Comparison tables: BBOB 2009 noisy testbed in 5-D

The BBOBies

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Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2009, see `http://coco.gforge.inria.fr/doku.php?id=bbob-2009`. More than 30 algorithms have been tested on 24 benchmark functions in dimensions between 2 and 40. A description of the used objective functions can be found in [13, 8]. The experimental set-up is described in [12].

The performance measure provided in the following tables is the expected number of objective function evaluations to reach a given target function value (ERT, expected running time), divided by the respective value for the best algorithm. Consequently, the best (smallest) value is 1 and the value 1 appears in each column at least once. See [12] for details on how ERT is obtained. All numbers are computed with no more than two digits of precision.

Table 1: 05-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\mathrm{best}}$ on f_{101}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

101 Sphere moderate Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	0.2	2.2	7.39	8.83	9.8	12.4	13.1	13.8	15	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1.3**	12	42	76	120	130	150	180	220	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	5.2	5.6	9.7	13	14	16	18	21	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**2.6**	**2.9**	**1.5**	**1.6**	**1.7**	**1.5**	**1.5**	**1.5**	**1.5**	avg NEWUOA [23]
BayEDAcG	**1**	**1.7**	6.2	23	64	89	120	120	120	130	BayEDAcG [9]
BFGS	**1**	91	740	*70e-1/4e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1.1**	3.2	3.1	4.6	6	6.1	7.2	8	9.6	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1.3**	**2.9**	**2**	**2.6**	3.2	3.3	3.9	4.3	5.4	(1+1)-CMA-ES [2]
DASA	**1**	11	19	15	18	21	23	26	27	32	DASA [18]
DEPSO	**1**	**1.3**	7.5	11	16	21	23	28	31	38	DEPSO [11]
EDA-PSO	**1**	**1.3**	4.1	8	100	270	320	400	490	630	EDA-PSO [5]
full NEWUOA	**1**	3.4	3.3	**1.3**	**1.3**	**1.2**	**1**	**1**	**1**	**1**	full NEWUOA [23]
GLOBAL	**1**	**1.3**	11	8.1	7.7	7.4	6.1	6.2	6.2	6.4	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.3**	3.3	3.4	5.1	6.8	7.1	8.5	9.6	12	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.3**	6.9	7.5	13	15	15	17	20	23	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	70	170	920	*82e-5/1e4*	.	.	MCS (Neum) [16]
NEWUOA	**1**	3.6	**2.5**	**1.6**	**2.1**	**2.5**	**2.6**	**2.9**	**3**	3.1	NEWUOA [23]
(1+1)-ES	**1**	**2.5**	**2.9**	**1.8**	**2.4**	3	3.1	3.4	3.8	4.6	(1+1)-ES [1]
PSO	**1**	**1.3**	4.2	7.8	17	29	36	46	57	76	PSO [6]
PSO_Bounds	**1**	**1.2**	4.9	13	53	110	140	190	220	330	PSO_Bounds [7]
Monte Carlo	**1**	**1.7**	9.8	460	1.9e5	*10e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.9**	4.2	**3**	4.1	4.9	5.2	5.8	6.4	7.7	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.1**	**2**	**1.1**	**1**	**1**	**1.1**	**1.3**	**1.5**	**1.8**	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	7.4	6.8	7.5	8.2	7.9	8.6	9.1	11	VNS (Garcia) [10]

Table 2: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{102}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

102 Sphere moderate unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	2.21	7.07	10	13.2	14.4	15.5	17.1	19.8	ERT$_{\text{best}}$/D
ALPS	**1**	**1.2**	6.6	51	73	92	110	130	150	170	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	5.7	6	7.6	8.7	10	12	13	15	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1.3**	**2.7**	**1.4**	**1.5**	**1.4**	**1.5**	**1.5**	**1.6**	**1.5**	avg NEWUOA [23]
BayEDAcG	**1**	**1.3**	12	23	59	110	120	120	120	130	BayEDAcG [9]
BFGS	**1**	29	890	*59e-1/3e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**2.7**	3	4	4.3	5.1	6	6.3	7.2	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1.1**	**2.5**	**2.3**	**2.5**	**2.6**	3.1	3.5	3.7	4.2	(1+1)-CMA-ES [2]
DASA	**1**	61	41	23	22	23	26	30	32	38	DASA [18]
DEPSO	**1**	**1.4**	7.8	9	13	15	18	22	24	28	DEPSO [11]
EDA-PSO	**1**	**1.5**	4.9	8.3	96	180	270	330	390	470	EDA-PSO [5]
full NEWUOA	**1**	3.8	3.2	**1.4**	**1.2**	**1**	**1**	**1**	**1**	**1**	full NEWUOA [23]
GLOBAL	**1**	**1.5**	8.2	8.9	6.7	5.5	5.3	5.2	5	5.1	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.3**	**2.8**	**2.8**	4.2	4.9	6.1	7	7.5	8.5	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.3**	6.9	8.2	12	12	13	16	16	17	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	120	500	9700	*58e-4/1e4*	.	.	MCS (Neum) [16]
NEWUOA	**1**	3.9	6.3	6	7	15	20	27	33	41	NEWUOA [23]
(1+1)-ES	**1**	3.9	**2.9**	**2.1**	**2.2**	**2.3**	**2.7**	3.1	3.3	3.9	(1+1)-ES [1]
PSO	**1**	**1.3**	4	10	15	23	31	39	45	55	PSO [6]
PSO_Bounds	**1**	**1.6**	4.1	15	47	82	120	150	180	250	PSO_Bounds [7]
Monte Carlo	**1**	**1.1**	4.2	430	1.7e5	*11e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.1**	3.1	**2.9**	3.2	3.6	4.1	4.8	5	5.7	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.1**	**2**	**1.2**	**1**	**1**	**1.3**	**1.5**	**1.7**	**2.1**	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	7.1	6.6	6	6.2	6.6	7.2	7.5	8.1	VNS (Garcia) [10]

Table 3: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{103}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

103 Sphere moderate Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	2.2	5.52	5.96	5.96	6.25	6.4	6.99	23	ERT$_{\text{best}}$/D
ALPS	**1**	**1.5**	8.1	61	120	190	240	8300	*31e-6/1e6*	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.8**	5	7	12	17	22	170	350	410	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**2.5**	**2.5**	**1.6**	3.6	5.4	13	26	42	34	avg NEWUOA [23]
BayEDAcG	**1**	**1.3**	12	60	130	360	360	460	440	140	BayEDAcG [9]
BFGS	**1**	**2.6**	7.5	4.2	3.9	**3.9**	**3.7**	**3.6**	**3.3**	**1**	BFGS [22]
BIPOP-CMA-ES	**1**	**1.7**	3.5	4.7	7.4	10	13	15	17	6.9	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1.2**	**2.4**	**2.5**	4.2	6.9	29	110	360	1100	(1+1)-CMA-ES [2]
DASA	**1**	7.7	16	19	68	430	2700	1.3e5	1.7e6	*59e-6/9e5*	DASA [18]
DEPSO	**1**	**1.5**	12	14	25	40	70	180	410	*33e-7/2e3*	DEPSO [11]
EDA-PSO	**1**	**1.1**	4.2	11	120	470	1100	2.2e5	*38e-5/1e5*	.	EDA-PSO [5]
full NEWUOA	**1**	5.1	**2.8**	**1.6**	**1.8**	**1.8**	**2.6**	**2.6**	**2.4**	**4.8**	full NEWUOA [23]
GLOBAL	**1**	**1.3**	6.4	11	11	12	16	34	38	33	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.3**	**2.7**	4.5	7.5	12	55	140	380	700	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.5**	6	11	19	26	33	44	49	22	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	100	100	130	130	130	230	MCS (Neum) [16]
NEWUOA	**1**	3.5	**2.4**	**1.9**	5.7	9.4	60	85	180	140	NEWUOA [23]
(1+1)-ES	**1**	3	**3**	**2.4**	**3.6**	5.2	27	120	530	3700	(1+1)-ES [1]
PSO	**1**	**1.3**	3.5	8.3	26	100	1400	4.7e4	*33e-5/1e5*	.	PSO [6]
PSO_Bounds	**1**	**1.1**	4.2	18	86	2800	1.5e4	*87e-5/1e5*	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.1**	6.2	830	2.9e5	*10e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.5**	3.4	3.9	5.9	8.1	9.9	13	14	5.7	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.5**	**1.6**	**1**	**1**	**1**	**1**	**1**	**1**	**3.5**	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	7.5	8.6	11	13	16	19	20	7.9	VNS (Garcia) [10]

