Numerical Results of SLPSQP, filterSQP and LANCELOT on Selected CUTE Test Problems

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Numerical Analysis Report NA/203, August 2001

Abstract

This paper is a companion report of the paper "numerical performance of an SLP-filter algorithm that takes EQP steps". The main intention of this paper is to present the numerical results of SLPSQP on selected CUTE test problems and also to provide numerical comparisons with filterSQP and LANCELOT.

1 Introduction

In the paper by Chin and Fletcher [1], the authors have discussed the numerical performance of a new globalization technique to solve NLP problems. This paper is intended to provide the complete numerical results of the performance of SLPSQP on each test problems. In addition, the full details of numerical comparisons of SLPSQP, filterSQP and LANCELOT is also described.

2 Numerical Results on Selected QP Problems

In this section we present some numerical results on the CUTE quadratic programming test problems. A description of the headers of each table is given as follows :

No.	The CUTE problem number
Problem	The CUTE name of the QP problem
n	The total number of variables
m	The total number of linear constraints
$\#k$	Number of iterations
ρ^*	The final trust region radius.

No.	Problem	n	m	$\#k$	ρ^*
1	AUG2DC	220	100	3	1.4557E+01
2	AUG2DCQP	220	100	12	7.6037E-01
3	AUG2DQP	220	100	9	4.2840E-01
4	AUG3DCQP	156	27	3	5.0
5	AUG3DQP	156	27	15	3.3076E-01
6	BLOCKQP1	205	101	4	6.2500E-01
7	BLOCKQP2	205	101	6	6.2500E-01
8	BLOCKQP3	205	101	4	6.2500E-01
9	BLOWEYA	202	102	52	1.0021
10	BLOWEYB	202	102	63	7.7685
11	BLOWEYC	202	102	53	4.2350E+01
12	CVXQP1	1000	500	21	1.5444E-02
13	CVXQP2	1000	250	20	1.5489E-01
14	CVXQP3	1000	750	28	1.5098E-01
15	DUALC1	9	215	5	7.8125E-02
16	DUALC2	7	229	6	7.8125E-02
17	DUALC5	8	278	9	5.4156E-02
18	DUALC8	8	503	6	1.5625E-01
19	GOULDQP2	699	349	3	5.0
20	GOULDQP3	699	349	20	5.5101E-03
21	KSIP	20	1001	9	5.0
22	MOSARQP1	900	90	17	6.6393E-02
23	MOSARQP2	900	90	3	5.0
24	NCVXQP1	1000	500	9	1.0048E+02
25	NCVXQP2	1000	500	9	1.024E+02

Table A Performance details of QP problems (1)

No.	Problem	n	m	$\#k$	ρ^*
26	NCVXQP3	1000	500	24	5.1843E-02
27	NCVXQP4	1000	250	15	1.1574E+01
28	NCVXQP5	1000	250	11	4.2185E+02
29	NCVXQP6	1000	250	17	6.3426E-01
30	NCVXQP7	1000	750	10	1.0046E+01
31	NCVXQP8	1000	750	12	5.0
32	NCVXQP9	1000	750	24	2.6452E-01
33	PRIMALC1	230	9	3	5.0
34	PRIMALC2	231	7	11	2.9299E+03
35	PRIMALC5	287	8	26	3.2412E+02
36	PRIMALC8	520	8	14	2.0480E+04
37	PRIMAL1	325	85	10	1.5395E-03
38	PRIMAL2	649	96	4	4.8828E-03
39	PRIMAL3	745	111	4	7.8125E-02
40	PRIMAL4	1489	75	10	2.4414E-03
41	QPCBOEI1	384	440	33	1.5695E-01
42	QPCBOEI2	143	185	20	1.5851
43	QPCSTAIR	467	356	24	4.6518E-03
44	SOSQP1	200	101	2	5.0
45	STCQP1	1025	510	16	2.5446E-01
46	STCQP2	1025	510	8	4.4863E-01
47	STNQP1	1025	510	8	1.25
48	STNQP2	1025	510	8	1.6250
49	UBH1	909	600	13	320.0
50	YAO	202	200	3	5.0

Table A Performance details of QP problems (2)

3 Selected CUTE NLP Test Problems

In this section we describe some details of the problems used in our test. For each table header, we tabulate the following information :

No.	The CUTE problem number
Problem	The CUTE name of the problem
n	The total number of variables
m_{tot}	The total number of constraints excluding the bounds
m_{nl}	The total number of nonlinear constraints
m_l	the total number of linear constraints

Take note that each of the problems selected has at least one nonlinear constraint and the test problems are divided into two groups. The first group consists of 200 small scale problems where $n \leq 25$ and $n + m_{tot} \leq 50$ while the second group consists of 100 medium and large scale problems.

No.	Problem	n	m_{tot}	m_{nl}	m_l
1	AIRCRFTA	8	5	5	0
2	ALJAZZAF	3	1	1	0
3	ALLINITC	4	1	1	0
4	ALSOTAME	2	1	1	0
5	ARGAUSS	3	15	15	0
6	ARGTRIG	10	10	10	0
7	ARTIF	12	10	10	0
8	BT1	2	1	1	0
9	BT2	3	1	1	0
10	BT4	3	2	1	1
11	BT5	3	2	1	1
12	BT6	5	2	2	0
13	BT7	5	3	3	0
14	BT8	5	2	2	0
15	BT9	4	2	2	0
16	BT10	2	2	2	0
17	BT11	5	3	2	1
18	BT12	5	3	3	0
19	BT13	5	1	1	0
20	BYRDSPHR	3	2	2	0
21	CANTILVR	5	1	1	0
22	CATENA	15	4	4	0
23	CATENARY	15	4	4	0
24	CB2	3	3	3	0
25	CB3	3	3	3	0
26	CHACONN1	3	3	3	0
27	CHACONN2	3	3	3	0
28	CLUSTER	2	2	2	0
29	CONCON	15	11	4	7
30	CONGIGMZ	3	5	2	3
31	COOLHANS	9	9	9	0
32	CRESC4	6	8	8	0
33	CSFI1	5	5	5	0
34	CSFI2	5	5	5	0
35	DEMYMALO	3	3	1	2
36	DIPIGRI	7	4	4	0
37	DIXCHLNG	10	5	5	0
38	EIGMINC	22	22	22	0
39	ERRINBAR	18	9	8	1
40	FLETCHER	4	4	1	3

Table B.1 Problem characteristics of small scale problems (1)

No.	Problem	n	m_{tot}	m_{nl}	m_l
41	GIGOMEZ1	3	3	1	2
42	GOTTFR	2	2	2	0
43	HAIFAS	13	9	9	0
44	HALDMADS	6	42	42	0
45	HATFLDF	3	3	3	0
46	HATFLDG	25	25	25	0
47	HEART6	6	6	6	0
48	HEART8	8	8	6	2
49	HIMMELBC	2	2	2	0
50	HIMMELBD	2	2	2	0
51	HIMMELBE	3	3	1	2
52	HIMMELBK	24	14	12	2
53	HIMMELP2	2	1	1	0
54	HIMMELP3	2	2	2	0
55	HIMMELP4	2	3	3	0
56	HIMMELP5	2	3	3	0
57	HIMMELP6	2	5	3	2
58	HS6	2	1	1	0
59	HS7	2	1	1	0
60	HS8	2	2	2	0
61	HS10	2	1	1	0
62	HS11	2	1	1	0
63	HS12	2	1	1	0
64	HS13	2	1	1	0
65	HS14	2	2	1	1
66	HS15	2	2	2	0
67	HS16	2	2	2	0
68	HS16R	3	3	3	0
69	HS17	2	2	2	0
70	HS18	2	2	2	0
71	HS19	2	2	2	0
72	HS20	2	3	3	0
73	HS22	2	2	1	1
74	HS23	2	5	4	1
75	HS26	3	1	1	0
76	HS27	3	1	1	0
77	HS27R	4	2	2	0
78	HS29	3	1	1	0
79	HS30	3	1	1	0
80	HS31	3	1	1	0

Table B.1 Problem characteristics of small scale problems (2)

