

Test results for selected optimization problems

1 Performance plots

1.1 For all problems

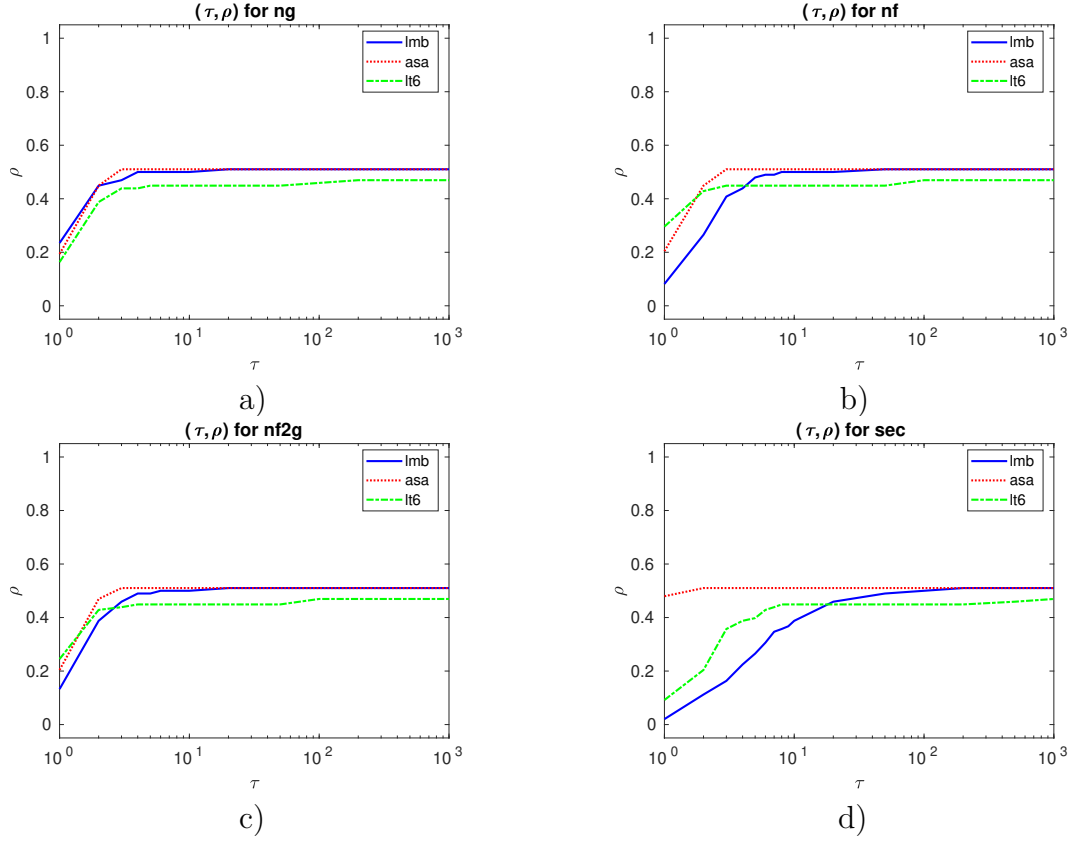


Figure 1: (a)-(e): Performance plots for $\text{ng}/(\text{best ng})$, $\text{nf}/(\text{best nf})$, $\text{nf2g}/(\text{best nf2g})$ and $\text{msec}/(\text{best msec})$, respectively. ρ designates the percentage of problems solved within a factor τ of the best solver. Problem solved by no solver are ignored.