Table 4: 05-D, running time excess ERT/ERT_{best} on f_{104}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

104 Rosenbrock moderate Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT_{best}/D	3.84	11.2	34.6	155	257	315	354	385	408	457	ERT_{best}/D
ALPS	6.3	22	18	18	29	37	40	45	48	71	ALPS [15]
AMaLGaM IDEA	3.3	3.1	**2.1**	3.6	**2.8**	**2.6**	**2.5**	**2.4**	**2.4**	**2.3**	AMaLGaM IDEA [4]
avg NEWUOA	**1.3**	**2.8**	**1**	5	7.6	14	23	21	20	24	avg NEWUOA [23]
BayEDAcG	6.8	8.8	21	180	*33e-1/2e3*	.	.	.	.	.	BayEDAcG [9]
BFGS	350	*61e+1/2e3*	.	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**2.4**	**2.6**	**1.4**	**1.9**	**2**	**2**	**2**	**2**	**1.9**	**1.8**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1.7**	**2.2**	**1**	3.7	4.1	4.8	4.4	4.1	3.9	3.5	(1+1)-CMA-ES [2]
DASA	23	27	11	35	46	88	190	870	3200	1.5e4	DASA [18]
DEPSO	7.6	7.9	4.4	10	55	*53e-2/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	4.2	5.6	32	39	53	72	92	110	130	160	EDA-PSO [5]
full NEWUOA	**1.8**	3.2	**1.1**	**1.8**	**1.7**	**1.4**	**1.4**	**1.3**	**1.3**	**1.2**	full NEWUOA [23]
GLOBAL	6.4	5.3	**2.2**	**2**	3.4	3.7	3.3	3	**2.9**	**2.6**	GLOBAL [20]
iAMaLGaM IDEA	**2.1**	**2.3**	**1.5**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	iAMaLGaM IDEA [4]
MA-LS-Chain	5	5.6	3.6	7.1	5.1	4.7	4.4	4.2	4.1	3.8	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1.5**	920	*23e-1/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1.1**	**2.8**	**1.2**	3.4	6	14	24	100	*14e-4/5e3*	.	NEWUOA [23]
(1+1)-ES	**2.2**	**2.6**	**1.1**	4.3	12	25	63	230	980	9900	(1+1)-ES [1]
PSO	3.3	5.1	5.7	170	190	1500	*22e-3/1e5*	.	.	.	PSO [6]
PSO_Bounds	3.4	10	17	2600	5400	*15e-1/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	10	150	9e3	*64e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**2.4**	15	5.4	14	8.7	7.7	7	6.4	6.1	5.5	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2.4**	**2.1**	**1.3**	91	*28e-1/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	7.3	4.1	**2**	7.4	5.6	5.9	11	11	10	9	VNS (Garcia) [10]

Table 5: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{105}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

105 Rosenbrock moderate unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	3.28	12.4	33.3	287	1030	2e3	2080	2130	2160	2240	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	13	26	22	7	5.1	4.6	6	7.8	9.4	17	ALPS [15]
AMaLGaM IDEA	4	3.2	**2.4**	11	3.3	**1.8**	**1.8**	**1.7**	**1.7**	**1.7**	AMaLGaM IDEA [4]
avg NEWUOA	**1.4**	3.7	**1.7**	**2.4**	**1.9**	4.4	14	47	46	*45e-4/7e3*	avg NEWUOA [23]
BayEDAcG	5.8	10	28	*37e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	410	*82e+1/1e3*	.	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**3**	**2.4**	**1.7**	3.7	**1.7**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**2.3**	3.2	**1.5**	4.4	4.1	11	34	33	*16e-3/1e4*	.	(1+1)-CMA-ES [2]
DASA	29	36	17	16	12	22	100	240	700	6600	DASA [18]
DEPSO	6	6.2	5.3	16	14	*17e-1/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	3.8	6.1	40	20	13	12	18	24	31	*38e-8/1e5*	EDA-PSO [5]
full NEWUOA	**2.2**	4.2	**1.7**	**1.6**	4.5	9.3	31	61	*22e-3/9e3*	.	full NEWUOA [23]
GLOBAL	10	4.8	**2.2**	**1**	**1**	*75e-2/200*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**2.3**	**1.9**	**1.5**	8	**2.8**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	iAMaLGaM IDEA [4]
MA-LS-Chain	6	5	3.9	58	44	33	32	31	31	30	MA-LS-Chain [19]
MCS (Neum)	**1.1**	**1**	**1.6**	520	*32e-1/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**2.8**	**1.7**	**2.7**	3.3	5	*38e-3/5e3*	.	.	.	NEWUOA [23]
(1+1)-ES	**2.6**	**1.8**	**1**	**1.7**	**1.3**	4.3	16	50	170	6500	(1+1)-ES [1]
PSO	6.3	6.5	6.4	64	630	700	*70e-2/1e5*	.	.	.	PSO [6]
PSO_Bounds	3.4	6.8	15	1400	1400	700	*15e-1/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	8.7	160	1.4e4	*69e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	3	**1.8**	**1.3**	18	5	**2.6**	**2.6**	**2.5**	**2.5**	**2.4**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2.5**	4	**2.5**	49	14	*32e-1/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	8.4	68	27	42	31	24	26	25	25	24	VNS (Garcia) [10]

Table 6: 05-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\mathrm{best}}$ on f_{106}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

106 Rosenbrock moderate Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	3.56	10.1	15.5	106	210	354	533	556	577	617	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	10	26	49	20	37	110	410	*28e-5/1e6*	.	.	ALPS [15]
AMaLGaM IDEA	4	3.7	5.3	8.8	5.3	11	12	22	28	78	AMaLGaM IDEA [4]
avg NEWUOA	**1.9**	**1.2**	**1**	**1.5**	**2.4**	5.8	9.1	30	200	*21e-5/8e3*	avg NEWUOA [23]
BayEDAcG	4.8	11	53	270	140	*34e-1/2e3*	.	.	.	.	BayEDAcG [9]
BFGS	13	22	23	54	100	210	*67e-2/5e3*	.	.	.	BFGS [22]
BIPOP-CMA-ES	**2.9**	3.4	3.9	4.3	3.2	**2.3**	**1.6**	**1.7**	**1.7**	**1.7**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**2.3**	**2.7**	**2.5**	4	8.6	22	85	*54e-4/1e4*	.	.	(1+1)-CMA-ES [2]
DASA	17	26	23	31	48	320	1.3e4	*18e-4/1e6*	.	.	DASA [18]
DEPSO	6.1	7.2	11	35	140	*14e-1/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	3.8	7.6	89	58	6700	*20e-2/1e5*	.	.	.	.	EDA-PSO [5]
full NEWUOA	**2**	**1.4**	**1.2**	**1**	**1**	**1.7**	3.1	7.8	18	31	full NEWUOA [23]
GLOBAL	6.7	6.5	4.6	**1.3**	**1**	**1**	**1.4**	**2.7**	13	*11e-4/400*	GLOBAL [20]
iAMaLGaM IDEA	**2.4**	**2.3**	3	9.1	10	11	13	23	43	140	iAMaLGaM IDEA [4]
MA-LS-Chain	4.8	5.9	7.5	3.9	3.7	3.1	**2.8**	3.1	**3.5**	**4.5**	MA-LS-Chain [19]
MCS (Neum)	**1**	**1.4**	3.2	1300	*27e-1/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1.1**	**1**	**1.1**	**2.2**	5	27	59	*79e-4/7e3*	.	.	NEWUOA [23]
(1+1)-ES	**2.2**	**1.7**	**1.7**	6.5	17	38	260	2900	*10e-5/1e6*	.	(1+1)-ES [1]
PSO	4	6.2	13	360	3100	*79e-2/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	6.1	17	35	1900	3100	*14e-1/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	8	150	1.6e4	*62e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	3.1	**2.2**	**2.7**	**3**	**2.1**	**1.4**	**1**	**1**	**1**	**1**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2.9**	**2.6**	3	18	19	40	*18e-1/1e3*	.	.	.	SNOBFIT [17]
VNS (Garcia)	8.2	5.4	5	11	6.3	7.7	5.2	5	4.9	4.6	VNS (Garcia) [10]