No.	Problem	n	m_{tot}	m_{nl}	m_l
81	HS32	3	2	1	1
82	HS33	3	2	2	0
83	HS34	3	2	2	0
84	HS39	4	2	2	0
85	HS40	4	3	3	0
86	HS42	4	2	1	1
87	HS43	4	3	3	0
88	HS46	5	2	2	0
89	HS47	5	3	3	0
90	HS56	7	4	4	0
91	HS57	2	1	1	0
92	HS59	2	3	3	0
93	HS60	3	1	1	0
94	HS61	3	2	2	0
95	HS63	3	2	1	1
96	HS64	3	1	1	0
97	HS65	3	1	1	0
98	HS66	3	2	2	0
99	HS67	3	14	14	0
100	HS68	4	2	2	0
101	HS69	4	2	2	0
102	HS70	4	1	1	0
103	HS71	4	2	2	0
104	HS72	4	2	2	0
105	HS73	4	3	1	2
106	HS74	4	5	3	2
107	HS75	4	5	3	2
108	HS77	5	2	2	0
109	HS78	5	3	3	0
110	HS79	5	3	3	0
111	HS80	5	3	3	0
112	HS81	5	3	3	0
113	HS83	5	6	6	0
114	HS84	5	6	6	0
115	HS85	5	38	35	3
116	HS87	6	4	4	0
117	HS88	2	1	1	0
118	HS89	3	1	1	0
119	HS90	4	1	1	0
120	HS91	5	1	1	0

Table B.1 Problem characteristics of small scale problems (3)

No.	Problem	n	m_{tot}	m_{nl}	m_l
121	HS92	6	1	1	0
122	HS93	6	2	2	0
123	HS95	6	4	4	0
124	HS96	6	4	4	0
125	HS97	6	4	4	0
126	HS98	6	4	4	0
127	HS99	7	2	2	0
128	HS100	7	4	4	0
129	HS100LNP	7	2	2	0
130	HS100MOD	7	4	4	0
131	HS101	7	6	6	0
132	HS101R	8	7	7	0
133	HS102	7	6	6	0
134	HS103	7	6	6	0
135	HS104	8	6	6	0
136	HS106	8	6	3	3
137	HS107	9	6	6	0
138	HS108	9	13	13	0
139	HS109	9	10	8	2
140	HS111	10	3	3	0
141	HS111LNP	10	3	3	0
142	HS113	10	8	5	3
143	HS114	10	11	6	5
144	HS116	13	15	10	5
145	HS117	15	5	5	0
146	HYPCIR	2	2	2	0
147	KIWCRESC	3	2	2	0
148	LEWISPOL	6	9	6	3
149	LOOTSMA	3	2	2	0
150	MADSEN	3	6	6	0
151	MAKELA1	3	2	1	1
152	MAKELA2	3	3	3	0
153	MAKELA3	21	20	20	0
154	MARATOS	2	1	1	0
155	MATRIX2	6	2	2	0
156	MCONCON	15	11	4	7
157	MIFFLIN1	3	2	1	1
158	MIFFLIN2	3	2	2	0
159	MINMAXBD	5	20	20	0
160	MINMAXRB	3	4	2	2

Table B.1 Problem characteristics of small scale problems (4)

No.	Problem	n	m_{tot}	m_{nl}	m_l
161	MISTAKE	9	13	13	0
162	MWRIGHT	5	3	3	0
163	NYSTROM5	18	20	18	2
164	PFIT1	3	3	3	0
165	PFIT2	3	3	3	0
166	PFIT3	3	3	3	0
167	PFIT4	3	3	3	0
168	POLAK1	3	2	2	0
169	POLAK2	11	2	2	0
170	POLAK3	12	10	10	0
171	POLAK4	3	3	3	0
172	POLAK5	3	2	2	0
173	POLAK6	5	4	4	0
174	POWELLBS	2	2	2	0
175	POWELLSQ	2	2	2	0
176	RK23	17	11	7	4
177	ROBOT	14	2	2	0
178	ROSENMMX	5	4	4	0
179	S316-322	2	1	1	0
180	SCHOLT1	3	1	1	0
181	SEMICON1	12	10	10	0
182	SEMICON2	12	10	10	0
183	SNAKE	2	2	2	0
184	SPIRAL	3	2	2	0
185	SREADIN3	6	3	2	1
186	SREADIN3	12	6	5	1
187	TENBARS1	18	9	8	1
188	TENBARS2	18	8	8	0
189	TENBARS3	18	8	8	0
190	TENBARS4	18	9	8	1
191	TRIGGER	7	6	3	3
192	TRUSPYR1	11	4	3	1
193	TRUSPYR2	11	11	3	8
194	TRY-B	2	1	1	0
195	TWOBARS	2	2	2	0
196	TWOPHAS	20	18	8	10
197	WOMFLET	3	3	3	0
198	ZECEVIC3	2	2	2	0
199	ZECEVIC4	2	2	1	1
200	ZY2	3	2	2	0

Table B.1 Problem characteristics of small scale problems (5)

No.	Problem	n	m_{tot}	m_{nl}	m_l
1	AIRPORT	84	42	42	0
2	ARGTRIG	100	100	100	0
3	ARTIF	1002	1000	1000	0
4	BDVALUE	502	500	500	0
5	BRATU2D	100	64	64	0
6	BRATU2D	484	400	400	0
7	BRATU3D	125	27	27	0
8	BRATU3D	512	216	216	0
9	CAR2	179	146	146	0
10	CATENARY	99	32	32	0
11	CBRATU2D	512	392	392	0
12	CBRATU3D	686	250	250	0
13	CHANDHEQ	100	100	100	0
14	CHEMRCTA	500	500	496	4
15	CHEMRCTA	1000	1000	996	4
16	CHEMRCTB	500	500	498	2
17	CHEMRCTB	1000	1000	998	2
18	CLNLBEAM	303	200	100	100
19	CORE1	65	59	24	35
20	CORE2	157	134	60	74
21	CORKSCRW	456	350	50	300
22	CORKSCRW	906	700	100	600
23	CRESC50	6	100	100	0
24	CRESC100	6	200	200	0
25	CRESC132	6	2654	2654	0
26	DISC2	29	23	23	0
27	DISCS	36	66	66	0
28	DNIEPER	61	24	24	0
29	DRCAVTY1	196	100	100	0
30	DRCAVTY2	196	100	100	0
31	DRCAVTY3	196	100	100	0
32	DRUGDIS	604	400	400	0
33	DRUGDISE	63	50	50	0
34	EIGENA	110	110	110	0
35	EIGENA2	110	55	55	0
36	EIGENB	110	110	110	0
37	EIGENB2	110	55	55	0
38	EIGMINA	101	101	101	0
39	EIGMINB	101	101	101	0
40	ELATTAR	7	102	102	0

Table B.2 Problem characteristics of medium and large scale problems (1)

No.	Problem	n	m_{tot}	m_{nl}	m_l
41	GROUPING	100	125	100	25
42	HADAMARD	401	1010	210	800
43	HAIFAM	99	150	150	0
44	HANGING	300	180	180	0
45	HET-Z	2	202	202	0
46	HET-Z	2	1002	1002	0
47	HS99EXP	31	21	21	0
48	HYDCAR6	29	29	29	0
49	HYDCAR20	99	99	99	0
50	LAKES	90	78	18	60
51	LAUNCH	25	29	11	18
52	LEAKNET	156	153	80	73
53	MANNE	300	200	100	100
54	MANNE	1095	730	365	365
55	METHANB8	31	31	31	0
56	METHANL8	31	31	31	0
57	MINPERM	93	69	57	12
58	MINPERM	583	520	502	18
59	MRIBASIS	36	55	11	44
60	NET1	48	57	20	37
61	NGONE	50	323	300	23
62	NGONE	100	1273	1225	48
63	OET2	3	1002	1002	0
64	OET4	4	1002	1002	0
65	OET5	5	1002	1002	0
66	OET6	5	1002	1002	0
67	OPTCDEG2	302	200	100	100
68	OPTCDEG3	302	200	100	100
69	OPTCNTRL	32	20	10	10
70	OPTMASS	610	505	101	404
71	OPTMASS	1210	1005	201	804
72	ORTHREGB	27	6	6	0
73	PRODPL0	60	29	4	25
74	PRODPL1	60	29	4	25
75	READING1	202	100	100	0
76	READING3	202	101	100	1
77	READING4	501	1000	1000	0
78	READING5	501	500	500	0
79	READING6	102	50	50	0
80	READING7	1002	500	500	0