1.2 For unconstrained problems

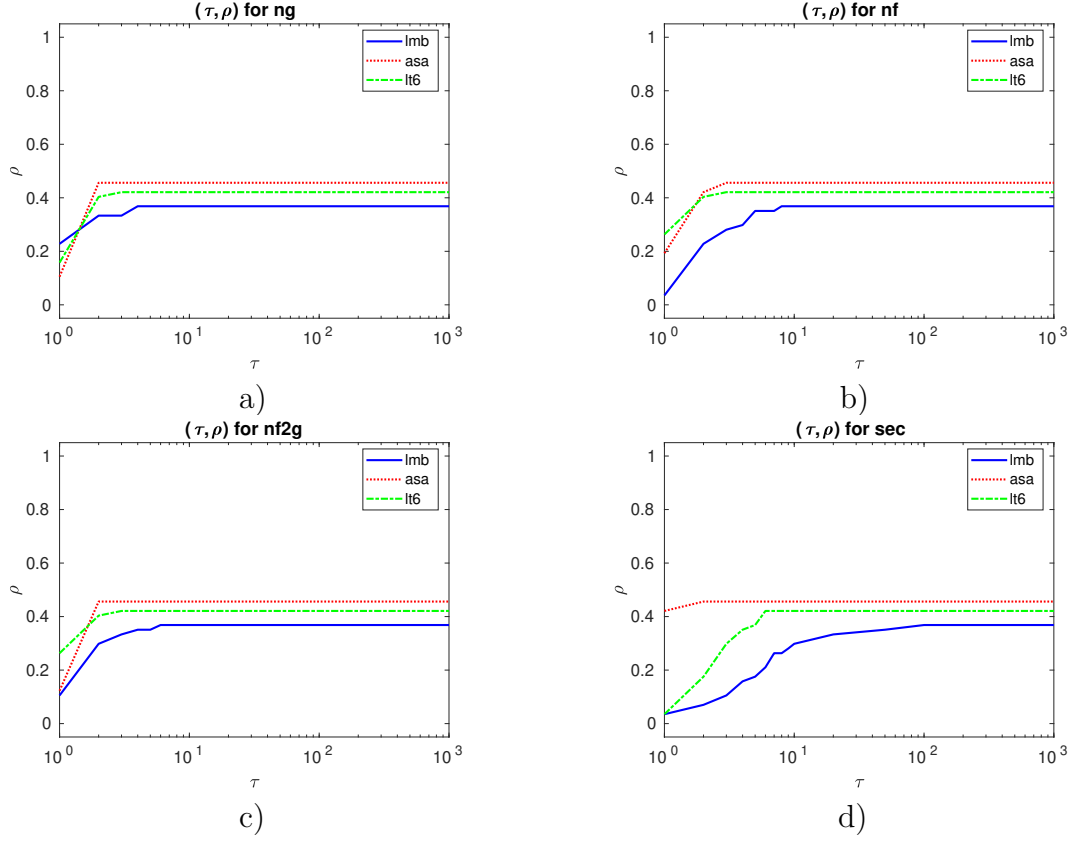


Figure 2: (a)-(e): Performance plots for $\text{ng}/(\text{best ng})$, $\text{nf}/(\text{best nf})$, $\text{nf2g}/(\text{best nf2g})$ and $\text{msec}/(\text{best msec})$, respectively. ρ designates the percentage of problems solved within a factor τ of the best solver. Problem solved by no solver are ignored.

1.3 For bound constrained problems

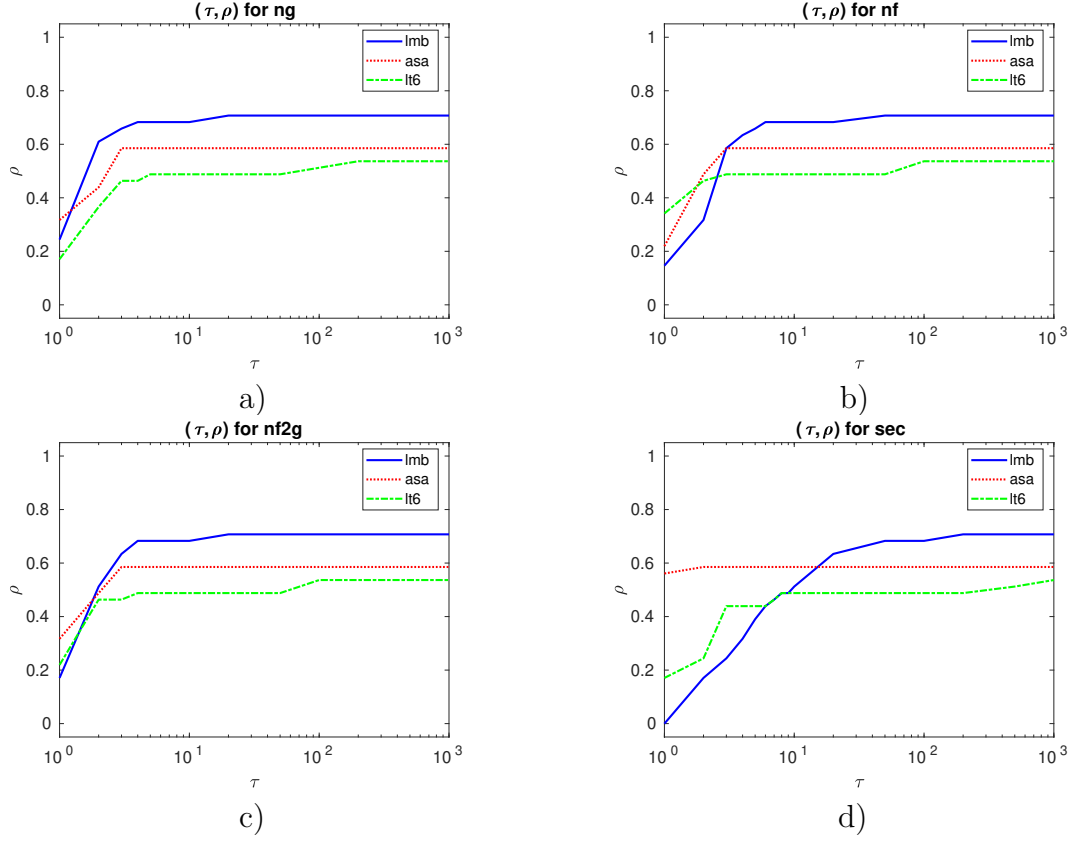


Figure 3: (a)-(e): Performance plots for $\text{ng}/(\text{best ng})$, $\text{nf}/(\text{best nf})$, $\text{nf2g}/(\text{best nf2g})$ and $\text{msec}/(\text{best msec})$, respectively. ρ designates the percentage of problems solved within a factor τ of the best solver. Problem solved by no solver are ignored.

1.4 Solvers compared

LMBOPT, ASACG and LMBFG-EIG-MS

1.5 Solver type, stopping tests and resdir

`nf`, `ng`, `sec`, `nact` and `resdir` denote the number of function evaluations, the number of gradients evaluations, the time in seconds, the number of active variables, and directory containing result files, respectively.

- `fist-order`
- `gradient accuracy`: $\|g(x_*)\|_\infty \leq 1e-06$
- `nf2g` $\leq 50 * n + 200000$
- `sec` ≤ 7200
- `resdir`: `resG1 - 6resN - 50 * n + 200000 - resS7200E`

1.6 Parameters used for problem selection

`name`, `dim` and `con` denote the name, the dimension, and the type of constraints of test problems, respectively.