Table 7: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{107}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

107 Sphere Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	7.97	45.5	90.6	138	188	234	275	370	ERT$_{\text{best}}$/D
ALPS	**1**	**1.4**	**2.7**	10	12	13	13	14	14	15	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	**1.7**	5.8	18	12	11	13	11	11	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**2.7**	68	320	*14e-1/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.4**	**2.5**	6.7	7.1	7.7	7.7	10	27	*29e-6/2e3*	BayEDAcG [9]
BFGS	**1**	12	150	*61e-1/2e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1.4**	**1.7**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	21	42	210	*19e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	110	600	3e3	3.6e4	*29e-2/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1.6**	3.3	**3.1**	**3.6**	**3.9**	**3.7**	**4.3**	**5.2**	**5.4**	DEPSO [11]
EDA-PSO	**1**	**1.3**	**1.6**	11	20	27	29	30	32	34	EDA-PSO [5]
full NEWUOA	**1**	6.1	85	250	1400	*96e-2/8e3*	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.1**	**2.6**	12	*77e-2/700*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.9**	33	31	28	26	22	22	22	30	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.5**	**1.9**	5	6.8	6.9	7	**6.5**	**6**	**5**	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	3.9	4.2	72	*81e-3/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**2.7**	60	190	*17e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	3.3	31	59	650	6800	7.5e4	*50e-4/1e6*	.	.	(1+1)-ES [1]
PSO	**1**	**1.3**	**1.3**	**2.6**	**4.3**	**4.8**	**6.6**	9.1	9.8	10	PSO [6]
PSO_Bounds	**1**	**1.7**	**1**	5.4	32	67	100	89	83	70	PSO_Bounds [7]
Monte Carlo	**1**	**1.9**	4.5	48	1.3e4	*96e-3/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.2**	5.6	10	5.6	11	11	10	9.5	8.9	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.2**	**1.5**	13	36	53	*14e-2/1e3*	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	**2.7**	8	6.3	6.7	10	9.5	8.7	9.1	VNS (Garcia) [10]

Table 8: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{108}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

108 Sphere unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	17.3	1030	2890	4930	6190	8240	11700	16100	ERT$_{\text{best}}$/D
ALPS	**1**	**1.1**	**1.1**	**1**	**4.5**	**13**	**35**	180	1200	*98e-6/1e6*	ALPS [15]
AMaLGaM IDEA	**1**	**1.7**	75	12	17	20	**31**	**73**	**170**	**450**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	3	150	44	*27e-1/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.5**	18	*34e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	6.6	56	*84e-1/900*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	6.1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	33	24	15	*12e-1/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	240	260	460	*65e-2/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1**	**1.1**	**2.3**	9.3	*19e-1/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1.1**	4.9	11	41	300	*38e-3/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	89	78	*43e-1/9e3*	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.2**	**1.4**	3.6	*16e-1/900*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.6**	130	16	26	33	42	**61**	**81**	**210**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.7**	**1.3**	**1**	**3.9**	17	*29e-3/2e4*	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	15	6.1	51	*54e-2/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	48	77	64	*41e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	96	24	30	830	*12e-2/1e6*	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.4**	420	48	71	290	*54e-2/1e5*	.	.	.	PSO [6]
PSO_Bounds	**1**	**1.1**	410	86	96	290	230	*69e-2/1e5*	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.6**	**1**	4.1	480	*98e-3/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	100	6.7	7.6	**9.7**	*20e-2/1e4*	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.5**	3.5	6.5	5	*25e-1/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	61	11	44	450	4900	*39e-4/7e6*	.	.	VNS (Garcia) [10]

Table 9: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{109}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

109 Sphere Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	2.2	11.4	43.3	75	114	139	175	189	ERT$_{\text{best}}$/D
ALPS	**1**	**1.7**	5.2	28	42	3500	*43e-4/1e6*	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	3.7	3.4	19	20	36	40	71	170	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1.5**	4.3	3.6	26	47	*67e-4/6e3*	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.3**	8.6	41	24	24	22	20	17	19	BayEDAcG [9]
BFGS	**1**	18	39	13	3.4	**2.5**	**1.7**	**1.4**	**1.1**	**1**	BFGS [22]
BIPOP-CMA-ES	**1**	**1.6**	3.5	**2.2**	**1.1**	**1**	**1.1**	**1.1**	**1.1**	**1.5**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**2.1**	**2.5**	6.5	25	430	*20e-3/1e4*	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	4.7	320	2800	4.3e4	*15e-2/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1.4**	9.9	6.7	5.7	25	130	*51e-4/2e3*	.	.	DEPSO [11]
EDA-PSO	**1**	**1.5**	3.1	4.9	550	2e4	*30e-3/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	5.6	5.6	5	6.1	13	21	28	22	20	full NEWUOA [23]
GLOBAL	**1**	**1.3**	8.1	7	5.1	53	35	*49e-3/200*	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.4**	**2.6**	**2.3**	16	33	65	110	180	410	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.5**	5.8	5.9	5.1	12	20	47	72	430	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	12	22	32	120	300	370	340	MCS (Neum) [16]
NEWUOA	**1**	**1.7**	4.8	13	83	880	*41e-3/5e3*	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**2.5**	**2.7**	5.4	13	290	1.4e4	*13e-4/1e6*	.	.	(1+1)-ES [1]
PSO	**1**	**1.1**	4.1	130	1400	2e4	*46e-3/1e5*	.	.	.	PSO [6]
PSO_Bounds	**1**	**1.4**	3.6	640	2700	1.9e4	*13e-2/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.5**	11	320	2.2e4	*88e-3/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.7**	4.1	**2.3**	**1**	**1.1**	**1**	**1**	**1**	**1.2**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.5**	**2.4**	**1**	3.6	16	35	100	*10e-3/1e3*	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.6**	7.3	4.2	**1.6**	**1.5**	**1.3**	**1.4**	**1.3**	**1.8**	VNS (Garcia) [10]

Table 10: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{110}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

110 Rosenbrock Gauss

Δftarget ERT$_{\text{best}}$/D	1e+03 9.69	1e+02 48	1e+01 190	1e+00 6720	1e-01 24000	1e-02 1.12e5	1e-03 1.19e5	1e-04 1.19e5	1e-05 1.21e5	1e-07 1.22e5	Δftarget ERT$_{\text{best}}$/D
ALPS	4.5	6.2	4.4	**1**	**1**	**1**	**1.8**	**3.6**	**8.3**	38	ALPS [15]
AMaLGaM IDEA	**1.5**	**1**	4.7	74	83	18	**17**	**17**	**17**	**17**	AMaLGaM IDEA [4]
avg NEWUOA	20	34	240	*27e+0/6e3*	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**2.4**	**2.7**	**1.9**	*30e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	92	*73e+1/1e3*	.	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1.3**	**2.2**	**1**	4.8	**3.7**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	8	13	20	22	*52e-1/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	550	1e3	3600	*92e-1/7e5*	.	.	.	.	.	.	DASA [18]
DEPSO	**2.7**	**2.2**	**1.7**	**1**	*20e-1/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1.7**	4.9	11	220	*23e-1/1e5*	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	28	37	140	*15e+0/8e3*	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**2.7**	5	9	*32e+0/400*	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.1**	5.6	4.7	9.1	46	12	17	20	20	**25**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.8**	**2.2**	**1.9**	11	15	*15e-1/2e4*	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**2.1**	3.1	8.3	*54e-1/1e4*	.	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	17	23	120	10	*13e+0/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	13	16	21	33	*29e-2/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**2.5**	**2.4**	30	*17e-1/1e5*	.	.	.	.	.	PSO [6]
PSO_Bounds	**1.7**	4	42	60	59	13	*20e-1/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	3.1	31	1900	*63e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.2**	3.9	**2.9**	6.1	*21e-1/1e4*	.	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1.7**	7.2	8.5	**2.1**	*15e+0/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	3.4	**1.5**	3.4	8.8	**11**	**9.7**	28	50	160	*77e-6/7e6*	VNS (Garcia) [10]