Table B.2 Problem characteristics of medium and large scale problems (2)

No.	Problem	n	m_{tot}	m_{nl}	m_l
81	READING9	1002	1504	500	0
82	SEMICON1	102	100	100	0
83	SEMICON1	502	500	500	0
84	SEMICON2	102	100	100	0
85	SEMICON2	502	500	500	0
86	SMMPSF	720	263	11	252
87	SSEBNLN	194	96	24	72
88	SSNLBEAM	303	260	160	100
89	SVANBERG	100	100	100	0
90	SVANBERG	500	500	500	0
91	SWOPF	83	92	49	43
92	TFI1	3	101	101	0
93	TFI1	3	501	501	0
94	TRAINF	808	402	201	201
95	TRAINH	808	402	201	201
96	ZAMB2-8	138	48	48	0
97	ZAMB2-9	138	48	48	0
98	ZAMB2-10	270	96	96	0
99	ZAMB2-11	270	96	96	0
100	ZIGZAG	604	500	100	400

Table B.2 Problem characteristics of medium and large scale problems (3)

4 Numerical Results of NLP Problems

In the next set of tables, we present the SLPSQP results on the CUTE test problems. A short description of the headers of each table is listed as follows:

No.	The CUTE problem number
Problem	The CUTE name of the problem
n_z	The dimension of the null space at the solution
#f	Number of objective function evaluations
#c	Number of constraint evaluations
#g	Number of gradient evaluations
ρ^*	The final trust region ρ
f^*	The optimal value of the objective function
CPU	Time in seconds needed to solve a CUTE problem
$\mathcal{F}^*$	The final size of the filter.

Take note that for every test problem which has a successful run we will tabulate the above details. As for the case of unsolvable test problems such that SLPSQP terminates before reaching a local solution, the following codes are used:

- E - An arithmetic error occurred causing the code to fail,
- H - The subproblem was found to be infeasible although $h(\mathbf{c}(\mathbf{x})) \leq \epsilon_{\text{tol}}$,
- I - Nonlinear constraints were found to be locally infeasible,
- M - The run was terminated after reaching the maximum number of iterations,
- R - Termination with $\rho < \epsilon_{\text{tol}}$.

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
1	AIRCRFTA	0	4	4	3	5.0	0.0	0.02	1
2	ALJAZZAF	1	426	471	43	2.8938E-03	7.5005E+01	0.51	26
3	ALLINITC	1	76	76	38	1.25	3.0497E+01	0.27	1
4	ALSOTAME	0	6	6	5	5.0	8.2085E-02	0.02	2
5	ARGAUSS	0	17	18	7	5.0	0.0	0.13	1
6	ARGTRIG	0	6	6	5	5.0	0.0	0.04	1
7	ARTIF	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
8	BT1	1	8	15	6	5.0	-1.0	0.05	3
9	BT2	2	19	20	12	1.4017E+01	3.2568E-02	0.06	1
10	BT4	1	50	56	12	1.25	-45.5106	0.07	7
11	BT5	1	9	9	6	10.0	9.6172E+02	0.02	5
12	BT6	3	79	79	10	4.0491E-03	2.7705E-01	0.11	3
13	BT7	2	56	56	8	1.5625E-01	3.0650E+02	0.09	6
14	BT8	3	153	154	18	1.1105E-03	1.0	0.17	8
15	BT9	2	143	144	20	2.0889E-01	-1.0	0.18	15
16	BT10	0	8	8	7	5.0	-1.0	0.03	7
17	BT11	2	71	74	8	5.0537E-03	8.2489E-01	0.09	4
18	BT12	2	5	5	4	1.4101E+02	6.1881	0.03	2
19	BT13	3	323	327	54	1.9531E-02	0.0	1.14	1
20	BYRDSPHR	1	23	51	11	5.0	-4.6833	0.09	5
21	CANTILVR	4	37	37	13	1.8147	1.3400	0.09	12
22	CATENA	7	36	36	8	4.0797E-01	-8.3498E+03	0.08	6
23	CATENARY	7	140	167	21	7.9564E-01	-8.1848E+03	0.26	9
24	CB2	1	19	19	6	7.8125E-02	1.9522	0.05	5
25	CB3	0	7	7	6	5.0	2.0	0.03	5
26	CHACONN1	1	13	13	6	7.8125E-02	1.9522	0.05	4
27	CHACONN2	0	7	7	6	5.0	2.0	0.03	5
28	CLUSTER	0	13	13	9	1.2500	0.0	0.05	1
29	CONCON	0	13	18	11	1.0391	-6.2308E+03	0.09	4
30	CONGIGMZ	1	9	9	4	1.0895E+01	28.0	0.04	3
31	COOLHANS	0	13	15	12	160.0	0.0	0.09	1
32	CRESC4	0	24	51	17	2.1991	8.7190E-01	0.16	11
33	CSFI1	0	20	24	14	2.0285E+01	-4.9075E+01	0.11	7
34	CSFI2	0	15	39	14	20.0	55.0176	0.12	10
35	DEMYMALO	0	8	8	5	5.0	-3.0	0.02	3
36	DIPIGRI	5	76	76	9	5.8157E-2	6.8063E+02	0.10	4
37	DIXCHLNG	5	33	33	9	1.5625E-01	2.4719E+03	0.07	4
38	EIGMINC	0	7	7	6	5.0	1.0	0.08	5
39	ERRINBAR	3	77	119	27	2.4074E+01	2.8045E+01	0.31	10
40	FLETCHER	1	131	157	91	1.25	1.1657E+01	0.38	18

Table C.1 Performance details of small scale problems (1)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
41	GIGOMEZ1	0	8	8	5	5.0	-3.0	0.02	3
42	GOTTFR	0	10	22	6	5.0	0.0	0.06	1
43	HAIFAS	7	33	33	8	1.25	-0.45	0.08	4
44	HALDMADS	0	15	15	7	2.5	1.2237E-04	0.09	3
45	HATFLDF	0	58	163	11	5.0	0.0	0.29	1
46	HATFLDG	0	11	34	9	5.0	0.0	0.14	1
47	HEART6	0	311	4079	155	5.0	0.0	4.29	1
48	HEART8	0	28	68	12	5.0	0.0	0.17	1
49	HIMMELBC	0	8	9	6	5.0	0.0	0.03	1
50	HIMMELBD	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
51	HIMMELBE	0	4	4	2	5.0	0.0	0.01	1
52	HIMMELBK	0	7	7	5	5.0	0.0	0.04	1
53	HIMMELP2	2	28	28	10	5.0	-6.2054E+01	0.07	0
54	HIMMELP3	0	7	7	4	49.0	-5.9013E+01	0.03	0
55	HIMMELP4	0	11	11	6	5.1062E+01	-5.9013E+01	0.04	0
56	HIMMELP5	0	10	10	8	29.8	-5.9013E+01	0.04	0
57	HIMMELP6	0	9	9	7	2.9939E+01	-5.9013E+01	0.04	2
58	HS6	1	11	11	4	5.0	0.0	0.03	2
59	HS7	1	58	58	9	1.0313	-1.7321	0.08	4
60	HS8	0	6	6	5	5.0	-1.0	0.03	1
61	HS10	1	22	22	9	2.0823	-1.0	0.05	9
62	HS11	1	14	14	5	1.25	-8.4985	0.03	5
63	HS12	1	25	25	7	6.2500E-01	-30.0	0.05	3
64	HS13	0	28	28	26	5.0	1.0	0.10	0
65	HS14	0	18	18	6	2.5	1.3935	0.02	4
66	HS15	0	4	4	3	5.0	3.0650E+02	0.01	1
67	HS16	0	8	8	2	3.1250E-01	0.25	0.03	0
68	HS16R	1	52	106	19	3.1250E-01	2.500E-01	0.32	17
69	HS17	0	14	14	6	6.8750E-01	1.0	0.05	1
70	HS18	1	21	22	7	2.5	5.0	0.06	4
71	HS19	0	7	7	6	10.84	-6.9618E+01	0.04	5
72	HS20	0	35	36	10	5.0	4.0199E+01	0.06	3
73	HS22	0	30	30	7	2.5	1.0	0.04	4
74	HS23	0	7	7	6	5.0	2.0	0.04	1
75	HS26	2	36	36	22	4.2265	0.0	0.09	1
76	HS27	2	105	106	25	6.4232E-02	0.04	0.15	5
77	HS27R	2	866	877	161	9.3830E-02	0.04	1.18	96
78	HS29	2	30	30	6	1.25	-2.2627E+01	0.05	2
79	HS30	1	29	29	17	2.5	1.0	0.08	1
80	HS31	2	27	27	6	1.5625E-01	6.0	0.04	3