- Selected range of `name`: A-S
- Selected range of `dim`: [1,100001]
- Selected kind of `con`: unconstrained and bound constrained
- Sorted by `dim`, `name` and `nact` (DNE)
- Sorted in increasing order

2 Summarizing tables

For a given collection S of solvers, the strength of a solver $so \in S$ – relative to an ideal solver that matches on each problem the best solver – is measured, for any given cost measure c_s by the number, q_{so} defined by

$$q_{so} := \begin{cases} \frac{\min_{s \in S} c_s}{c_{so}}, & \text{if } so \text{ solved the problem,} \\ 0, & \text{otherwise,} \end{cases}$$

called the **efficiency** of the solver so with respect to this cost measure. In the tables, efficiencies are given in percent. Larger efficiencies in the table imply a better average behavior; a zero efficiency indicates failure. All values are rounded (towards zero) to integers. Mean efficiencies are taken over the 57 problems tried by all solvers and solved by at least one of them, from a total of 98 problems. In the following tables, of test problems in which the solver needed the least number **nf2g** and !100 the total number of test problems where the solver was the only one needing this many **nf2g**. T_{mean} is defined by

$$T_{mean} := \frac{\sum \text{ solved}}{\# \text{ solved}} \quad (\text{in msec}),$$

regardless of the time for unsolved problems.

In tables not recording efficiencies, a sign

- n indicates that **nf2g** ≥ 5200050 was reached.
- t indicates that **sec** ≥ 7200 was reached.
- f indicates that the **algorithm** failed for other reasons.

In times, the (for some problems significant) setup time for CUTEST is not included. Although running times are reported the comparison of times is not very reliable for several reasons:

- (i) The times were obtained under different conditions (solver source code Fortran, C and Matlab).
- (ii) In unsuccessful runs, the actual running time depends a lot on when and why the solver was stopped.
- (iii) Function and gradient evaluation includes times for computing various statistics and the interface to CUTEST; cf. Figure 5.

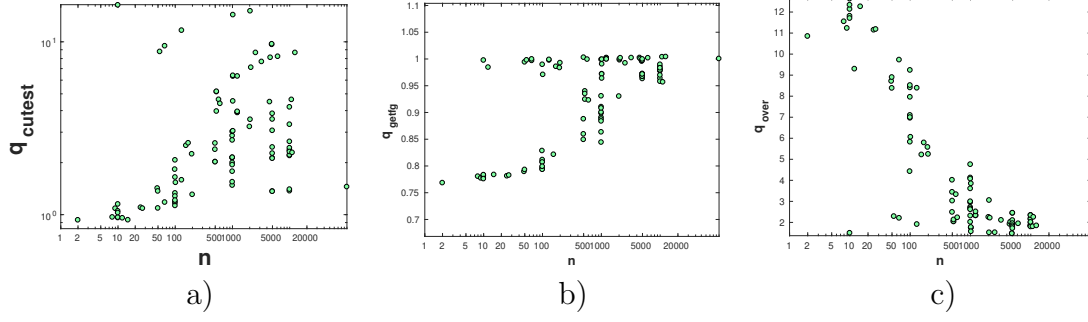


Figure 4: Comparison of $q_{cutest} := \frac{t_g(cutest)}{t_f(cutest)}$, $q_{getfg} := \frac{t_g(getfg)}{t_f(getfg)}$ and $q_{over} := \frac{t_{f2g}(getfg)}{t_{f2g}(cutest)}$ versus dimensions, respectively, where t_f and t_g are considered the time to compute f and g by `cutest` or `getfg` and $t_{f2g} := t_f + 2t_g$.

2.1 Summary for all problems

stopping test: $\ g\ _\infty \leq 1e-06$, $sec \leq 7200$, $nf2g \leq 50 * n + 200000$													
57 of 98 problems solved										mean efficiency in %			
dim $\in[1,100001]$							# of anomalies			for cost measure			
solver		solved	#100	!100	T_{mean}	#n	#t	#f	nf2g	ng	nf	msec	
LMBOPT	lmb	50	13	13	224127	44	4	0	36	41	28	15	
ASACG	asa	50	20	20	104569	31	0	17	42	42	39	50	
LMBFG-EIG-MS	lt6	46	24	24	157855	41	1	10	39	35	41	25	

2.2 Classified by constraints

stopping test: $\ g\ _\infty \leq 1e-06$, $sec \leq 7200$, $nf2g \leq 50 * n + 200000$													
28 of 57 problems without bounds solved										mean efficiency in %			
dim $\in[1,100001]$							# of anomalies			for cost measure			
solver		solved	#100	!100	T_{mean}	#n	#t	#f	nf2g	ng	nf	msec	
ASACG	asa	26	7	7	170316	22	0	9	38	35	35	44	
LMBFG-EIG-MS	lt6	24	15	15	247233	26	1	6	38	35	39	21	
LMBOPT	lmb	21	6	6	247561	33	3	0	27	31	20	11	

stopping test: $\ g\ _\infty \leq 1e-06$, $sec \leq 7200$, $nf2g \leq 50 * n + 200000$													
29 of 41 problems with bounds solved										mean efficiency in %			
dim $\in[1,100001]$							# of anomalies			for cost measure			
solver		solved	#100	!100	T_{mean}	#n	#t	#f	nf2g	ng	nf	msec	
LMBOPT	lmb	29	7	7	207158	11	1	0	48	54	38	21	
ASACG	asa	24	13	13	33344	9	0	8	47	46	45	58	
LMBFG-EIG-MS	lt6	22	9	9	60353	15	0	4	40	36	45	31	