Table 11: 05-D, running time excess ERT/ERT_{best} on f_{111}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

111 Rosenbrock unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT_{best}/D	13.9	214	1370	1.22e5	1.77e6	4.59e6	4.61e6	4.62e6	6.2e6	6.26e6	ERT_{best}/D
ALPS	**2.9**	**2.5**	**1.5**	**1**	**2.5**	*34e-2/1e6*	.	.	.	.	ALPS [15]
AMaLGaM IDEA	**1.3**	3	6.6	4.5	*53e-2/1e6*	.	.	.	.	.	AMaLGaM IDEA [4]
avg NEWUOA	140	60	*20e+1/6e3*	.	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.8**	4.1	*67e+0/2e3*	.	.	.	.	.	.	.	BayEDAcG [9]
BFGS	61	38	*10e+2/600*	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	4.7	**1.5**	**1**	**2.5**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	19	20	110	*44e+0/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1e3	680	3500	*21e+0/7e5*	.	.	.	.	.	.	DASA [18]
DEPSO	3.2	**2.9**	22	*31e+0/2e3*	.	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**3**	3.5	5.4	*24e-1/1e5*	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	150	100	*16e+1/8e3*	.	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	3.5	7.8	*12e+1/900*	.	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.3**	8.3	7.2	3.7	**2.5**	**3.2**	***26e-2/1e6***	.	.	.	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.5**	**1**	**1.4**	**1.4**	*19e-1/2e4*	.	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	7.1	5	22	*12e+0/1e4*	.	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	78	97	*36e+1/5e3*	.	.	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	19	28	130	*45e-1/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
PSO	**2.6**	35	38	3.4	*31e-1/1e5*	.	.	.	.	.	PSO [6]
PSO_Bounds	**2.5**	73	110	12	*14e+0/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**2.3**	14	210	*66e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	85	13	4.9	*46e-1/1e4*	.	.	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2.1**	8.7	*10e+1/1e3*	.	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	83	21	11	3.6	5.4	**20**	***11e-2/6e6***	.	.	.	VNS (Garcia) [10]

Table 12: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{112}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

112 Rosenbrock Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	3.33	9.63	21.3	337	684	832	900	963	1030	1120	ERT$_{\text{best}}$/D
ALPS	9	29	33	19	330	*50e-3/1e6*	.	.	.	.	ALPS [15]
AMaLGaM IDEA	3.9	3.6	3.5	30	190	270	260	330	380	350	AMaLGaM IDEA [4]
avg NEWUOA	**1.5**	**2.5**	3.1	4.9	23	110	*14e-2/7e3*	.	.	.	avg NEWUOA [23]
BayEDAcG	4.9	8.2	46	*35e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	130	390	920	*92e+0/3e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**2.5**	6.3	4	**1**	**1.2**	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**2.1**	3.9	3.2	6.8	100	*29e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	22	41	79	340	5600	*18e-2/9e5*	.	.	.	.	DASA [18]
DEPSO	6.8	6.1	7.4	40	44	*25e-1/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	5.2	12	62	*18e-1/1e5*	.	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	**2**	**1.8**	**1**	6.3	18	150	*93e-3/9e3*	.	.	.	full NEWUOA [23]
GLOBAL	6.1	7	4.1	**1.7**	7	*16e-1/300*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**2.4**	**2.5**	**2.3**	91	340	420	430	460	440	570	iAMaLGaM IDEA [4]
MA-LS-Chain	6.4	6.3	5.4	15	110	420	390	*28e-2/2e4*	.	.	MA-LS-Chain [19]
MCS (Neum)	**1.1**	**1.4**	41	*37e-1/1e4*	.	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	**1.9**	7.7	110	*44e-2/5e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**2.6**	**2.7**	**2.4**	4.5	65	2400	*14e-3/1e6*	.	.	.	(1+1)-ES [1]
PSO	4.1	5.8	8.4	1900	2e3	*15e-1/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	5.4	11	29	1200	*29e-1/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	12	160	1.9e4	*71e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**2.6**	**2.2**	**2**	**2.5**	**1.7**	**1.5**	**1.5**	**1.5**	**1.4**	**1.4**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2.4**	**1.9**	**2.7**	*34e-1/1e3*	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	9.1	7.2	4.5	**1.1**	**1**	**1**	**1**	**1**	**1**	**1**	VNS (Garcia) [10]

Table 13: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{113}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

113 Step-ellipsoid Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	1.92	26.5	377	1620	4800	4830	4830	4830	4880	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1.3**	**1.2**	5.9	**2.6**	**2**	**1.1**	**1.5**	**1.5**	**1.5**	**1.6**	ALPS [15]
AMaLGaM IDEA	**1.3**	**1**	**1.2**	4.6	**2.4**	**1**	**1**	**1**	**1**	**1**	AMaLGaM IDEA [4]
avg NEWUOA	**1.7**	23	14	31	55	*13e-1/6e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.8**	**1.3**	3.4	**2.6**	3.2	6.1	6.1	6.1	6.1	6	BayEDAcG [9]
BFGS	14	100	180	*24e+0/2e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**2.1**	**2.4**	**1.5**	**1.3**	**1.7**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1.1**	25	8.6	40	92	*96e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	6.3	220	540	2700	*11e-1/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1.3**	3.5	3.1	**1**	**1**	**1.1**	**1.4**	**1.4**	**1.4**	**1.4**	DEPSO [11]
EDA-PSO	**1.3**	**2.8**	4.5	3.4	17	11	15	15	15	15	EDA-PSO [5]
full NEWUOA	**2.3**	28	19	57	*14e-1/8e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1.9**	**1.1**	4.1	9.9	7.3	*18e-1/900*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.9**	**1.8**	**1**	4.7	4.2	**1.6**	**1.8**	**1.8**	**1.8**	**1.8**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.5**	**2.1**	**2.2**	**1.5**	4.9	3.4	5.3	5.3	5.3	5.3	MA-LS-Chain [19]
MCS (Neum)	**1**	**2**	**1.5**	9	92	*48e-2/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**2.1**	15	13	44	*18e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**2.2**	12	13	32	230	1400	*23e-3/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1.5**	**1.8**	470	180	420	*54e-2/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1.5**	**1.8**	**2.5**	21	56	33	43	43	43	43	PSO_Bounds [7]
Monte Carlo	**1.3**	**1.3**	8.7	350	*31e-2/1e6*	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**2.5**	74	16	6.7	3.3	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1.2**	**2.3**	7.7	18	*30e-1/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**2.3**	28	13	13	7.3	15	15	15	15	VNS (Garcia) [10]

Table 14: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{114}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

114 Step-ellipsoid unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	2.32	153	2940	11300	15800	16700	16700	16700	17000	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1.3**	**1**	**1.2**	**1.6**	7	35	63	63	63	96	ALPS [15]
AMaLGaM IDEA	**1.6**	**1.4**	17	7.1	**5.7**	**14**	**19**	**19**	**19**	**20**	AMaLGaM IDEA [4]
avg NEWUOA	**1.3**	110	74	*11e+0/6e3*	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.2**	**1.3**	6.9	*73e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	20	67	*28e+0/800*	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1.5**	21	**2.2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1.1**	43	7.2	24	*29e-1/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	4.6	430	260	1100	*18e-1/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1.2**	**2.6**	4.7	*42e-1/2e3*	.	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1.3**	**1.3**	21	28	*73e-2/1e5*	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1.1**	180	60	*82e-1/8e3*	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1.5**	**2**	**2.7**	4.5	*45e-1/900*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.5**	**1.5**	11	14	15	**28**	**43**	**43**	**43**	**42**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.3**	**2.1**	**1.3**	**1.6**	**5.8**	*29e-2/2e4*	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	5	**2.2**	7.5	*13e-1/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	150	43	*89e-1/5e3*	.	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	9.9	38	13	70	*29e-2/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	**1.2**	**1.6**	**1**	27	39	*73e-2/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1.4**	**1.9**	100	140	130	*47e-1/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1.5**	**1.6**	**2.7**	34	1300	*44e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.3**	130	15	4.6	12	*99e-2/1e4*	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1.5**	**2.7**	3.5	*56e-1/1e3*	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.9**	34	14	140	1200	5400	5400	5400	5300	VNS (Garcia) [10]