Table C.1 Performance details of small scale problems (2)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
81	HS32	0	4	4	3	5.0	1.0	0.02	1
82	HS33	0	5	5	4	5.0	-4.0	0.02	0
83	HS34	0	12	12	7	2.5	-8.3400E-01	0.04	3
84	HS39	2	143	144	20	2.0889E-01	-1.0	0.18	15
85	HS40	1	29	29	4	7.8125E-02	-0.25	0.04	3
86	HS42	2	27	38	9	2.6919	1.3858E+01	0.05	5
87	HS43	2	46	46	15	3.1250E-01	-44.0	0.09	8
88	HS46	3	30	30	29	5.0	0.0	0.10	1
89	HS47	2	39	39	22	1.25	0.0	0.09	1
90	HS56	3	51	51	7	7.8125E-02	-3.4560	0.07	4
91	HS57	1	22	22	5	3.1250E-01	2.8460E-02	0.06	1
92	HS59	1	11	11	7	1.0944E+01	-6.7495	0.05	0
93	HS60	2	8	8	7	5.0	3.2568E-02	0.04	1
94	HS61	1	20	34	7	6.2500E-01	-1.4365E+02	0.06	3
95	HS63	1	10	10	6	1.25	9.6172E+02	0.03	6
96	HS64	2	35	35	18	1.9706E+01	6.2998E+03	0.11	5
97	HS65	2	21	21	7	4.6875E-01	9.5353E-01	0.04	4
98	HS66	1	13	13	4	1.25	5.1816E-01	0.03	3
99	HS67	1	266	266	38	1.4062E+01	-1.1621E+03	0.35	2
100	HS68	2	128	128	20	2.4093E-02	-9.2042E-01	0.20	6
101	HS69	2	145	146	27	1.8837E-03	-9.5671E+02	0.27	5
102	HS70	4	201	201	27	3.5395E-01	7.4985E-03	0.53	0
103	HS71	1	10	10	5	3.1250E-01	1.7014E+01	0.05	4
104	HS72	2	30	30	17	5.2498E+01	7.2768E+02	0.10	16
105	HS73	0	5	5	3	5.0	2.9894E+01	0.01	2
106	HS74	1	12	13	6	5.3207E+01	5.1265E+03	0.07	6
107	HS75	0	7	8	6	8.0551E+02	5.1744E+03	0.05	5
108	HS77	3	61	61	9	2.4414E-03	2.4150E-01	0.09	3
109	HS78	2	22	22	5	3.1250E-01	-2.9197	0.04	4
110	HS79	2	6	6	5	5.0	7.8777E-02	0.03	1
111	HS80	2	34	34	10	1.5625E-01	5.3950E-02	0.08	6
112	HS81	2	17	17	10	6.2500E-01	5.3950E-02	0.07	8
113	HS83	0	6	6	5	1.8532E+01	-3.0666E+04	0.04	3
114	HS84	0	28	28	9	3.1250E-01	-5.2803E+06	0.09	1
115	HS85	0	15	15	9	1.8817E+01	-2.2156	0.08	2
116	HS87	1	703	703	67	1.9531E-02	9.1969E+03	0.68	21
117	HS88	1	81	94	15	1.9531E-02	1.3627	1.73	11
118	HS89	2	87	87	13	7.3242E-03	1.3627	2.52	11
119	HS90	3	937	957	87	1.2207E-03	1.3627	36.00	74
120	HS91	4	1684	1704	157	1.7754E-03	1.3627	87.20	35

Table C.1 Performance details of small scale problems (3)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
121	HS92	5	1678	1717	167	6.7691E-04	1.3627	158.87	69
122	HS93	4	463	463	57	2.3049E-01	1.3508E+02	0.51	22
123	HS95	0	3	3	2	5.0	1.5620E-02	0.02	1
124	HS96	0	3	3	2	5.0	1.5620E-02	0.02	1
125	HS97	0	7	7	6	5.0	3.1358	0.04	3
126	HS98	0	7	7	6	5.0	3.1358	0.04	3
127	HS99	5	14	14	5	3.1250E-01	-8.3108E+08	0.05	3
128	HS100	5	76	76	9	5.8157E-02	6.8063E+02	0.10	4
129	HS100LNP	5	77	77	11	8.3408E-02	6.8063E+02	0.12	6
130	HS100MOD	6	66	66	7	1.9531E-02	6.7868E+02	0.09	3
131	HS101	5	114	114	23	1.5653E-01	1.8098E+03	0.27	8
132	HS101R	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
133	HS102	4	265	269	41	5.4044E-02	9.1188E+02	0.50	24
134	HS103	3	89	91	24	1.6018E-01	5.4367E+02	0.28	9
135	HS104	4	99	100	9	1.7612E-01	3.9512	0.14	4
136	HS106	2	91	91	21	4.7949	7.0492E+03	0.16	6
137	HS107	1	9	9	5	6.2500E-01	5.0550E+03	0.05	3
138	HS108	2	542	542	119	3.0814E-03	-8.6603E-01	0.90	104
139	HS109	1	16	16	11	1.3954E+02	5.3621E+03	0.09	7
140	HS111	7	32	32	13	2.5	-4.7761E+01	0.14	10
141	HS111LNP	7	30	30	13	2.5	-4.7761E+01	0.13	10
142	HS113	4	28	28	6	1.25	2.4306E+01	0.06	1
143	HS114	1	110	110	35	1.5193E+02	-1.7688E+03	0.26	7
144	HS116	0	35	46	18	2.4044E-01	9.7591E+01	0.20	8
145	HS117	4	164	164	17	4.2751E-01	3.2349E+01	0.23	1
146	HYPCIR	0	8	9	5	5.0	0.0	0.03	1
147	KIWCRESC	1	17	17	8	2.5	0.0	0.05	6
148	LEWISPOL	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
149	LOOTSMA	0	6	6	4	5.0	2.0	0.02	0
150	MADSEN	1	20	20	8	1.5625E-01	6.1643E-01	0.06	3
151	MAKELA1	1	10	10	6	2.5	-1.4142	0.02	4
152	MAKELA2	1	30	31	9	2.1673E+01	7.2	0.07	5
153	MAKELA3	1	24	25	23	68.0	0.0	0.13	3
154	MARATOS	1	17	17	4	6.2500E-01	-1.0	0.04	4
155	MATRIX2	2	69	69	18	2.5625	0.0	0.11	0
156	MCONCON	0	13	18	11	1.0392E+03	-6.2308E+03	0.09	4
157	MIFFLIN1	1	32	32	7	6.2500E-01	-1.0	0.05	6
158	MIFFLIN2	1	34	34	9	1.25	-1.0	0.07	5
159	MINMAXBD	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
160	MINMAXRB	0	15	15	6	6.2500E-01	0.0	0.05	2