2.3 Classified by time

stopping test: $\ g\ _{\infty} \leq 1e-06$, $sec \leq 7200$, $nf2g \leq 50 * n + 200000$												
23 of 23 problems solved									mean efficiency in %			
dim $\in[1,100001]$, best time ≤ 1 sec						# of anomalies			for cost measure			
solver		solved	#100	!100	T_{mean}	#n	#t	#f	nf2g	ng	nf	msec
LMBOPT	lmb	22	3	3	1099	1	0	0	62	73	49	27
ASACG	asa	21	10	10	236	0	0	2	73	76	66	88
LMBFG-EIG-MS	lt6	19	10	10	3218	1	0	3	64	59	67	45

stopping test: $\ g\ _{\infty} \leq 1e-06$, $sec \leq 7200$, $nf2g \leq 50 * n + 200000$												
21 of 21 problems solved									mean efficiency in %			
dim $\in[1,100001]$, best time > 1 sec						# of anomalies			for cost measure			
solver		solved	#100	!100	T_{mean}	#n	#t	#f	nf2g	ng	nf	msec
LMBOPT	lmb	20	7	7	32757	1	0	0	75	82	58	30
ASACG	asa	16	6	6	3399	0	0	5	64	64	58	76
LMBFG-EIG-MS	lt6	16	8	8	13523	5	0	0	65	56	71	37

2.4 Failure analysis

41 test problems unsolved by all solvers used for dim $\in [1,100001]$			
OSCIPATH:10	SCOSINE:10	SCOND1LS	ANTWERP
NONMSQRT:49	SBRYBND:50	HYDC20LS	FLETCHBV:100
NONMSQRT:100	SBRYBND:100	SCOSINE:100	SCURLY10:100
SCOND1LS:102	PENALTY2:500	SBRYBND:500	SCOND1LS:502
NONMSQRT:529	FLETCHBV:1000	PENALTY2:1000	SBRYBND
SCOSINE	SCURLY10	SSCOSINE	SCOND1LS:1002
NONMSQRT:1024	DRCV1LQ:1225	DRCV2LQ:1225	DRCV3LQ:1225
DRCV3LQ:4489	FLETCHBV3:5000	FLETCHBV:5000	SBRYBND:5000
SCOSINE:5000	SCOND1LS:5002	BRATU1D:5003	FLETCHBV3:10000
FLETCHBV:10000	SCOSINE:10000	SCURLY10:10000	DRCV3LQ:10816
SSCOSINE:100000			

solver	dim $\in[1,100001]$	problem	error message	# same error
lmb	10	OSCIGRAD	nf2gmax reached	44
	10000	FLETCHBV3	secmax reached	4
asa	10	OSCIPATH	nf2gmax reached	31
Continued on next page				

	10	STRATEC	cg: too many secant iterates	11
	10	SCOSINE	cg: Wolfe conditions never satisfied	3
	27	ANTWERP	cg: function nan or inf	1
	54	RAYBENDS	unrecognized exit flag	15
	100	FLETCHBV	cg: no cost or gradient improvement	1
	6218	GRIDGENA	cbb: line search failed	1
lt6	8	PALMER5E	nf2gmax reached	41
	50	HS110	line search failed	6
	500	PENALTY2	TR radius too small	4
	100000	SSCOSINE	secmax reached	1

kind of anomalies	44 test problems unsolved by LMBOPT for $\dim \in [1, 100001]$		
n	OSCIGRAD:10 SCURLY10:10 NONMSQRT:49 FLETCHBV:100 SCOSINE:100 PENALTY2:500 NONMSQRT:529 SBRYBND SSCOSINE DRCAV1LQ:1225 DRCAV3LQ:4489 SBRYBND:5000 SCOND1LS:5002 CURLY20:10000 SCURLY10:10000	OSCIPATH:10 SCOND1LS SBRYBND:50 NONMSQRT:100 SCURLY10:100 SBRYBND:500 FLETCHBV:1000 SCOSINE SCOND1LS:1002 DRCAV2LQ:1225 FLETCHBV3:5000 SCOSINE:5000 BRATU1D:5003 CURLY30:10000 SSCOSINE:10000	SCOSINE:10 ANTWERP HYDC20LS SBRYBND:100 SCOND1LS:102 SCOND1LS:502 PENALTY2:1000 SCURLY10 NONMSQRT:1024 DRCAV3LQ:1225 FLETCHBV:5000 SSCOSINE:5000 CURLY10:10000 SCOSINE:10000
t	FLETCHBV3:10000 SSCOSINE:100000	FLETCHBV:10000	DRCAV3LQ:10816

kind of anomalies	44 test problems unsolved by ASACG for $\dim \in [1,100001]$		
n	OSCIPATH:10 HYDC20LS SCURLY10:100 SCOND1LS:502 SBRYBND SSCOSINE DRCV1LQ:1225 DRCV3LQ:4489 SBRYBND:5000 FLETCHBV3:10000 DRCV3LQ:10816	NONMSQRT:49 NONMSQRT:100 SCOND1LS:102 NONMSQRT:529 SCOSINE SCOND1LS:1002 DRCV2LQ:1225 FLETCHBV3:5000 SCOSINE:5000 FLETCHBV:10000	SBRYBND:50 SBRYBND:100 SBRYBND:500 FLETCHBV:1000 SCURLY10 NONMSQRT:1024 DRCV3LQ:1225 FLETCHBV:5000 SCOND1LS:5002 SCURLY10:10000
f	STRATEC ANTWERP RAYBENDS:66 SSCOSINE:100 GRIDGENA:170 GRIDGENA RAYBENDL:1026 LINVERSE:1999 GRIDGENA:2114 BRATU1D:5003 GRIDGENA:12482	SCOSINE:10 RAYBENDS FLETCHBV:100 RAYBENDL:130 DRCV1LQ LINVERSE:999 RAYBENDS:1026 RAYBENDL:2050 GRIDGENA:3242 GRIDGENA:6218 SSCOSINE:100000	SCOND1LS RAYBENDL:66 SCOSINE:100 RAYBENDS:130 PENALTY2:500 PENALTY2:1000 GRIDGENA:1226 RAYBENDS:2050 GRIDGENA:4610 SCOSINE:10000