Table 15: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{115}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

115 Step-ellipsoid Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	2.01	12.7	97	366	455	510	510	510	594	ERT$_{\text{best}}$/D
ALPS	**1.3**	**2.5**	13	6.8	25	9600	1.3e4	1.3e4	1.3e4	*16e-3/1e6*	ALPS [15]
AMaLGaM IDEA	**1.3**	**1.9**	**1.8**	4.1	**2.9**	**5.6**	**5**	**5**	**5**	6.5	AMaLGaM IDEA [4]
avg NEWUOA	**1.1**	**1.6**	**1.1**	4.2	28	*10e-2/6e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.5**	**1.5**	5.9	21	78	63	*89e-2/2e3*	.	.	.	BayEDAcG [9]
BFGS	32	120	2200	*24e+0/2e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1.3**	**1.7**	**1.5**	**2.6**	6.5	6.6	5.9	5.9	5.9	**5.7**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1.3**	**1.4**	4.7	7.4	43	*11e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	18	45	420	2700	*63e-2/8e5*	.	.	.	.	.	DASA [18]
DEPSO	**1.1**	**2.3**	4.8	5.5	6.5	65	*58e-3/2e3*	.	.	.	DEPSO [11]
EDA-PSO	**1.7**	**1.7**	7.7	19	180	*65e-3/1e5*	.	.	.	.	EDA-PSO [5]
full NEWUOA	**2.9**	**2**	**1**	**2.8**	17	*57e-3/8e3*	.	.	.	.	full NEWUOA [23]
GLOBAL	**1.2**	**1.2**	4.4	4.7	*84e-2/300*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.1**	**1.3**	**1.6**	4.2	8.7	19	20	20	20	18	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.3**	**1.5**	**3**	3.2	30	72	150	150	150	280	MA-LS-Chain [19]
MCS (Neum)	**1**	**1.4**	**1.4**	43	400	*83e-2/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**2.1**	**1.2**	**2.9**	14	42	*34e-2/4e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1.9**	**2.1**	**1.7**	11	64	3e3	1.4e4	1.4e4	1.4e4	2.5e4	(1+1)-ES [1]
PSO	**1.5**	**1.3**	**2.6**	190	580	*36e-2/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1.3**	**1**	5.1	400	1100	*38e-2/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1.3**	**1.8**	22	910	*34e-2/1e6*	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.4**	**1.4**	**1.5**	**1**	**1**	**1**	**1**	**1**	**1**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1.1**	**1.4**	4.6	17	*11e-1/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**2.1**	3.4	**1**	**4.4**	**5.7**	**5.3**	**5.3**	**5.3**	**5.2**	VNS (Garcia) [10]

Table 16: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{116}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

116 Ellipsoid Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	22.9	268	1150	2890	4460	5250	5370	5520	6070	6330	ERT$_{\text{best}}$/D
ALPS	3.1	**2.1**	**1.5**	**2.4**	4.5	14	26	57	280	2300	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	AMaLGaM IDEA [4]
avg NEWUOA	29	35	*95e+0/6e3*	.	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**3**	4.3	12	*37e+0/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	68	*12e+2/900*	.	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1.8**	**1.1**	**1.2**	**2**	**1.9**	**2.1**	**2.1**	**2.1**	**2**	**2**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	8.1	13	37	*18e+0/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	150	220	1300	*12e+0/7e5*	.	.	.	.	.	.	DASA [18]
DEPSO	**2.6**	**1.5**	**1.9**	4.7	3.2	*73e-1/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	**1.7**	3.4	25	96	150	270	*18e-1/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	37	45	*10e+1/8e3*	.	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**2.6**	3.2	4.5	*94e+0/900*	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	15	4	4	3.2	**2.5**	**2.4**	**2.4**	**2.8**	**2.6**	**2.6**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1.4**	**1**	**2.6**	5.6	14	69	*37e-2/2e4*	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1.8**	**1.3**	16	49	*12e+0/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	27	20	*74e+0/5e3*	.	.	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	6.2	11	40	1600	*17e-1/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	**2.8**	60	240	*15e+0/1e5*	.	.	.	.	.	.	PSO [6]
PSO_Bounds	**1.2**	60	130	150	*19e+0/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	3.8	19	1700	*11e+0/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.9**	6.3	4.5	**2.5**	**2.7**	**2.3**	**2.3**	**2.2**	**2.1**	**2**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1.1**	4.7	*83e+0/1e3*	.	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**2**	12	14	22	52	200	260	630	570	910	VNS (Garcia) [10]

Table 17: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{117}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

117 Ellipsoid unif

Δftarget ERT$_{\text{best}}$/D	1e+03 34.5	1e+02 865	1e+01 5340	1e+00 15200	1e-01 21900	1e-02 25700	1e-03 27400	1e-04 30300	1e-05 34600	1e-07 38300	Δftarget ERT$_{\text{best}}$/D
ALPS	**1.4**	**1**	**3.1**	9.3	79	570	*13e-2/1e6*	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	5.9	5.6	**5.9**	**8.4**	**9.9**	**15**	**27**	**45**	**370**	AMaLGaM IDEA [4]
avg NEWUOA	38	100	*30e+1/6e3*	.	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.6**	*21e+1/2e3*	.	.	.	.	.	.	.	.	BayEDAcG [9]
BFGS	18	*91e+1/600*	.	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	6.6	**2.1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	24	11	28	*77e+0/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	160	190	*39e+0/7e5*	.	.	.	.	.	.	.	DASA [18]
DEPSO	3.7	7.2	*15e+1/2e3*	.	.	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1.2**	15	28	*15e+0/1e5*	.	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	160	45	*28e+1/8e3*	.	.	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**2.9**	3.6	*17e+1/800*	.	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	15	4.5	4.3	**9**	12	**17**	**32**	**35**	**67**	***14e-6/1e6***	iAMaLGaM IDEA [4]
MA-LS-Chain	**2**	**1.2**	**2.2**	24	*27e-1/2e4*	.	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**2.2**	**1.3**	12	*36e+0/1e4*	.	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	41	*41e+1/5e3*	.	.	.	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	18	17	130	930	*67e-1/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	68	46	57	96	*19e+0/1e5*	.	.	.	.	.	PSO [6]
PSO_Bounds	**2**	43	120	93	*39e+0/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1.7**	7.7	240	*94e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	62	10	8.7	9.7	**6.7**	*26e+0/1e4*	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**2**	8.4	*21e+1/1e3*	.	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	100	14	21	270	4600	*60e-2/7e6*	.	.	.	.	VNS (Garcia) [10]

Table 18: 05-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\mathrm{best}}$ on f_{118}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

118 Ellipsoid Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}/D$	5.28	10.9	85.8	243	311	355	400	441	486	583	$\mathrm{ERT}_{\mathrm{best}}/D$
ALPS	10	34	13	32	940	4.1e4	*41e-3/1e6*	.	.	.	ALPS [15]
AMaLGaM IDEA	3.4	4.6	**1**	**2.6**	3.6	4.9	10	16	30	54	AMaLGaM IDEA [4]
avg NEWUOA	**1.2**	**1**	**1.8**	8.3	64	*18e-2/7e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	12	190	99	*90e+0/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	210	1800	*31e+1/3e3*	.	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	4.2	7.8	3.2	**2**	**1.9**	**2.1**	**2.1**	**2**	**2**	**1.8**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**2.8**	5.7	8	22	230	*32e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	53	270	1300	2.7e4	*27e-1/9e5*	.	.	.	.	.	DASA [18]
DEPSO	10	18	17	38	97	*37e-1/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	5.6	65	110	320	910	4e3	*57e-2/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	**1.3**	**1**	**1.3**	5.9	70	*22e-2/9e3*	.	.	.	.	full NEWUOA [23]
GLOBAL	9	7	**1.8**	**3**	*74e-2/700*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**2.8**	3.4	**2.7**	3.1	7.7	11	22	44	60	130	iAMaLGaM IDEA [4]
MA-LS-Chain	5	12	4.1	14	44	86	130	260	370	640	MA-LS-Chain [19]
MCS (Neum)	10	24	140	*13e+0/1e4*	.	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1.3**	4.3	10	120	*30e-2/5e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	3.7	13	36	530	*22e-2/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	4.3	670	800	2700	*51e-1/1e5*	.	.	.	.	.	PSO [6]
PSO_Bounds	4.9	29	1800	*12e+0/1e5*	.	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	9	500	1.5e4	*10e+0/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	3.9	9.7	3.8	**2**	**1.8**	**1.7**	**1.7**	**1.6**	**1.6**	**1.4**	IPOP-SEP-CMA-ES [21]
SNOBFIT	3.2	23	87	*33e+0/1e3*	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	8.4	8.3	**1.8**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	VNS (Garcia) [10]