Table C.1 Performance details of small scale problems (4)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
161	MISTAKE	3	512	512	68	6.1579E-02	-1.0	0.61	34
162	MWRIGHT	2	88	92	12	6.2500E-01	2.4979E+01	0.13	2
163	NYSTROM5	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
164	PFIT1	0	17	29	10	5.0	0.0	0.09	1
165	PFIT2	0	10	19	7	5.0	0.0	0.06	1
166	PFIT3	0	15	25	7	5.0	0.0	0.08	1
167	PFIT4	0	16	34	8	5.0	0.0	0.09	1
168	POLAK1	1	155	162	67	1.4642E+01	2.7183	0.44	10
169	POLAK2	9	483	574	98	1.4159E+01	5.4598E+01	1.97	92
170	POLAK3	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
171	POLAK4	1	5	5	4	5.0	0.0	0.03	3
172	POLAK5	1	103	105	16	7.7056E-03	50.0	0.16	14
173	POLAK6	2	651	651	297	7.8125E-02	-44.0	2.06	4
174	POWELLBS	0	1199	6082	282	5.0	0.0	6.94	1
175	POWELLSQ	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
176	RK23	1	88	88	34	3.8146E-04	8.3333E-02	0.37	2
177	ROBOT	5	90	92	18	1.25	5.4628	0.17	2
178	ROSENMMX	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
179	S316-322	1	10	11	6	20.0	3.3431E+02	0.03	3
180	SCHOLT1	1	19	20	5	3.1250E-01	1.0492E+01	0.05	4
181	SEMICON1	0	22	130	21	4.5329E+01	0.0	0.33	1
182	SEMICON2	0	18	59	17	1.1533E+01	0.0	0.22	1
183	SNAKE	0	4	4	3	5.0	0.0	0.02	1
184	SPIRAL	2	135	135	31	8.2924E-02	0.0	0.21	11
185	SREADIN3	0	6	6	5	5.0	-1.7870	0.03	2
186	SREADIN3	0	8	8	4	1.375	-1.9147E-01	0.06	1
187	TENBARS1	5	77	142	24	1.7002E+01	2.3025E+03	0.33	19
188	TENBARS2	4	40	88	18	4.5400E+01	2.3025E+03	0.25	14
189	TENBARS3	4	67	117	26	1.5922E+01	2.2471E+03	0.31	22
190	TENBARS4	5	348	362	41	1.0619E+01	3.6849E+02	0.54	26
191	TRIGGER	0	5	5	3	5.0	0.0	0.01	1
192	TRUSPYR1	2	172	172	33	5.9642E-01	1.1229E+01	0.29	16
193	TRUSPYR2	0	6	6	4	10.0	1.1229E+01	0.03	1
194	TRY-B	1	10	10	9	10.0	0.0	0.04	1
195	TWOBARS	1	20	20	7	1.3125E-01	1.5087	0.05	5
196	TWOPHAS	0	8	8	6	5.0	0.0	0.07	1
197	WOMFLET	0	23	23	19	5.0	0.0	0.09	4
198	ZECEVIC3	1	38	38	10	6.8493E-01	9.7310E+01	0.08	5
199	ZECEVIC4	1	16	16	5	1.25	7.5575	0.03	2
200	ZY2	0	5	5	4	5.0	2.0	0.03	0

Table C.1 Performance details of small scale problems (5)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
1	AIRPORT	42	81	81	13	1.2678E-01	4.7953E+04	1.57	7
2	ARGTRIG	0	5	5	4	5.0	0.0	0.36	1
3	ARTIF	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
4	BDVALUE	0	4	4	3	5.0	0.0	1.20	1
5	BRATU2D	0	5	5	4	5.0	0.0	0.11	1
6	BRATU2D	0	5	5	4	5.0	0.0	1.49	1
7	BRATU3D	0	5	5	4	5.0	0.0	0.13	1
8	BRATU3D	0	5	5	4	5.0	0.0	1.39	1
9	CAR2	27	289	1445	77	1.4741E-01	2.6676	130.58	75
10	CATENARY	63	3366	3977	411	7.9518E-04	-6.7051E+04	47.55	106
11	CBRATU2D	0	5	5	4	5.0	0.0	1.57	1
12	CBRATU3D	0	5	5	4	5.0	0.0	2.66	1
13	CHANDHEQ	0	19	19	18	5.0	0.0	1.44	1
14	CHEMRCTA	0	5	5	3	5.0	0.0	1.47	1
15	CHEMRCTA	0	5	5	3	5.0	0.0	4.76	1
16	CHEMRCTB	0	5	5	3	5.0	0.0	1.47	1
17	CHEMRCTB	0	4	4	2	5.0	0.0	3.43	1
18	CLNLBEAM	95	170	170	28	1.7475	3.4488E+02	33.12	2
19	CORE1	0	71	73	16	1.8499E+03	9.1056E+01	0.87	4
20	CORE2	17	82	87	30	7.70098E-03	72.9	7.16	3
21	CORKSCRW	36	3081	4486	428	1.9531E-03	2.6589E+01	965.15	114
22	CORKSCRW	1	498	705	120	1.5859E-02	4.4369E+01	631.57	48
23	CRESC50	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
24	CRESC100	1	102	220	52	1.0028	5.6760E-01	1.39	24
25	CRESC132	1	1374	1377	134	1.1840E-02	8.5771E-01	53.58	10
26	DISC2	5	528	528	81	2.3138E-02	1.5625	1.08	22
27	DISCS	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
28	DNIEPER	0	5	5	4	5.0	1.8744E+04	0.09	2
29	DRCAVTY1	0	48	97	10	5.0	0.0	6.20	1
30	DRCAVTY2	0	51	121	11	5.0	0.0	8.20	1
31	DRCAVTY3	0	25	39	8	5.0	0.0	2.57	1
32	DRUGDIS	0	21	75	19	5.3893E+01	4.2613	81.04	16
33	DRUGDISE	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
34	EIGENA	0	4	4	3	10.0	0.0	0.23	1
35	EIGENA2	55	46	46	9	7.0068	0.0	1.19	1
36	EIGENB	0	315	13320	242	5.0	0.0	608.78	1
37	EIGENB2	55	1080	1090	123	3.6942E-01	0.0	19.68	1
38	EIGMINA	0	17	17	16	5.0	1.0	1.31	1
39	EIGMINB	0	8	8	7	5.0	9.6744E-04	0.25	5
40	ELATTAR	6	59	63	16	1.4311E-03	7.4206E+01	0.38	8

Table C.2 Performance details of medium and large scale problems (1)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
41	GROUPING	0	2	2	1	5.0	1.3850E+01	0.06	0
42	HADAMARD	0	43	86	36	1.5774E-01	1.1660	94.75	2
43	HAIFAM	15	318	318	49	2.1474E+03	-45.0	3.86	2
44	HANGING	108	1156	1164	106	9.5515E-02	-6.2018E+02	191.77	28
45	HET-Z	0	4	4	3	5.0	1.0	0.05	1
46	HET-Z	0	4	4	3	5.0	1.0	0.20	1
47	HS99EXP	0	28	28	21	1.4909E+09	-1.2600E+12	0.26	10
48	HYDCAR6	0	9	14	8	2.3630E+01	0.0	0.23	1
49	HYDCAR20	0	32	117	20	5.0	0.0	4.19	1
50	LAKES	12	112	171	36	2.5250E+03	3.5052E+05	3.10	1
51	LAUNCH	0	16	16	9	7.4456E+01	9.0049	0.14	4
52	LEAKNET	0	8	8	7	1.1449E+02	8.0021	0.47	2
53	MANNE	0	7	7	5	40.0	-9.7457E-01	1.21	1
54	MANNE	- R -	- R -	- R -	- R -	- R -	- R -	- R -	- R -
55	METHANB8	0	4	4	3	5.0	0.0	0.05	1
56	METHANL8	0	7	7	6	10.0	0.0	0.11	1
57	MINPERM	25	119	121	16	5.9575E-03	1.5432E-02	1.47	7
58	MINPERM	64	102	104	19	4.3436E-02	9.3666E-04	56.50	5
59	MRIBASIS	0	56	79	25	5.4988E-01	1.8218E+01	0.67	5
60	NET1	0	10	10	8	3.3385E+02	9.4119E+05	0.34	4
61	NGONE	4	71	71	11	7.1149E-02	-6.3597E-01	0.59	4
62	NGONE	3	86	86	15	1.6178E-01	-6.3328E-01	3.55	3
63	OET2	0	8	8	6	5.0	8.7160E-02	0.30	2
64	OET4	0	16	16	7	1.25	4.2954E-01	1.17	4
65	OET5	1	42	42	14	8.2815E-02	2.6500E-03	1.06	7
66	OET6	2	74	74	13	6.6623E-01	2.0689E-03	1.93	3
67	OPTCDEG2	12	524	536	69	8.3313E-02	2.3728E+02	49.79	4
68	OPTCDEG3	- I -	- I -	- I -	- I -	- I -	- I -	- I -	- I -
69	OPTCNTRL	0	6	6	4	5.0	550.0	0.04	4
70	OPTMASS	102	138	138	20	7.4250E-01	-1.2622E-01	132.18	4
71	OPTMASS	202	164	164	21	1.0658	-1.2327E-01	1267.37	3
72	ORTHREGB	21	149	149	14	3.9937E-02	0.0	0.24	2
73	PRODPL0	0	10	10	8	20.0	5.87901E+01	0.09	6
74	PRODPL1	0	9	9	7	20.0	3.5739E+01	0.09	5
75	READING1	0	19	19	8	1.1051	-1.6049E-01	0.96	2
76	READING3	1	243	245	29	2.9897E-01	-1.5262E-01	13.14	1
77	READING4	4	22	22	7	4.8833E-03	-2.8928E-01	7.49	2
78	READING5	0	7	7	5	5.0	0.0	2.46	4
79	READING6	8	324	341	54	1.7692E-02	-1.4466E+02	4.80	11
80	READING7	0	42	42	8	1.6270	-1.3307E+03	171.52	2