kind of anomalies	44 test problems unsolved by LMBFG-EIG-MS for $\dim \in [1,100001]$		
n	PALMER5E OSCIPATH:10 SCOND1LS SBRYBND:50 NONMSQRT:100 SSCOSINE:100 SCOND1LS:502	PALMER5B SBRYBND:10 ANTWERP HYDC20LS SBRYBND:100 SCOND1LS:102 NONMSQRT:529	OSCIGRAD:10 SCOSINE:10 NONMSQRT:49 FLETCHBV:100 SCURLY10:100 SBRYBND:500 QR3DLS:610
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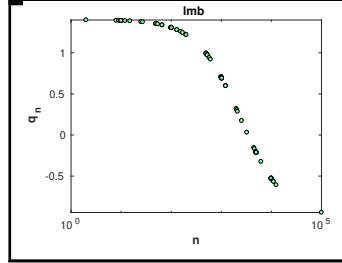
	CHENHARK	FLETCHBV:1000	SBRYBND
	SCURLY10	SCOND1LS:1002	NONMSQRT:1024
	DRCV1LQ:1225	DRCV2LQ:1225	DRCV3LQ:1225
	DRCV3LQ:4489	FLETGBV3:5000	SBRYBND:5000
	SCOSINE:5000	SCOND1LS:5002	FLETGBV3:10000
	FLETCHBV:10000	SCOSINE:10000	SCURLY10:10000
	SSCOSINE:10000	DRCV3LQ:10816	
t	SSCOSINE:100000		
f	HS110:50	HS110:100	SCOSINE:100
	HS110:200	PENALTY2:500	PENALTY2:1000
	SCOSINE	SSCOSINE	FLETCHBV:5000
	BRATU1D:5003		

2.5 Timing analysis

$x_i \geq 0$, for $i = 1, 2, 3, 4$, are obtained by at least squares fit of

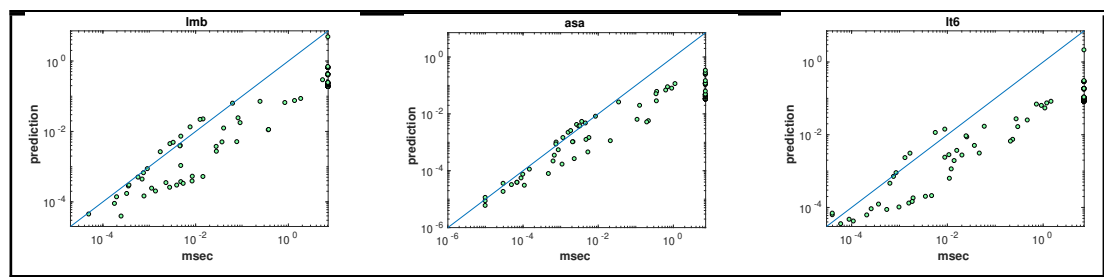
$$msec = (x_1 + x_2 * dim) * nf + (x_3 + x_4 * dim) * ng.$$

Comparison of $q_n := \frac{x_3 + dim * x_4}{x_1 + dim * x_2}$ versus dimension:



solver	x_1	x_2	x_3	x_4
lmb	0	0	1.8499e-06	0
asa	9.5068e-08	3.8994e-11	2.2823e-07	0
lt6	0	0	8.168e-07	0

Comparison of predicted time versus actual time used:



2.6 nf2g efficiency for accuracy 1e-06

problem	dim	nact	nf2g best	nf2g efficiency for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
BROWNBS	2	—	56	54	100	82
PALMER5E	8	—	20472	40	100	—
PALMER5B	9	—	13653	44	100	—
OSCIGRAD:10	10	—	24037	—	100	—
STRATEC	10	—	1195	100	—	50
SBRYBND:10	10	—	1052	93	100	—
SCURLY10:10	10	—	80	—	100	54
OSCIGRAD:15	15	—	172	58	52	100
OSCIGRAD:25	25	—	231	37	77	100
HS110:50	50	50	4	44	100	—
RAYBENDS	54	4	1864	100	37	56
RAYBENDL:66	66	4	9416	99	100	83
RAYBENDS:66	66	4	1428	100	44	55
HS110:100	100	100	4	33	100	—
OSCIGRAD:100	100	—	255	38	71	100
SSCOSINE:100	100	—	5714	100	—	—
RAYBENDL:130	130	4	38669	83	100	92
RAYBENDS:130	130	4	945	100	47	56
QR3DLS	155	—	15636	100	47	30

problem	dim	nact	nf2g best	nf2g efficiency for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:170	170	94	76	78	73	100
DRCV1LQ	196	96	7901	76	100	93
HS110:200	200	200	4	33	100	—
SPMSRTLS:499	499	—	339	92	71	100
MSQRTALS:529	529	—	8531	100	95	83
MSQRTBLS:529	529	—	8270	100	93	94
GRIDGENA	578	188	155	81	—	100
QR3DLS:610	610	—	134750	100	61	—
LINVERSE:999	999	500	149	6	100	1
CURLY20	1000	—	31723	20	82	100
CHENHARK	1000	300	27174	100	60	—
SPMSRTLS:1000	1000	—	453	87	76	100
MSQRTALS:1024	1024	—	10086	94	87	100
MSQRTBLS:1024	1024	—	7074	88	71	100
RAYBENDL:1026	1026	4	30021	58	100	89
RAYBENDS:1026	1026	4	3611	62	100	86
GRIDGENA:1226	1226	282	227	71	74	100