Table 19: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{119}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

119 Sum of different powers Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	2.35	131	227	473	2070	6190	7060	9950	ERT$_{\text{best}}$/D
ALPS	**1**	**1.8**	**2.1**	**1.9**	4.8	4.6	**2**	**2.2**	29	*15e-7/1e6*	ALPS [15]
AMaLGaM IDEA	**1**	**1.8**	**1.4**	4.6	9.8	10	**2.7**	**1**	**1**	**1**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	3.4	19	23	*42e-2/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1.1**	**1.3**	**2.2**	**2.5**	4.6	4.2	7.1	*68e-4/2e3*	.	.	BayEDAcG [9]
BFGS	**1**	45	220	120	*50e-1/2e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1.7**	**1.9**	**1**	**1**	**1**	**1**	**1**	**1.5**	**2.3**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	32	18	15	140	*20e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	41	210	750	1.5e4	*31e-2/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1.5**	**1.5**	**1**	**2.8**	**3.8**	**1.8**	*19e-4/2e3*	.	.	DEPSO [11]
EDA-PSO	**1**	**1.4**	**1.4**	**1.9**	8.6	8.5	**2.8**	15	210	*98e-6/1e5*	EDA-PSO [5]
full NEWUOA	**1**	4.6	12	22	260	*31e-2/8e3*	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.5**	**1**	4.7	*80e-2/900*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.3**	**1.3**	**2.8**	9.1	19	6.7	3.8	3.8	3.6	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.8**	**1.6**	**1.3**	**4**	**3.3**	**1.3**	**1.1**	4.7	*61e-7/2e4*	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	3.5	**2**	43	*75e-3/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1.7**	26	35	*90e-2/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	63	15	12	260	3900	*13e-3/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.3**	**1.8**	71	120	60	18	36	*14e-5/1e5*	.	PSO [6]
PSO_Bounds	**1**	**1.2**	**1.7**	56	73	44	17	35	97	*19e-5/1e5*	PSO_Bounds [7]
Monte Carlo	**1**	**1.5**	**1.4**	12	6400	*10e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	5.4	4.5	11	8.5	5.9	**2.5**	**1.5**	**1.7**	**2.8**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.3**	**1.7**	4.1	21	*51e-2/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.2**	**2.8**	8.2	7.4	10	4.6	7.9	130	1.2e4	VNS (Garcia) [10]

Table 20: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{120}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

120 Sum of different powers unif

Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D	1e+03 0.2	1e+02 0.2	1e+01 3.21	1e+00 580	1e-01 3740	1e-02 6900	1e-03 14500	1e-04 35400	1e-05 66700	1e-07 1.1e5	Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1.3**	**1.5**	**1**	**2.8**	53	1e3	*34e-4/1e6*	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.4**	**1.5**	13	16	35	**66**	**130**	***68e-5/1e6***	.	AMaLGaM IDEA [4]
avg NEWUOA	**1**	42	94	49	*15e-1/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.6**	**1.2**	49	*17e-1/2e3*	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	19	40	*37e-1/900*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	26	17	**1.1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	4.6	29	9.4	*45e-2/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	40	840	260	*44e-2/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1**	**1.4**	**2.3**	5	*10e-1/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1.3**	**1.1**	14	23	64	*68e-3/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	30	150	63	*22e-1/9e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.3**	**1**	**1.8**	*90e-2/900*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.2**	**1.2**	24	34	52	130	**420**	***13e-4/1e6***	.	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.1**	**1**	**1.2**	**5.1**	**26**	*34e-3/2e4*	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	3.7	8.5	38	*48e-2/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	34	130	55	*24e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1.3**	**2.7**	54	21	340	*91e-3/1e6*	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.8**	**2**	120	44	200	**100**	*16e-2/1e5*	.	.	PSO [6]
PSO_Bounds	**1**	**1.7**	**1**	88	77	*60e-2/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.8**	**1.1**	**2.3**	550	*11e-2/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.2**	48	11	5.9	**21**	*30e-2/1e4*	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.5**	**1.2**	3.3	*13e-1/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.2**	**2**	11	41	740	*58e-4/7e6*	.	.	.	VNS (Garcia) [10]

Table 21: 05-D, running time excess ERT/ERT_{best} on f_{121}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

121 Sum of different powers Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT_{best}/D	0.2	0.2	1.72	22.2	54.6	107	317	525	774	1240	ERT_{best}/D
ALPS	**1.1**	**1.3**	**1**	11	150	1.3e4	*97e-4/1e6*	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.5**	**2.1**	**1.8**	12	25	26	34	42	99	AMaLGaM IDEA [4]
avg NEWUOA	**1**	3.3	4.3	3.3	45	790	*38e-3/6e3*	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.7**	3	23	25	18	29	*41e-4/2e3*	.	.	BayEDAcG [9]
BFGS	**1**	130	42	71	370	*50e-2/3e3*	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	4.3	**2.7**	**1.1**	**1**	**1**	**1.1**	**1.7**	**2**	**2.2**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	**1.6**	9.8	59	*35e-3/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	13	180	3100	1.9e5	*34e-2/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1.1**	4.6	**2.9**	5.9	62	*14e-3/2e3*	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1.7**	**2.2**	9.9	2100	*98e-3/1e5*	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1.2**	8	3.2	9.6	33	150	*13e-3/8e3*	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.7**	**1.9**	3.5	11	*10e-2/400*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.3**	**2.2**	**1.1**	5.6	41	49	110	110	210	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.7**	**2.8**	3.7	5.2	40	120	*99e-5/2e4*	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1.5**	11	180	*88e-3/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	3.9	4.8	15	76	*86e-3/4e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	4.4	3	4.5	49	2200	*51e-4/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.5**	**1.6**	380	2300	*83e-3/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1.1**	**1.5**	**1.8**	700	3800	1.4e4	*27e-2/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.6**	**2.4**	53	2e4	*87e-3/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.5**	**2.3**	**1**	**1.1**	**1.3**	**1.1**	**1.2**	**1.2**	**1.1**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.5**	**1.6**	**1.9**	24	*11e-2/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1.2**	3.8	**1.9**	**1.3**	**1.3**	**1**	**1**	**1**	**1**	VNS (Garcia) [10]

Table 22: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{122}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

122 Schaffer F7 Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	2.04	345	1840	4320	6020	8140	10700	22300	ERT$_{\text{best}}$/D
ALPS	**1**	**1.1**	**2**	**2.9**	**2.8**	4.9	20	47	640	*29e-6/1e6*	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	**1.3**	4.9	5.6	**3.5**	**3.6**	**3.7**	**3.8**	**2.6**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1.5**	6.1	34	*11e-1/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.3**	**1.3**	**2.3**	*30e-2/2e3*	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	12	87	*36e-1/3e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**2.2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	21	58	*12e-1/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	3.7	410	3200	*10e-1/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1**	**1.1**	3.4	**2.9**	*57e-2/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1**	**1.2**	10	33	96	230	*37e-3/1e5*	.	.	EDA-PSO [5]
full NEWUOA	**1**	**2.1**	30	110	*17e-1/8e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.2**	**1.4**	*18e-1/900*	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1.1**	**1.3**	**1.3**	12	14	9	7.1	**5.8**	**5.7**	**3.6**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.3**	**1.6**	4.3	4.8	6.8	61	*76e-4/2e4*	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**2.8**	13	*54e-2/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1.9**	14	91	*18e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	3.1	17	72	*24e-2/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.1**	**1**	48	120	330	*17e-2/1e5*	.	.	.	PSO [6]
PSO_Bounds	**1**	**1.1**	**1.7**	77	55	160	*85e-3/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.1**	**2**	100	*46e-2/1e6*	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**2**	8.1	**3.6**	**3.3**	**3.3**	9	14	6.7	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.1**	**1.9**	13	*20e-1/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	3.4	18	34	120	1800	*76e-5/8e6*	.	.	VNS (Garcia) [10]