Table C.2 Performance details of medium and large scale problems (2)

No.	Problem	n_z	#f	#c	#g	ρ^*	f^*	CPU	$\mathcal{F}^*$
81	READING9	0	5	5	3	5.0	0.0	3.67	1
82	SEMICON1	0	77	533	75	3.3667E+01	0.0	15.21	1
83	SEMICON1	0	98	831	96	2.6567E+01	0.0	516.60	1
84	SEMICON2	0	32	178	31	2.0957E+01	0.0	5.62	1
85	SEMICON2	0	26	98	24	2.0216E+01	0.0	91.07	1
86	SMMPSF	0	20	24	18	4.7705E+03	1.0329E+09	50.22	9
87	SSEBNLN	0	18	18	16	4.0960E+04	1.6171E+07	1.72	0
88	SSNLBEAM	95	73	73	12	4.3487E-01	3.4248E+02	14.37	4
89	SVANBERG	23	154	154	35	2.3375E-03	1.6620E+02	5.57	11
90	SVANBERG	- H -	- H -	- H -	- H -	- H -	- H -	- H -	- H -
91	SWOPF	2	62	75	20	1.6811E-01	6.7860E-02	1.00	11
92	TFI1	2	23	24	7	6.2500E-01	5.3347	0.10	2
93	TFI1	2	23	24	7	6.2500E-01	5.3347	0.23	2
94	TRAINF	0	12	12	10	2.1698E+02	3.1031	32.81	3
95	TRAINH	14	403	403	52	6.8059E-01	1.2310E+01	237.43	11
96	ZAMB2-8	30	176	176	19	1.7235E-02	-1.5294E-01	2.82	1
97	ZAMB2-9	12	279	279	28	7.8798E-03	-3.5459E-01	3.95	2
98	ZAMB2-10	21	296	305	33	2.1256E-02	-1.5824	20.66	2
99	ZAMB2-11	59	209	209	24	1.5208E-02	-1.1161	16.76	1
100	ZIGZAG	0	43	48	11	2.5044	5.2305E+01	27.18	2

Table C.2 Performance details of medium and large scale problems (3)

5 Numerical Comparison with filterSQP and LANCELOT

In this section, we present a detailed comparison of the performance of SLPSQP and the default versions of filterSQP and LANCELOT. We will use the failure notation codes described in Section 4 if either SLPSQP, filterSQP or LANCELOT terminates before reaching a local solution.

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
1	AIRCRFTA	3	4	5	0.02	0.01	0.01
2	ALJAZZAF	43	15	24	0.51	0.02	0.04
3	ALLINITC	38	21	67	0.27	0.03	0.11
4	ALSOTAME	5	5	6	0.02	0.01	0.02
5	ARGAUSS	7	- I -	3	0.13	- I -	0.01
6	ARGTRIG	5	5	8	0.04	0.01	0.02
7	ARTIF	- R -	14	11	- R -	0.03	0.02
8	BT1	6	10	46	0.05	0.02	0.06
9	BT2	12	13	27	0.06	0.02	0.04
10	BT4	12	7	23	0.07	0.01	0.04
11	BT5	6	9	18	0.02	0.01	0.03
12	BT6	10	10	25	0.11	0.02	0.04
13	BT7	8	12	47	0.09	0.02	0.07
14	BT8	18	12	26	0.17	0.01	0.04
15	BT9	20	18	21	0.18	0.03	0.04
16	BT10	7	7	18	0.03	0.01	0.03
17	BT11	8	8	20	0.09	0.01	0.03
18	BT12	4	5	18	0.03	0.01	0.03
19	BT13	54	32	3361	1.14	0.05	2.76
20	BYRDSPHR	11	9	41	0.09	0.02	0.05
21	CANTILVR	13	13	23	0.09	0.03	0.04
22	CATENA	8	14	39	0.08	0.03	0.07
23	CATENARY	21	13	47	0.26	0.03	0.09
24	CB2	6	7	14	0.05	0.01	0.03
25	CB3	6	7	14	0.03	0.01	0.03
26	CHACONN1	6	5	12	0.05	0.01	0.02
27	CHACONN2	6	7	15	0.03	0.01	0.03
28	CLUSTER	9	9	11	0.05	0.01	0.01
29	CONCON	11	8	1179	0.09	0.02	2.67
30	CONGIGMZ	4	5	35	0.04	0.01	0.05
31	COOLHANS	12	11	- I -	0.09	0.02	- I -
32	CRESC4	17	29	5348	0.16	0.08	9.89
33	CSFI1	14	12	154	0.11	0.03	0.21
34	CSFI2	14	11	82	0.12	0.02	0.11
35	DEMYMALO	5	9	25	0.02	0.01	0.04
36	DIPIGRI	9	6	50	0.10	0.02	0.10
37	DIXCHLNG	9	11	33	0.07	0.02	0.06
38	EIGMINC	6	- H -	11	0.08	- H -	0.04
39	ERRINBAR	27	21	3536	0.31	0.01	9.21
40	FLETCHER	91	- I -	28	0.38	- I -	0.04

Table D.1 Performance of SLPSQP, filterSQP and LANCELOT on small scale problems (1)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
41	GIGOMEZ1	5	9	25	0.02	0.01	0.04
42	GOTTFR	6	7	26	0.06	0.01	0.03
43	HAIFAS	8	9	23	0.08	0.02	0.06
44	HALDMADS	7	19	54	0.09	0.23	0.29
45	HATFLDF	11	10	23	0.29	0.02	0.03
46	HATFLDG	9	15	15	0.14	0.11	0.02
47	HEART6	155	42	1533	4.29	0.12	1.73
48	HEART8	12	15	354	0.17	0.05	0.65
49	HIMMELBC	6	6	8	0.03	0.01	0.01
50	HIMMELBD	- I -	- I -	- I -	- I -	- I -	- I -
51	HIMMELBE	2	3	4	0.01	0.01	0.01
52	HIMMELBK	5	7	132	0.04	0.07	0.78
53	HIMMELP2	10	9	131	0.07	0.01	0.14
54	HIMMELP3	4	5	659	0.03	0.01	0.70
55	HIMMELP4	6	5	431	0.04	0.01	0.49
56	HIMMELP5	8	10	286	0.04	0.01	0.34
57	HIMMELP6	7	8	296	0.04	0.01	0.35
58	HS6	4	3	49	0.03	0.01	0.08
59	HS7	9	9	18	0.08	0.01	0.04
60	HS8	5	6	11	0.03	0.01	0.02
61	HS10	9	10	18	0.05	0.01	0.03
62	HS11	5	6	16	0.03	0.01	0.03
63	HS12	7	6	22	0.05	0.01	0.04
64	HS13	26	34	58	0.10	0.02	0.10
65	HS14	6	7	13	0.02	0.01	0.03
66	HS15	3	7	45	0.01	0.01	0.08
67	HS16	2	5	15	0.03	0.01	0.04
68	HS16R	19	5	26	0.32	0.01	0.05
69	HS17	6	7	18	0.05	0.01	0.04
70	HS18	7	7	80	0.06	0.01	0.12
71	HS19	6	7	34	0.04	0.01	0.06
72	HS20	10	5	22	0.06	0.01	0.05
73	HS22	7	3	10	0.04	0.01	0.03
74	HS23	6	7	42	0.04	0.01	0.07
75	HS26	22	18	34	0.09	0.01	0.06
76	HS27	25	5	16	0.15	0.01	0.04
77	HS27R	161	13	18	1.18	0.02	0.04
78	HS29	6	7	27	0.05	0.01	0.05
79	HS30	17	12	8	0.08	0.01	0.02
80	HS31	6	6	13	0.04	0.01	0.03

