

Comparison tables: BBOB 2009 function 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 [14, 9]. The experimental set-up is described in [13].

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 [13] 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 ERT/ERT_{best} on f_1 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

		1 Sphere											Δf_{target}
ERT_{best}/D		1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}	
		0.2	0.2	2.2	2.44	2.44	2.44	2.44	2.44	2.44	2.44	ERT_{best}/D	
ALPS	1	1.6	9.2	9.2	140	300	490	680	850	1e3	1400	ALPS [17]	
AMaLGA _M IDEA	1	1.5	5.5	16	16	29	44	58	72	87	120	AMaLGA _M IDEA [4]	
avg NEWUOA	1	3.3	1.5	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	avg NEWUOA [31]	
BayEDA _{cG}	1	1.2	5.2	46	46	92	130	170	280	390	560	BayEDA _{cG} [10]	
BFGS	1	3.4	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	BFGS [30]	
Cauchy EDA	1	2.4	41	90	90	170	240	310	400	460	600	Cauchy EDA [24]	
BIPOP-CMA-ES	1	2.1	3.2	9	15	15	21	27	33	40	53	BIPOP-CMA-ES [15]	
(1+1)-CMA-ES	1	1.3	2.3	5.9	9.7	14	14	17	21	25	32	(1+1)-CMA-ES [2]	
DASA	1	5.2	23	44	59	71	88	110	120	150	150	DASA [19]	
DEPSO	1	1.3	8.1	8.1	26	48	77	110	130	170	220	DEPSO [12]	
DIRECT	1	1	2	7	7	19	31	44	62	84	150	DIRECT [25]	
EDA-PSO	1	1.1	3.2	20	320	890	1500	2100	2700	3800	3800	EDA-PSO [6]	
full NEWUOA	1	2.9	1.9	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	full NEWUOA [31]	
G3-PCX	1	1.5	5.2	12	15	19	25	31	35	35	45	G3-PCX [26]	
simple GA	1	1.5	8.7	360	1200	2100	2900	4100	5400	8300	8300	simple GA [22]	
GLOBAL	1	1.3	6.8	26	28	28	30	32	33	35	39	GLOBAL [23]	
iAMaLGA _M IDEA	1	1.4	2.5	9.8	6	6.7	6.7	6.8	6.8	6.8	73	iAMaLGA _M IDEA [4]	
LSfm _{in} bd	1	2.8	6	6	6.3	6.7	6.7	6.8	6.8	6.8	6.8	LSfm _{in} bd [28]	
LSstep	1	1.40	92	120	130	130	130	130	130	130	130	LSstep [28]	
MA-LS-Chain	1	1.3	7.8	25	47	60	74	90	90	120	140	MA-LS-Chain [21]	
MCS (Neum)	1	1	1.8	2.5	3.3	5.4	2.6	2.6	2.6	2.6	2.6	MCS (Neum) [18]	
NELDER (Han)	1	1.7	1.5	3.3	3.3	5.4	7.2	9.2	11	13	17	NELDER (Han) [16]	
NELDER (Doe)	1	2.3	1.5	3.4	5.6	7.4	7.4	9.5	11	13	17	NELDER (Doe) [5]	
NEWUOA	1	2.4	1.1	1	1	1	1	1	1	1	1	NEWUOA [31]	
(1+1)-ES	1	1.2	2.3	5	8.4	11	11	15	18	22	28	(1+1)-ES [1]	
POEMS	1	2.40	1.10	130	380	760	1200	1600	2100	2900	2900	POEMS [20]	
PSO	1	1.3	3.7	22	55	110	180	240	320	450	450	PSO [7]	
PSO_Bounds	1	1.2	3.8	41	210	430	730	980	1300	1900	1900	PSO_Bounds [8]	
Monte Carlo	1	1.4	7.5	1700	6.8e5	<i>10e-2/1e6</i>	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	1	2.9	2.9	4.2	5.5	6.8	8.7	10	12	15	15	Rosenbrock [27]	
IPOP-SEP-CMA-ES	1	1.5	2.8	7	14	18	23	29	34	44	44	IPOP-SEP-CMA-ES [29]	
VNS (Garcia)	1	1.6	7.4	18	25	31	38	45	50	64	64	VNS (Garcia) [11]	

Table 2: 05-D, running time excess ERT/ERT_{best} on f_2 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