Table 23: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{123}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

123 Schaffer F7 unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	0.2	2.24	3210	16300	45500	67100	90300	1.34e5	4.43e5	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1.1**	**1.1**	**2.1**	*25e-2/1e6*	.	.	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.4**	**1.8**	8.7	**150**	***15e-2/1e6***	.	.	.	.	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**2.5**	80	*26e-1/6e3*	.	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.1**	**2.7**	*25e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1.4**	46	*39e-1/900*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1.5**	8.1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	27	*21e-1/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	60	420	3e3	*14e-1/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1**	**1.3**	**2.5**	9.2	*26e-1/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1.2**	**1.7**	33	*74e-2/1e5*	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1.1**	110	18	*35e-1/9e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.1**	**1.4**	*20e-1/800*	.	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	**2.1**	19	160	***18e-2/1e6***	.	.	.	.	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.3**	**1.3**	**2.4**	*64e-2/2e4*	.	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	6.3	21	*16e-1/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1.3**	65	*37e-1/5e3*	.	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1.2**	22	23	*59e-2/1e6*	.	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1**	**1.7**	48	**87**	***12e-1/1e5***	.	.	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**1.2**	70	*18e-1/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.2**	**1**	15	*49e-2/1e6*	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.1**	6.1	5.5	*10e-1/1e4*	.	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1.2**	3.5	*25e-1/1e3*	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	3.1	28	3300	***16e-2/8e6***	.	.	.	.	VNS (Garcia) [10]

Table 24: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{124}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

124 Schaffer F7 Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	0.2	1.95	40.4	208	1790	4100	5280	9070	19000	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1.1**	**1.4**	14	3.3e4	*15e-2/1e6*	.	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1.3**	**2.1**	25	15	10	**10**	**16**	**19**	**17**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**2.1**	6.1	89	*63e-2/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1.1**	**1.8**	8.7	**6.9**	**3**	*13e-3/2e3*	.	.	.	BayEDAcG [9]
BFGS	**1**	**2.2**	73	990	*39e-1/3e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1.5**	**1.5**	**1.1**	**1**	**1.2**	**1.1**	**1.1**	**1.2**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1.1**	4.7	33	*38e-2/1e4*	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	6.5	320	2e4	*97e-2/7e5*	.	.	.	.	.	DASA [18]
DEPSO	**1**	**1.1**	**2**	10	*27e-2/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1.1**	**2**	270	*56e-2/1e5*	.	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1.3**	5.3	45	*47e-2/8e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1.2**	**1.7**	21	*91e-2/800*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1.1**	**1.1**	15	40	18	17	48	57	35	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1.3**	**1.8**	**5.1**	870	*20e-2/2e4*	.	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	16	*55e-2/1e4*	.	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1.1**	**3**	160	*11e-1/4e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1.4**	4.7	35	3.5e4	*12e-2/1e6*	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1.1**	**1.2**	930	6800	*52e-2/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**1.6**	1400	*77e-2/1e5*	.	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1.1**	**1.9**	960	*46e-2/1e6*	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.6**	**1.8**	**1**	**3.9**	**1**	**1**	**1**	**1**	**1.9**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**1.1**	18	*88e-2/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	3.5	21	30	41	69	460	5400	*20e-6/7e6*	VNS (Garcia) [10]

Table 25: 05-D, running time excess ERT/$\mathrm{ERT_{best}}$ on f_{125}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

125 Griewank-Rosenbrock Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT_{best}}$/D	0.2	0.2	0.2	0.2	0.2	25000	47700	48300	48600	49200	$\mathrm{ERT_{best}}$/D
ALPS	**1**	**1**	**1.3**	35	1e4	3.5	140	290	290	*21e-4/1e6*	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**1.1**	37	6800	3.2	**13**	**20**	**23**	**22**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	**2**	81	1e4	*36e-3/6e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	**1.2**	42	**3200**	*65e-3/2e3*	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	37	2400	*46e-2/3e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**1.1**	**17**	**3400**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	**1**	140	4.6e4	*75e-3/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	36	6500	1.2e6	*68e-3/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1**	**1**	35	1.2e4	*98e-3/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1**	**1.1**	31	9200	7.7	*11e-3/1e5*	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1**	3.9	26	5600	4.8	*41e-3/8e3*	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**1.3**	35	1.3e4	*13e-2/900*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	**1.2**	24	6400	5.9	**29**	**53**	**53**	**52**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**1.3**	35	4700	**1.2**	*80e-4/2e4*	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	**1**	**1.7**	*15e-3/1e4*	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	3.9	**15**	6100	**2.8**	*40e-3/5e3*	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	**2.5**	210	3.3e4	180	*13e-3/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1**	**1**	**1.2**	50	7e4	28	30	*29e-3/1e5*	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**1.2**	27	2.2e4	7.9	*14e-3/1e5*	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1**	**1.1**	60	1.5e5	*36e-3/1e6*	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**1**	22	1.2e4	5.8	*28e-3/1e4*	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**1.3**	30	1.1e4	*13e-2/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**1**	52	2.6e4	27	250	1200	2500	*87e-5/8e6*	VNS (Garcia) [10]

Table 26: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{126}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

126 Griewank-Rosenbrock unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	0.2	0.2	0.2	1.75e5	nan	nan	nan	nan	ERT$_{\text{best}}$/D
ALPS	**1**	**1**	**1.2**	30	4.2e4	*21e-3/1e6*	.	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**1**	45	3e4	84	***15e-3/1e6***	.	.	.	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	22	1600	4.5e5	*26e-2/6e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	**1.2**	**29**	*27e-2/2e3*	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	5.4	460	*49e-2/1e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**1**	160	**1.3e4**	**2.1**	***67e-4/9e5***	.	.	.	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	**1**	410	1.6e5	*12e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	**2.9**	3300	2.4e6	*70e-3/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1**	**1.1**	51	1.4e5	*21e-2/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1**	**1**	34	4.7e4	*35e-3/1e5*	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1**	**2.6**	1700	*25e-2/9e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**1**	42	6.2e4	*23e-2/800*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	**1**	38	6.9e4	**42**	***16e-3/1e6***	.	.	.	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**1.1**	35	**9400**	**1**	***27e-3/2e4***	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	**1**	*25e-3/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	**1.2**	1100	3.5e5	*26e-2/5e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	18	430	2.4e5	*27e-3/1e6*	.	.	.	.	(1+1)-ES [1]
PSO	**1**	**1**	**1.2**	40	2.1e5	*63e-3/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**1.3**	**26**	3.6e5	*84e-3/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1**	**1.1**	43	1.2e5	82	***34e-3/1e6***	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**1**	110	4e4	*85e-3/1e4*	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**1.3**	90	*19e-2/1e3*	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**1**	56	1.2e5	680	***15e-3/8e6***	.	.	.	VNS (Garcia) [10]

Table 27: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{127}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

127 Griewank-Rosenbrock Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.2	0.2	0.2	0.2	0.2	25700	68300	77000	77900	79100	ERT$_{\text{best}}$/D
ALPS	**1**	**1**	**1.4**	46	2.5e4	*17e-3/1e6*	.	.	.	.	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**1.1**	40	2700	**2.2**	**5.1**	**10**	**14**	**26**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	**2**	**18**	5200	*53e-3/6e3*	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	**1.3**	35	**2200**	*41e-3/2e3*	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	7.8	1300	*38e-2/3e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**1**	19	**2100**	**1.2**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	**1.3**	51	5.5e4	*92e-3/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	61	4400	2.8e6	*86e-3/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1**	**1.3**	36	1.5e4	*96e-3/2e3*	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1**	**1.3**	32	6.3e4	*49e-3/1e5*	.	.	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1**	4.1	25	1.1e4	*59e-3/8e3*	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**1.1**	37	*24e-2/800*	.	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	**1.3**	24	9800	3.9	17	**41**	**40**	**180**	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**1.2**	39	8600	7	*32e-3/2e4*	.	.	.	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	**1**	**1**	**1**	*25e-3/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	**2.5**	**14**	7200	*62e-3/4e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	**1.1**	65	3.6e4	550	*24e-3/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1**	**1**	**1**	40	1.5e5	*75e-3/1e5*	.	.	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**1.2**	44	1.3e5	*78e-3/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1**	**1**	47	1.2e5	540	*33e-3/1e6*	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**1**	19	3700	**1**	**2.2**	*18e-3/1e4*	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**1.3**	24	2.2e4	*20e-2/1e3*	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**1**	52	2.7e4	14	120	210	210	210	VNS (Garcia) [10]