Table D.1 Performance of SLPSQP, filterSQP and LANCELOT on small scale problems (2)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
81	HS32	3	3	7	0.02	0.01	0.02
82	HS33	4	5	12	0.02	0.01	0.03
83	HS34	7	8	19	0.04	0.01	0.04
84	HS39	20	18	21	0.18	0.03	0.05
85	HS40	4	5	11	0.04	0.01	0.04
86	HS42	9	7	13	0.05	0.01	0.03
87	HS43	15	9	21	0.09	0.02	0.05
88	HS46	29	19	24	0.10	0.02	0.05
89	HS47	22	17	21	0.09	0.03	0.04
90	HS56	7	16	17	0.07	0.05	0.04
91	HS57	5	5	2	0.06	0.01	0.01
92	HS59	7	11	335	0.05	0.02	0.50
93	HS60	7	7	15	0.04	0.01	0.03
94	HS61	7	2	18	0.06	0.01	0.04
95	HS63	6	- I -	14	0.03	- I -	0.03
96	HS64	18	16	51	0.11	0.02	0.08
97	HS65	7	5	27	0.04	0.01	0.05
98	HS66	4	14	9	0.03	0.02	0.03
99	HS67	38	12	- I -	0.35	0.02	- I -
100	HS68	20	23	65	0.20	0.02	0.16
101	HS69	27	23	69	0.27	0.04	0.14
102	HS70	27	19	28	0.53	0.07	0.08
103	HS71	5	6	15	0.05	0.01	0.03
104	HS72	17	18	90	0.10	0.02	0.14
105	HS73	3	5	16	0.01	0.01	0.04
106	HS74	6	11	28	0.07	0.02	0.05
107	HS75	6	10	134	0.05	0.02	0.22
108	HS77	9	13	22	0.09	0.02	0.04
109	HS78	5	5	11	0.04	0.01	0.03
110	HS79	5	5	10	0.03	0.01	0.02
111	HS80	10	8	14	0.08	0.01	0.03
112	HS81	10	18	16	0.07	0.04	0.04
113	HS83	5	5	24	0.04	0.01	0.05
114	HS84	9	5	60	0.09	0.01	0.16
115	HS85	9	8	134	0.08	0.02	0.35
116	HS87	67	57	271	0.68	0.18	0.42
117	HS88	15	10	53	1.73	0.24	0.63
118	HS89	13	18	61	2.52	0.90	1.14
119	HS90	87	- I -	57	36.00	- I -	1.70
120	HS91	157	151	60	87.20	21.39	3.02

Table D.1 Performance of SLPSQP, filterSQP and LANCELOT on small scale problems (3)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
121	HS92	167	- I -	54	158.87	- I -	2.35
122	HS93	57	- I -	- I -	0.51	- I -	- I -
123	HS95	2	3	8	0.02	0.01	0.03
124	HS96	2	3	8	0.02	0.01	0.03
125	HS97	6	7	20	0.04	0.01	0.07
126	HS98	6	7	18	0.04	0.01	0.06
127	HS99	5	5	- I -	0.05	0.01	- I -
128	HS100	9	6	47	0.10	0.02	0.10
129	HS100LNP	11	9	31	0.12	0.02	0.05
130	HS100MOD	7	6	152	0.09	0.02	0.54
131	HS101	23	21	- M -	0.27	0.08	- M -
132	HS101R	- R -	42	- E -	- R -	0.16	- E -
133	HS102	41	20	- M -	0.50	0.07	- M -
134	HS103	24	17	6999	0.27	0.07	9.57
135	HS104	9	17	54	0.14	0.05	0.10
136	HS106	21	15	- M -	0.16	0.02	- M -
137	HS107	5	6	31	0.05	0.01	0.07
138	HS108	119	23	30	0.90	0.06	0.09
139	HS109	11	13	3531	0.09	0.03	10.54
140	HS111	13	30	46	0.14	0.13	0.11
141	HS111LNP	13	30	53	0.13	0.13	0.11
142	HS113	6	6	81	0.06	0.02	0.19
143	HS114	35	14	785	0.26	0.02	1.60
144	HS116	18	14	6235	0.20	0.04	23.79
145	HS117	17	6	64	0.23	0.02	0.24
146	HYPCIR	5	7	8	0.03	0.01	0.01
147	KIWCRESC	8	9	22	0.05	0.01	0.04
148	LEWISPOL	- R -	- I -	- I -	- R -	- I -	- I -
149	LOOTSMA	4	- I -	- I -	0.02	- I -	- I -
150	MADSEN	8	12	26	0.06	0.03	0.05
151	MAKELA1	6	11	16	0.02	0.02	0.03
152	MAKELA2	9	6	28	0.07	0.01	0.05
153	MAKELA3	23	20	75	0.13	0.09	0.24
154	MARATOS	4	9	8	0.04	0.01	0.02
155	MATRIX2	18	12	11	0.11	0.01	0.03
156	MCONCON	11	8	519	0.09	0.02	1.14
157	MIFFLIN1	7	8	12	0.05	0.02	0.03
158	MIFFLIN2	9	8	38	0.07	0.01	0.05
159	MINMAXBD	- I -	18	471	- I -	0.06	1.91
160	MINMAXRB	6	4	75	0.05	0.01	0.11

Table D.1 Performance of SLPSQP, filterSQP and LANCELOT on small scale problems (4)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
161	MISTAKE	68	19	29	0.61	0.06	0.10
162	MWRIGHT	12	8	20	0.13	0.02	0.04
163	NYSTROM5	- I -	- I -	- I -	- I -	- I -	- I -
164	PFIT1	10	12	351	0.09	0.02	0.45
165	PFIT2	7	8	220	0.06	0.02	0.26
166	PFIT3	7	7	130	0.08	0.01	0.15
167	PFIT4	8	- I -	317	0.09	- I -	0.37
168	POLAK1	67	8	33	0.44	0.01	0.05
169	POLAK2	98	16	25	1.97	0.06	0.05
170	POLAK3	- I -	20	119	- I -	0.20	0.43
171	POLAK4	4	5	16	0.03	0.01	0.04
172	POLAK5	16	53	12	0.16	0.06	0.03
173	POLAK6	297	16	245	2.06	0.04	0.42
174	POWELLBS	282	13	42	6.94	0.02	0.05
175	POWELLSQ	- R -	- I -	16	- R -	- I -	0.02
176	RK23	34	8	50	0.37	0.02	0.13
177	ROBOT	18	9	28	0.17	0.02	0.06
178	ROSENMMX	- R -	19	97	- R -	0.04	0.18
179	S316-322	6	- I -	24	0.03	- I -	0.04
180	SCHOLT1	5	5	14	0.05	0.01	0.02
181	SEMICON1	21	30	102	0.33	0.07	0.10
182	SEMICON2	17	21	37	0.22	0.07	0.04
183	SNAKE	3	3	- M -	0.02	0.01	- M -
184	SPIRAL	31	73	77	0.21	0.10	0.11
185	SREADIN3	5	5	18	0.03	0.01	0.03
186	SREADIN3	4	7	62	0.06	0.02	0.14
187	TENBARS1	24	23	462	0.33	0.17	1.80
188	TENBARS2	18	21	304	0.25	0.14	0.99
189	TENBARS3	26	22	221	0.31	0.15	0.69
190	TENBARS4	41	23	2491	0.54	0.16	6.47
191	TRIGGER	3	17	20	0.01	0.03	0.03
192	TRUSPYR1	33	14	835	0.29	0.05	1.81
193	TRUSPYR2	4	12	2835	0.03	0.05	9.65
194	TRY-B	9	8	14	0.04	0.01	0.03
195	TWOBARS	7	8	13	0.05	0.01	0.03
196	TWOPHAS	6	6	11	0.07	0.03	0.04
197	WOMFLET	19	7	38	0.09	0.01	0.07
198	ZECEVIC3	10	11	15	0.08	0.01	0.03
199	ZECEVIC4	5	7	15	0.03	0.01	0.03
200	ZY2	4	5	9	0.03	0.01	0.02