problem	dim	nact	nf2g best	nf2g efficiency for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
LINVERSE:1999	1999	1000	217	26	100	1
RAYBENDL:2050	2050	4	37693	100	64	61
RAYBENDS:2050	2050	4	7964	73	100	70
GRIDGENA:2114	2114	376	321	74	—	100
EIGENALS:2550	2550	—	42493	26	100	70
GRIDGENA:3242	3242	470	375	66	75	100
GRIDGENA:4610	4610	564	480	74	—	100
MSQRTALS:4900	4900	—	23686	100	80	87
MSQRTBLS:4900	4900	—	24153	100	91	99
SPMSRTLS:4999	4999	—	666	83	80	100
SPARSINE:5000	5000	—	99172	70	76	100
SSCOSINE:5000	5000	—	253105	—	75	100
GRIDGENA:6218	6218	658	530	73	—	100
CURLY10:10000	10000	—	219578	—	100	95
CURLY20:10000	10000	—	270744	—	89	100
CURLY30:10000	10000	—	300755	—	83	100
SPARSINE:10000	10000	—	92209	50	62	100
SPMSRTLS:10000	10000	—	742	89	85	100
SSCOSINE:10000	10000	—	432983	—	100	—
ODNAMUR	11130	5618	199625	28	62	100

problem	dim	nact	nf2g best	nf2g efficiency for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:12482	12482	940	773	68	—	100

2.7 Time in milliseconds, 1e-06

problem	dim	nact	nf2g best	time in milliseconds for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
BROWNBS	2	—	56	250	10	40
PALMER5E	8	—	20472	14610	1610	—
PALMER5B	9	—	13653	7700	1170	—
OSCIGRAD:10	10	—	24037	—	1880	—
STRATEC	10	—	1195	8580	—	11160
SBRYBND:10	10	—	1052	580	150	—
SCURLY10:10	10	—	80	—	10	60
OSCIGRAD:15	15	—	172	200	30	90
OSCIGRAD:25	25	—	231	360	50	40
HS110:50	50	50	4	20	1	—
RAYBENDS	54	4	1864	920	880	860
RAYBENDL:66	66	4	9416	2830	770	1680
RAYBENDS:66	66	4	1428	760	690	760
HS110:100	100	100	4	20	10	—
OSCIGRAD:100	100	—	255	370	70	40
SSCOSINE:100	100	—	5714	1750	—	—
RAYBENDL:130	130	4	38669	12640	2700	5670
RAYBENDS:130	130	4	945	710	640	640
QR3DLS	155	—	15636	4860	3100	8960

problem	dim	nact	nf2g best	time in milliseconds for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:170	170	94	76	50	10	30
DRCV1LQ	196	96	7901	3320	760	1320
HS110:200	200	200	4	20	1	—
SPMSRTLS:499	499	—	339	330	90	260
MSQRTALS:529	529	—	8531	4720	2170	10910
MSQRTBLS:529	529	—	8270	4650	2110	8960
GRIDGENA	578	188	155	180	—	110
QR3DLS:610	610	—	134750	63450	35490	—
LINVERSE:999	999	500	149	4840	30	15930
CURLY20	1000	—	31723	248140	4630	25780
CHENHARK	1000	300	27174	40750	3700	—
SPMSRTLS:1000	1000	—	453	1140	100	370
MSQRTALS:1024	1024	—	10086	37490	5750	20420
MSQRTBLS:1024	1024	—	7074	28100	4810	14020
RAYBENDL:1026	1026	4	30021	83280	3300	24880
RAYBENDS:1026	1026	4	3611	28370	5400	12200
GRIDGENA:1226	1226	282	227	780	70	210

problem	dim	nact	nf2g best	time in milliseconds for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
LINVERSE:1999	1999	1000	217	2320	110	37170
RAYBENDL:2050	2050	4	37693	92160	8600	59710
RAYBENDS:2050	2050	4	7964	78210	21350	47010
GRIDGENA:2114	2114	376	321	1380	—	550
EIGENALS:2550	2550	—	42493	1376570	109830	299140
GRIDGENA:3242	3242	470	375	2790	480	990
GRIDGENA:4610	4610	564	480	3960	—	1590
MSQRTALS:4900	4900	—	23686	373300	219590	234110
MSQRTBLS:4900	4900	—	24153	379710	198410	210260
SPMSRTLS:4999	4999	—	666	4850	1110	1950
SPARSINE:5000	5000	—	99172	849930	128370	276170
SSCOSINE:5000	5000	—	253105	—	364970	732800
GRIDGENA:6218	6218	658	530	5460	—	1870
CURLY10:10000	10000	—	219578	—	350310	930120
CURLY20:10000	10000	—	270744	—	634820	1204240
CURLY30:10000	10000	—	300755	—	917030	1477010
SPARSINE:10000	10000	—	92209	1869270	358320	472110
SPMSRTLS:10000	10000	—	742	8500	2340	3530
SSCOSINE:10000	10000	—	432983	—	1121250	—
ODNAMUR	11130	5618	199625	5536620	709380	1100870

problem	dim	nact	nf2g best	time in milliseconds for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:12482	12482	940	773	14560	—	4750