Table 28: 05-D, running time excess ERT/ERT_{best} on f_{128}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

128 Gallagher Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT_{best}/D	0.2	0.2	22.2	850	1560	2100	2490	2980	3440	4230	ERT_{best}/D
ALPS	**1**	**1**	**1.7**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**1.2**	46	46	35	30	25	22	18	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	11	9.3	7.5	42	*31e-2/6e3*	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	**1.3**	**2.8**	19	*60e-2/2e3*	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	88	*94e-1/2e3*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**2.2**	6.9	10	7.8	6.6	5.5	4.8	3.9	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	9.1	4.6	6.8	11	17	14	19	*28e-3/1e4*	(1+1)-CMA-ES [2]
DASA	**1**	**1**	230	180	400	2400	4200	*65e-3/7e5*	.	.	DASA [18]
DEPSO	**1**	**1**	**2.8**	4.4	3.9	**2.9**	**2.5**	**2.1**	**1.8**	**1.5**	DEPSO [11]
EDA-PSO	**1**	**1**	**1.4**	33	44	33	28	24	21	17	EDA-PSO [5]
full NEWUOA	**1**	**1**	15	11	36	57	*16e-2/8e3*	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**1**	**1.6**	**2.3**	**1.7**	4.8	*17e-1/900*	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	8.2	34	21	16	15	12	11	8.9	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**1.1**	**1.3**	**1.3**	**1.5**	**1.6**	**1.5**	**1.4**	**1.3**	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	4.6	**2.3**	3.6	9.5	59	*49e-3/1e4*	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	12	17	43	*19e-1/5e3*	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	7.5	5.8	8.4	10	26	75	140	1e3	(1+1)-ES [1]
PSO	**1**	**1**	**1.9**	50	73	55	46	39	34	27	PSO [6]
PSO_Bounds	**1**	**1**	**2.2**	100	130	130	110	93	81	66	PSO_Bounds [7]
Monte Carlo	**1**	**1**	**1.8**	4.1	41	710	6e3	*10e-3/1e6*	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	6.8	13	7.6	5.7	4.8	4	3.5	**2.8**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**2.4**	3.3	4.7	7.1	6	*18e-1/1e3*	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**1**	13	12	8.7	7.4	6.2	5.5	5	VNS (Garcia) [10]

Table 29: 05-D, running time excess ERT/ERT$_{\text{best}}$ on f_{129}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

129 Gallagher unif

Δftarget ERT$_{\text{best}}$/D	1e+03 0.2	1e+02 0.2	1e+01 12.8	1e+00 2140	1e-01 11900	1e-02 46300	1e-03 56900	1e-04 72900	1e-05 1.02e5	1e-07 1.16e5	Δftarget ERT$_{\text{best}}$/D
ALPS	**1**	**1**	3.3	**2.7**	**1.7**	**1**	**1**	**1**	**1**	**1**	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**2.7**	19	12	**4.2**	4.8	4.5	**3.3**	**4.2**	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	68	20	*30e-1/6e3*	.	.	.	.	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	27	*62e-1/2e3*	.	.	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	85	*76e-1/900*	.	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	12	7.1	9.2	4.8	**3.9**	**3**	**2.2**	**1.9**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	34	5.7	5.9	*77e-2/1e4*	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	230	140	400	*25e-2/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1**	5.7	14	*24e-1/2e3*	.	.	.	.	.	DEPSO [11]
EDA-PSO	**1**	**1**	5.3	36	11	9	12	9.2	6.7	12	EDA-PSO [5]
full NEWUOA	**1**	**1**	130	58	*55e-1/9e3*	.	.	.	.	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**1.5**	**1.7**	**1**	*21e-1/900*	.	.	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	25	25	13	4.3	**4.7**	**4.4**	5.8	8.6	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**1.5**	**1**	**1.6**	**1.7**	6.5	5	3.6	*16e-3/2e4*	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	9.9	4.9	**2.8**	*64e-2/1e4*	.	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	120	16	*61e-1/5e3*	.	.	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	29	6.8	9	23	*60e-4/1e6*	.	.	.	(1+1)-ES [1]
PSO	**1**	**1**	**1**	130	34	15	*20e-1/1e5*	.	.	.	PSO [6]
PSO_Bounds	**1**	**1**	**2.8**	130	34	*20e-1/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1**	**2.8**	**1.3**	5.7	36	260	*13e-3/1e6*	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	42	9.2	3.8	*18e-1/1e4*	.	.	.	.	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	5.3	*29e-1/1e3*	.	.	.	.	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**2.2**	16	8.9	7	8.9	16	26	240	VNS (Garcia) [10]

Table 30: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ on f_{130}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

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Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.2	0.2	10.9	162	607	1640	6560	6750	6780	6910	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1**	**1.4**	7.7	4.5	4.8	19	220	2100	*12e-5/1e6*	ALPS [15]
AMaLGaM IDEA	**1**	**1**	**2.1**	160	140	52	13	13	14	15	AMaLGaM IDEA [4]
avg NEWUOA	**1**	**1**	**1.3**	6.4	5.9	6	**3**	13	*14e-3/6e3*	.	avg NEWUOA [23]
BayEDAcG	**1**	**1**	**2.5**	170	47	*19e-1/2e3*	.	.	.	.	BayEDAcG [9]
BFGS	**1**	**1**	34	110	*20e-1/3e3*	.	.	.	.	.	BFGS [22]
BIPOP-CMA-ES	**1**	**1**	**1.9**	57	55	20	5.1	5	5	**5**	BIPOP-CMA-ES [14]
(1+1)-CMA-ES	**1**	**1**	**2.7**	6.8	4.6	6	6.8	*71e-4/1e4*	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	150	550	1500	*60e-3/7e5*	.	.	.	.	DASA [18]
DEPSO	**1**	**1**	4.6	12	5.7	**3.1**	**1**	**4.4**	**4.4**	*94e-2/2e3*	DEPSO [11]
EDA-PSO	**1**	**1**	5	310	110	130	110	*23e-3/1e5*	.	.	EDA-PSO [5]
full NEWUOA	**1**	**1**	3	7	**3**	**3**	**2.4**	17	*14e-4/8e3*	.	full NEWUOA [23]
GLOBAL	**1**	**1**	**2.5**	**1**	**1**	**1**	**1.1**	*33e-3/500*	.	.	GLOBAL [20]
iAMaLGaM IDEA	**1**	**1**	**1.5**	130	55	23	6.4	7	7.5	7.5	iAMaLGaM IDEA [4]
MA-LS-Chain	**1**	**1**	**2.4**	27	17	8.2	**2.1**	**2.3**	**2.5**	**2.9**	MA-LS-Chain [19]
MCS (Neum)	**1**	**1**	4.1	21	29	40	*35e-2/1e4*	.	.	.	MCS (Neum) [16]
NEWUOA	**1**	**1**	**2.3**	11	10	19	*62e-3/4e3*	.	.	.	NEWUOA [23]
(1+1)-ES	**1**	**1**	3.3	**5.8**	**3.1**	6.6	7	76	380	*57e-6/1e6*	(1+1)-ES [1]
PSO	**1**	**1**	**1.7**	380	330	250	110	220	*78e-2/1e5*	.	PSO [6]
PSO_Bounds	**1**	**1**	3.1	570	480	*84e-2/1e5*	.	.	.	.	PSO_Bounds [7]
Monte Carlo	**1**	**1**	3.2	31	110	530	2300	*42e-4/1e6*	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**1**	27	11	4.1	**1**	**1**	**1**	**1**	IPOP-SEP-CMA-ES [21]
SNOBFIT	**1**	**1**	**1.5**	**3.8**	5.3	9.1	**2.3**	*39e-2/1e3*	.	.	SNOBFIT [17]
VNS (Garcia)	**1**	**1**	**1.8**	120	110	70	18	18	18	17	VNS (Garcia) [10]

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