Table D.1 Performance of SLPSQP, filterSQP and LANCELOT on small scale problems (5)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
1	AIRPORT	13	16	48	1.57	0.89	0.54
2	ARGTRIG	4	4	12	0.36	1.03	1.49
3	ARTIF	- R -	11	25	- R -	50.71	0.80
4	BDVALUE	3	3	2	1.20	1.11	0.15
5	BRATU2D	4	4	4	0.11	0.07	0.04
6	BRATU2D	4	4	4	1.49	4.40	0.31
7	BRATU3D	4	4	5	0.13	0.03	0.03
8	BRATU3D	4	4	5	1.39	1.23	0.15
9	CAR2	77	11	65	130.58	2.38	3.40
10	CATENARY	411	185	107	47.55	16.06	0.75
11	CBRATU2D	4	4	4	1.57	3.99	0.23
12	CBRATU3D	4	4	5	2.66	1.62	0.16
13	CHANDHEQ	18	14	14	1.44	4.75	2.02
14	CHEMRCTA	3	5	- I -	1.47	5.26	- I -
15	CHEMRCTA	3	5	762	4.76	21.74	1258.70
16	CHEMRCTB	3	5	67	1.47	4.03	0.90
17	CHEMRCTB	2	5	108	3.43	16.29	2.80
18	CLNLBEAM	28	8	114	33.12	2.48	5.60
19	CORE1	16	16	829	0.87	0.21	4.48
20	CORE2	30	29	900	7.16	4.13	21.84
21	CORKSCRW	428	16	130	965.15	13.80	65.83
22	CORKSCRW	120	12	170	631.57	27.70	347.42
23	CRESC50	- R -	326	- M -	- R -	3.75	- M -
24	CRESC100	52	68	- M -	1.39	2.00	- M -
25	CRESC132	134	356	- M -	53.58	111.66	- M -
26	DISC2	81	- I -	63	1.08	- I -	0.25
27	DISCS	- I -	30	1269	- I -	1.20	32.98
28	DNIEPER	4	4	54	0.09	0.04	0.22
29	DRCAVTY1	10	10	40	6.20	1.25	1.33
30	DRCAVTY2	11	33	- I -	8.20	5.80	- I -
31	DRCAVTY3	8	- I -	- I -	2.57	- I -	- I -
32	DRUGDIS	19	9	299	81.04	9.54	10.68
33	DRUGDISE	- R -	- I -	- M -	- R -	- I -	- M -
34	EIGENA	3	2	16	0.23	0.05	0.12
35	EIGENA2	9	3	35	1.19	0.06	0.23
36	EIGENB	242	- I -	143	608.78	- I -	4.30
37	EIGENB2	123	26	40	19.63	10.76	0.48
38	EIGMINA	16	- I -	8	1.31	- I -	0.08
39	EIGMINB	7	9	468	0.25	0.23	3.96
40	ELATTAR	16	50	298	0.38	1.05	2.37

Table D.2 Performance of SLPSQP, filterSQP and LANCELOT on medium and large scale problems (1)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
41	GROUPING	1	2	- I -	0.06	0.04	- I -
42	HADAMARD	36	- I -	1311	94.75	- I -	1552.27
43	HAIFAM	49	24	5156	3.86	5.55	573.63
44	HANGING	106	23	85	191.77	28.65	2.40
45	HET-Z	3	2	64	0.05	0.01	0.51
46	HET-Z	3	2	145	0.20	0.03	5.14
47	HS99EXP	21	33	- M -	0.26	0.15	- M -
48	HYDCAR6	8	7	1323	0.23	0.07	21.37
49	HYDCAR20	20	12	- M -	4.19	0.76	- M -
50	LAKES	36	20	2937	3.10	0.87	11.02
51	LAUNCH	9	8	- M -	0.14	0.03	- M -
52	LEAKNET	7	9	482	0.47	0.54	36.22
53	MANNE	5	3	7	1.21	0.24	0.26
54	MANNE	- R -	3	14	- R -	2.43	1.85
55	METHANB8	3	3	231	0.05	0.02	3.62
56	METHANL8	6	5	668	0.11	0.05	9.49
57	MINPERM	16	4	18	1.47	0.10	0.12
58	MINPERM	19	4	219	56.50	4.97	26.69
59	MRIBASIS	25	5	- I -	0.67	0.04	- I -
60	NET1	8	12	80	0.34	0.22	0.36
61	NGONE	11	7	978	0.59	0.10	43.33
62	NGONE	15	7	1859	3.55	0.10	388.63
63	OET2	6	6	63	0.30	0.96	4.78
64	OET4	7	7	49	1.17	2.19	9.00
65	OET5	14	11	2000	1.06	3.34	102.62
66	OET6	13	32	149	1.93	20.35	23.55
67	OPTCDEG2	69	5	80	49.79	0.90	1.39
68	OPTCDEG3	- I -	5	46	- I -	0.92	0.94
69	OPTCNTRL	4	5	24	0.04	0.02	0.07
70	OPTMASS	20	7	- M -	132.18	4.94	- M -
71	OPTMASS	21	7	- M -	1267.37	18.91	- M -
72	ORTHREGB	14	2	92	0.24	0.01	0.23
73	PRODPL0	8	10	34	0.09	0.08	0.23
74	PRODPL1	7	8	62	0.09	0.07	0.39
75	READING1	8	8	670	0.96	0.46	13.05
76	READING3	29	7	2286	13.14	0.51	34.84
77	READING4	7	7	2011	7.49	5.27	686.60
78	READING5	5	6	237	2.46	2.50	27.64
79	READING6	54	10	- M -	4.80	0.35	- M -
80	READING7	8	17	- M -	171.52	143.66	- M -

Table D.2 Performance of SLPSQP, filterSQP and LANCELOT on medium and large scale problems (2)

No.	Problem	gradient evaluations			CPU		
		SLPSQP	filterSQP	LANCELOT	SLPSQP	filterSQP	LANCELOT
81	READING9	3	3	- M -	3.67	3.51	- M -
82	SEMICON1	75	71	750	15.21	3.33	2.13
83	SEMICON1	96	92	655	516.60	97.26	7.22
84	SEMICON2	31	28	108	5.62	1.61	0.33
85	SEMICON2	24	25	116	91.07	24.91	1.22
86	SMMPSF	18	17	6633	50.22	14.76	3167.13
87	SSEBNLN	16	12	67	1.72	0.98	0.91
88	SSNLBEAM	12	8	55	14.37	3.55	3.19
89	SVANBERG	35	9	65	5.57	2.12	1.78
90	SVANBERG	- H -	20	75	- H -	85.69	14.27
91	SWOPF	20	7	235	1.00	0.19	4.59
92	TFI1	7	13	41	0.10	0.05	0.24
93	TFI1	7	13	91	0.23	0.18	2.29
94	TRAINF	10	6	55	32.81	4.22	4.11
95	TRAINH	52	10	483	237.43	9.55	24.32
96	ZAMB2-8	19	5	54	2.82	0.23	0.64
97	ZAMB2-9	28	4	36	3.95	0.18	0.78
98	ZAMB2-10	33	4	40	20.66	0.66	2.30
99	ZAMB2-11	24	6	52	16.76	0.90	1.69
100	ZIGZAG	11	8	90	27.18	7.47	37.26

Table D.2 Performance of SLPSQP, filterSQP and LANCELOT on medium and large scale problems (3)

6 References

[1] Chin, C.M. and Fletcher, R. (2001), *Numerical performance of an SLP-filter algorithm that takes EQP steps*, Numerical Analysis Report NA/202, University of Dundee, Dundee, Scotland.