2.8 Effort nf2g for accuracy 1e-06

problem	dim	nact	nf2g best	nf2g for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
BROWNBS	2	—	56	104	56	68
PALMER5E	8	—	20472	51686	20472	—
PALMER5B	9	—	13653	30736	13653	—
OSCIGRAD:10	10	—	24037	—	24037	—
STRATEC	10	—	1195	1195	—	2393
SBRYBND:10	10	—	1052	1127	1052	—
SCURLY10:10	10	—	80	—	80	148
OSCIGRAD:15	15	—	172	299	333	172
OSCIGRAD:25	25	—	231	629	300	231
HS110:50	50	50	4	9	4	—
RAYBENDS	54	4	1864	1864	5062	3322
RAYBENDL:66	66	4	9416	9552	9416	11340
RAYBENDS:66	66	4	1428	1428	3256	2610
HS110:100	100	100	4	12	4	—
OSCIGRAD:100	100	—	255	677	358	255
SSCOSINE:100	100	—	5714	5714	—	—
RAYBENDL:130	130	4	38669	46703	38669	42147
RAYBENDS:130	130	4	945	945	2009	1695
QR3DLS	155	—	15636	15636	33313	52821

problem	dim	nact	nf2g best	nf2g for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:170	170	94	76	97	104	76
DRCV1LQ	196	96	7901	10437	7901	8537
HS110:200	200	200	4	12	4	—
SPMSRTLS:499	499	—	339	369	478	339
MSQRTALS:529	529	—	8531	8531	8966	10302
MSQRTBLS:529	529	—	8270	8270	8889	8754
GRIDGENA	578	188	155	192	—	155
QR3DLS:610	610	—	134750	134750	221230	—
LINVERSE:999	999	500	149	2596	149	13991
CURLY20	1000	—	31723	161098	38730	31723
CHENHARK	1000	300	27174	27174	44995	—
SPMSRTLS:1000	1000	—	453	523	597	453
MSQRTALS:1024	1024	—	10086	10720	11582	10086
MSQRTBLS:1024	1024	—	7074	8003	9991	7074
RAYBENDL:1026	1026	4	30021	51740	30021	33824
RAYBENDS:1026	1026	4	3611	5821	3611	4184
GRIDGENA:1226	1226	282	227	318	306	227

problem	dim	nact	nf2g best	nf2g for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
LINVERSE:1999	1999	1000	217	824	217	19697
RAYBENDL:2050	2050	4	37693	37693	58622	62022
RAYBENDS:2050	2050	4	7964	10893	7964	11358
GRIDGENA:2114	2114	376	321	436	—	321
EIGENALS:2550	2550	—	42493	160396	42493	60919
GRIDGENA:3242	3242	470	375	567	502	375
GRIDGENA:4610	4610	564	480	650	—	480
MSQRTALS:4900	4900	—	23686	23686	29562	27233
MSQRTBLS:4900	4900	—	24153	24153	26465	24330
SPMSRTLS:4999	4999	—	666	803	832	666
SPARSINE:5000	5000	—	99172	140708	130681	99172
SSCOSINE:5000	5000	—	253105	—	336144	253105
GRIDGENA:6218	6218	658	530	723	—	530
CURLY10:10000	10000	—	219578	—	219578	231537
CURLY20:10000	10000	—	270744	—	305170	270744
CURLY30:10000	10000	—	300755	—	361427	300755
SPARSINE:10000	10000	—	92209	183318	148814	92209
SPMSRTLS:10000	10000	—	742	835	874	742
SSCOSINE:10000	10000	—	432983	—	432983	—
ODNAMUR	11130	5618	199625	712198	323500	199625

problem	dim	nact	nf2g best	nf2g for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:12482	12482	940	773	1129	—	773

2.9 Number of gradients evaluations, accuracy 1e-06

problem	dim	nact	nf2g best	ng for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
BROWNBS	2	—	56	21	15	16
PALMER5E	8	—	20472	12032	6687	—
PALMER5B	9	—	13653	7151	3684	—
OSCIGRAD:10	10	—	24037	—	6456	—
STRATEC	10	—	1195	284	—	764
SBRYBND:10	10	—	1052	268	291	—
SCURLY10:10	10	—	80	—	26	43
OSCIGRAD:15	15	—	172	74	95	57
OSCIGRAD:25	25	—	231	150	83	76
HS110:50	50	50	4	2	1	—
RAYBENDS	54	4	1864	466	1272	1089
RAYBENDL:66	66	4	9416	2388	2372	3743
RAYBENDS:66	66	4	1428	357	816	860
HS110:100	100	100	4	3	1	—
OSCIGRAD:100	100	—	255	160	96	84
SSCOSINE:100	100	—	5714	1410	—	—
RAYBENDL:130	130	4	38669	11675	9807	13901
RAYBENDS:130	130	4	945	236	514	558
QR3DLS	155	—	15636	3900	8487	17157

problem	dim	nact	nf2g best	ng for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:170	170	94	76	24	29	25
DRCV1LQ	196	96	7901	2609	1976	2827
HS110:200	200	200	4	2	1	—
SPMSRTLS:499	499	—	339	92	121	111
MSQRTALS:529	529	—	8531	2131	2244	3399
MSQRTBLS:529	529	—	8270	2067	2224	2895
GRIDGENA	578	188	155	48	—	51
QR3DLS:610	610	—	134750	33669	67946	—
LINVERSE:999	999	500	149	574	42	4465
CURLY20	1000	—	31723	38037	12889	10531
CHENHARK	1000	300	27174	6631	17993	—
SPMSRTLS:1000	1000	—	453	130	151	149
MSQRTALS:1024	1024	—	10086	2679	2897	3328
MSQRTBLS:1024	1024	—	7074	1999	2774	2341
RAYBENDL:1026	1026	4	30021	12935	7869	11217
RAYBENDS:1026	1026	4	3611	1455	935	1386
GRIDGENA:1226	1226	282	227	78	91	75

