eps} \]
\[ \text{cgtwon} \leq \text{eps}^2 \]
where:
\text{cginfn} is the gradient infinite-norm, and \text{eps} = \text{0.0000000000000E+00}
\text{cgtwon} is the gradient 2-norm, and \text{eps} = \text{0.1000000000000E-05}

Line search interpolation:
Line search with safeguarded cubic interpolation
==================================================================

Optimal Design with Composite Materials Problem    \(n = 40000\)
F = -8.2074125860D-03
CGINFNORM = 1.2007121466D-07
CGTWONORM = 9.9581382847D-07
FLAG = 1
ITER = 2228
FCNT = 2890
GCNT = 2229
TIME (csec.) = 9574

Fig. 15. Optimal Design with Composite Materials (quadratic).

Fig. 16. Optimal Design with Composite Materials (cubic).
4. Inhomogeneous Superconductors

Ginzburg-Landau Problem

Experiment Nr. 1: $0 \leq x \leq 10^8$

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day: 8 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .100000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation
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Ginzburg-Landau (1-dimensional) problem n= 1000

F= -1.6748781298D-04
CGINFNORM= 6.4907074271D-05
CGTWNORM= 1.4326190175D-03
FLAG= 3

ITER= 3465
FCNT= 6001
GCNT= 3466
TIME(csec.)= 81

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day: 8 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .100000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
==================================================================
Fig. 17. Inhomogeneous Superconductors. Ginzburg-Landau Problem (quadratic).

Fig. 18. Inhomogeneous Superconductors. Ginzburg-Landau Problem (cubic).
Experiment Nr. 2: $0 \leq x \leq 10^{-3}$

Project: Simple Bounded Optimization


Date: ---  Month: 9  Day: 8  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation

Ginzburg-Landau (1-dimensional) problem  n = 1000

F=    -2.8506126485D-06
CGINFNORM=  1.2754051055D-05
CGTWONORM=  6.0947115351D-05
FLAG=       3
ITER=        3967
FCNT=        6001
GCNT=        3968
TIME(csec.)=     74

Project: Simple Bounded Optimization


Date: ---  Month: 9  Day: 8  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation

Ginzburg-Landau (1-dimensional) problem  n = 1000

F=    -2.8507522910D-06
CGINFNORM=  2.5856929101D-06
CGTWONORM=  4.2072170753D-05
FLAG=       3
ITER=        4713
FCNT=        6001
GCNT=        4714
TIME(csec.)=     92

Fig. 19. Inhomogeneous Superconductors. Ginzburg-Landau Problem (quadratic).

Fig. 20. Inhomogeneous Superconductors. Ginzburg-Landau Problem (cubic).
5. Steady State Combustion Problem

Experiment Nr. 1: $0 \leq x \leq 1$

Project: Simple Bounded Optimization


Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
CGTWN is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation

Steady State Combustion Problem n= 40000

F= -5.6114485117D+00
CGINFNORM= 1.0769991071D-07
CGTWONORM= 7.9920712403D-07
FLAG= 1

ITER= 5134
FCNT= 8418
GCNT= 5135
TIME(csec.)= 42192

Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
CGTWN is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
Steady State Combustion Problem  \( n = 40000 \)

\[ F = -5.614485103D+00 \]
\[ \text{CGINFNORM} = 1.2148512307D-08 \]
\[ \text{CGTWONORM} = 9.8766050698D-07 \]
\[ \text{FLAG} = 1 \]
\[ \text{ITER} = 5352 \]
\[ \text{FCNT} = 7236 \]
\[ \text{GCNT} = 5353 \]
\[ \text{TIME (csec.)} = 39513 \]

**Fig. 21.** Steady State Combustion Problem (quadratic).

**Fig. 22.** Steady State Combustion Problem (cubic).
**Experiment Nr. 2: 0 ≤ x ≤ 0.2**

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps=  .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2=  .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation
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Steady State Combustion Problem  n=  40000

F=         -5.4413175451D+00
CGINFNORM=  2.0415915966D-07
CGTWNORM=  9.0042370018D-07
FLAG=       1

ITER=        1843
FCNT=        2795
GCNT=        1844
TIME(csec.)=  13732

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps=  .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2=  .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
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Steady State Combustion Problem  n=  40000
Fig. 23. Steady State Combustion Problem (quadratic).

Fig. 24. Steady State Combustion Problem (cubic).
Experiment Nr. 3: $0 \leq x \leq 0.1$

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day:14  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded quadratic interpolation
====================================
Steady State Combustion Problem    n=  40000
F=       -5.2852405614D+00
CGINFNORM=  1.6756601870D-08
CGTWONORM=  9.9178012235D-07
FLAG=       1
ITER=      1140
FCNT=       1724
GCNT=       1141
TIME(csec.)=   8152

Project: Simple Bounded Optimization
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Date: ---  Month: 9  Day:14  Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where :
cginfn is the gradient infinite-norm, and eps= .0000000000000E+00
cgtwon is the gradient 2-norm, and eps2= .1000000000000E-05

Line search interpolation:
Line search with safeguarded cubic interpolation
====================================
Steady State Combustion Problem    n=  40000
F=       -5.2852405614D+00
CGINFNORM=  1.4179800306D-08
CGTWONORM = 9.8735462081D-07
FLAG = 1
ITER = 665
FCNT = 854
GCNT = 666
TIME (csec.) = 4345

Fig. 25. Steady State Combustion Problem (quadratic).

Fig. 26. Steady State Combustion Problem (cubic).
Experiment Nr. 4: \(0 \leq x \leq 0.05\)

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps = 0.00000000000000E+00
cgtwon is the gradient 2-norm, and eps2 = 1.00000000000000E-05

Line search interpolation:
Line search with safeguarded \textbf{quadratic} interpolation
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Steady State Combustion Problem \(n = 40000\)

\begin{align*}
F &= -5.1692563011D+00 \\
CGINFNORM &= 2.8256471371D-08 \\
CGTWNORM &= 9.7633280794D-07 \\
\text{FLAG} &= 1 \\
\text{ITER} &= 383 \\
\text{FCNT} &= 543 \\
\text{GCNT} &= 384 \\
\text{TIME(csec.)} &= 2585
\end{align*}

Project: Simple Bounded Optimization
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Date: --- Month: 9 Day:14 Year: 2010

Termination criteria:
cginfn .le. eps
cgtwon .le. eps2**2
where:
cginfn is the gradient infinite-norm, and eps = 0.00000000000000E+00
cgtwon is the gradient 2-norm, and eps2 = 1.00000000000000E-05

Line search interpolation:
Line search with safeguarded \textbf{cubic} interpolation
==================================================================

Steady State Combustion Problem \(n = 40000\)

\begin{align*}
F &= -5.1692563011D+00
\end{align*}
CGINFNORM = 2.0536686053D-08
CGTWONORM = 9.8611315784D-07
FLAG = 1
ITER = 468
FCNT = 587
GCNT = 469
TIME (csec.) = 2972

Fig. 27. Steady State Combustion Problem (quadratic).

Fig. 28. Steady State Combustion Problem (cubic).
References