problem	dim	nact	nf2g best	ng for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
LINVERSE:1999	1999	1000	217	187	62	6117
RAYBENDL:2050	2050	4	37693	9422	17810	20558
RAYBENDS:2050	2050	4	7964	2721	2297	3766
GRIDGENA:2114	2114	376	321	108	—	106
EIGENALS:2550	2550	—	42493	40085	12294	20108
GRIDGENA:3242	3242	470	375	138	154	124
GRIDGENA:4610	4610	564	480	159	—	159
MSQRTALS:4900	4900	—	23686	5921	8224	8986
MSQRTBLS:4900	4900	—	24153	6038	7194	8031
SPMSRTLS:4999	4999	—	666	199	210	220
SPARSINE:5000	5000	—	99172	35174	52100	32965
SSCOSINE:5000	5000	—	253105	—	105651	83737
GRIDGENA:6218	6218	658	530	178	—	176
CURLY10:10000	10000	—	219578	—	76143	77073
CURLY20:10000	10000	—	270744	—	108475	90088
CURLY30:10000	10000	—	300755	—	130508	100075
SPARSINE:10000	10000	—	92209	45828	59346	30612
SPMSRTLS:10000	10000	—	742	208	220	244
SSCOSINE:10000	10000	—	432983	—	129864	—
ODNAMUR	11130	5618	199625	156191	100258	65610

problem	dim	nact	nf2g best	ng for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:12482	12482	940	773	279	—	255

2.10 Number of functions evaluations, accuracy 1e-06

problem	dim	nact	nf2g best	nf for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
BROWNBS	2	—	56	62	26	36
PALMER5E	8	—	20472	27622	7098	—
PALMER5B	9	—	13653	16434	6285	—
OSCIGRAD:10	10	—	24037	—	11125	—
STRATEC	10	—	1195	627	—	865
SBRYBND:10	10	—	1052	591	470	—
SCURLY10:10	10	—	80	—	28	62
OSCIGRAD:15	15	—	172	151	143	58
OSCIGRAD:25	25	—	231	329	134	79
HS110:50	50	50	4	5	2	—
RAYBENDS	54	4	1864	932	2518	1144
RAYBENDL:66	66	4	9416	4776	4672	3854
RAYBENDS:66	66	4	1428	714	1624	890
HS110:100	100	100	4	6	2	—
OSCIGRAD:100	100	—	255	357	166	87
SSCOSINE:100	100	—	5714	2894	—	—
RAYBENDL:130	130	4	38669	23353	19055	14345
RAYBENDS:130	130	4	945	473	981	579
QR3DLS	155	—	15636	7836	16339	18507

problem	dim	nact	nf2g best	nf for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:170	170	94	76	49	46	26
DRCV1LQ	196	96	7901	5219	3949	2883
HS110:200	200	200	4	8	2	—
SPMSRTLS:499	499	—	339	185	236	117
MSQRTALS:529	529	—	8531	4269	4478	3504
MSQRTBLS:529	529	—	8270	4136	4441	2964
GRIDGENA	578	188	155	96	—	53
QR3DLS:610	610	—	134750	67412	85338	—
LINVERSE:999	999	500	149	1448	65	5061
CURLY20	1000	—	31723	85024	12952	10661
CHENHARK	1000	300	27174	13912	9009	—
SPMSRTLS:1000	1000	—	453	263	295	155
MSQRTALS:1024	1024	—	10086	5362	5788	3430
MSQRTBLS:1024	1024	—	7074	4005	4443	2392
RAYBENDL:1026	1026	4	30021	25870	14283	11390
RAYBENDS:1026	1026	4	3611	2911	1741	1412
GRIDGENA:1226	1226	282	227	162	124	77

problem	dim	nact	nf2g best	nf for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
LINVERSE:1999	1999	1000	217	450	93	7463
RAYBENDL:2050	2050	4	37693	18849	23002	20906
RAYBENDS:2050	2050	4	7964	5451	3370	3826
GRIDGENA:2114	2114	376	321	220	—	109
EIGENALS:2550	2550	—	42493	80226	17905	20703
GRIDGENA:3242	3242	470	375	291	194	127
GRIDGENA:4610	4610	564	480	332	—	162
MSQRTALS:4900	4900	—	23686	11844	13114	9261
MSQRTBLS:4900	4900	—	24153	12077	12077	8268
SPMSRTLS:4999	4999	—	666	405	412	226
SPARSINE:5000	5000	—	99172	70360	26481	33242
SSCOSINE:5000	5000	—	253105	—	124842	85631
GRIDGENA:6218	6218	658	530	367	—	178
CURLY10:10000	10000	—	219578	—	67292	77391
CURLY20:10000	10000	—	270744	—	88220	90568
CURLY30:10000	10000	—	300755	—	100411	100605
SPARSINE:10000	10000	—	92209	91662	30122	30985
SPMSRTLS:10000	10000	—	742	419	434	254
SSCOSINE:10000	10000	—	432983	—	173255	—
ODNAMUR	11130	5618	199625	399816	122984	68405

problem	dim	nact	nf2g best	nf for solver		
				LMBOPT	ASACG	LMBFG-EIG-MS
GRIDGENA:12482	12482	940	773	571	—	263