2 Ellipsoid separable											
Δf_{target} ERT_{best}/D	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} ERT_{best}/D
ALPS	45	55	73	95	120	150	170	190	210	260	ALPS [17]
AMaLGaM IDEA	5.2	5.3	7.1	10	13	15	17	19	21	24	AMaLGaM IDEA [4]
avg NEWUOA	1.2	2	6.4	21	41	56	75	92	110	150	avg NEWUOA [31]
BayEDA-cG	32	38	41	46	52	58	64	79	84	95	BayEDA-cG [10]
BFGS	3.3	3.4	3.8	5.6	6.2	6.5	6.6	6.8	6.9	7.1	BFGS [30]
Cauchy EDA	35	35	42	49	58	71	80	91	100	120	Cauchy EDA [24]
BIPOP-CMA-ES	11	11	13	16	18	19	20	20	21	22	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	5.6	6.6	9.4	11	12	13	14	14	14	15	(1+1)-CMA-ES [2]
DASA	10	8.6	9.7	12	13	15	17	19	21	26	DASA [19]
DEPSO	11	11	13	16	21	24	28	32	37	44	DEPSO [12]
DIRECT	4.2	4.3	5.7	7.2	8.4	10	14	16	22	380	DIRECT [25]
EDA-PSO	8.6	58	140	210	290	360	420	490	550	690	EDA-PSO [6]
full NEWUOA	1.5	2.7	6.9	19	36	50	69	87	100	130	full NEWUOA [31]
G3-PCX	15	30	69	150	220	280	340	410	470	620	G3-PCX [26]
simple GA	180	230	330	460	610	770	1300	1500	2200	2500	simple GA [22]
GLOBAL	7.1	5.4	6.3	6.9	7.3	7.5	7.8	8	8.2	8.5	GLOBAL [23]
iAMaLGaM IDEA	4.4	4.7	6.2	8.1	10	12	13	14	15	17	iAMaLGaM IDEA [4]
LSfminbd	1.5	1.1	1	1	1	1	1	1	1	1	LSfminbd [28]
LSstep	25	17	16	16	16	15	15	15	15	15	LSstep [28]
MA-LS-Chain	7.9	10	13	16	22	27	32	36	41	49	MA-LS-Chain [21]
MCS (Neum)	1.3	1	1.1	1.5	2.2	3.2	4.7	5.7	6.5	29	MCS (Neum) [18]
NELDER (Han)	2.4	2.7	5	6.8	7.4	7.7	7.9	8.1	8.3	8.6	NELDER (Han) [16]
NELDER (Doe)	2	2.5	4.9	8.1	8.9	9.3	9.6	9.8	10	10	NELDER (Doe) [5]
NEWUOA	1	1.8	5.7	22	45	60	85	100	130	170	NEWUOA [31]
(1+1)-ES	110	1600	5600	1.6e4	3e4	4.6e4	1.9e5	2.6e5	8e5	<i>19e-4/1e6</i>	(1+1)-ES [1]
POEMS	150	160	210	270	330	380	440	470	520	630	POEMS [20]
PSO	19	25	32	41	49	59	68	78	89	110	PSO [7]
PSO_Bounds	47	83	150	190	260	300	400	590	860	1200	PSO_Bounds [8]
Monte Carlo	1800	1.2e5	<i>11e+1/1e6</i>	.	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	2.2	8.6	13	100	140	140	150	190	190	240	Rosenbrock [27]
IPOP-SEP-CMA-ES	5.4	5.7	7.2	8.5	9.4	10	11	11	12	13	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	15	14	18	20	24	24	25	26	26	27	VNS (Garcia) [11]

Table 3: 05-D, running time excess ERT/ERT_{best} on f_3 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	Δf_{target} ERT _{best} /D	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} ERT _{best} /D
ALPS	0.2	2.92	143	5.7	12	22	24	26	28	29	33	ALPS [17]
AMaLgAM IDEA	1.5	2	2.1	4.5	65	480	500	510	520	520	520	AMaLgAM IDEA [4]
avg NEWUOA	3.3	4.8	3	130	<i>40e-1/6e3</i>	.	.	.	.	.	.	avg NEWUOA [31]
BayEDAacG	1.2	1.7	2.7	<i>29e-1/2e3</i>	.	.	.	.	.	.	.	BayEDAacG [10]
BFGS	7.4	56	110	<i>21e+0/4e3</i>	.	.	.	.	.	.	.	BFGS [30]
Cauchy EDA	35	25	6.7	2200	<i>26e-1/5e4</i>	.	.	.	.	.	.	Cauchy EDA [24]
BIPOP-CMA-ES	3.5	1.5	1.4	16	140	140	140	140	140	140	140	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	2.2	1.3	9.1	440	<i>30e-1/1e4</i>	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	8.7	18	1.2	1.6	10	10	10	10	10	10	11	DASA [19]
DEPSO	1.4	2.9	3.7	29	30	30	30	30	<i>23e-1/2e3</i>	.	.	DEPSO [12]
DIRECT	1	2.6	45	300	<i>30e-1/2e4</i>	.	.	.	.	.	.	DIRECT [25]
EDA-PSO	1.4	2.2	12	170	860	860	860	860	860	870	870	EDA-PSO [6]
full NEWUOA	4.3	3.7	4.2	160	<i>20e-1/7e3</i>	.	.	.	.	.	.	full NEWUOA [31]
G3-PCX	2	3	84	2100	<i>30e-1/5e4</i>	.	.	.	.	.	.	G3-PCX [26]
simple GA	1.1	1.6	19	18	25	34	43	53	53	110	200	simple GA [22]
GLOBAL	1.2	2.4	3.3	<i>50e-1/500</i>	.	.	.	.	.	.	.	GLOBAL [23]
iAMaLgAM IDEA	1.2	1.4	1.4	33	180	180	180	180	190	190	190	iAMaLgAM IDEA [4]
LSfminbd	11	2.7	1	52	<i>21e-1/4e3</i>	.	.	.	.	.	.	LSfminbd [28]
LSstep	81	62	2.2	1	1	1	1	1	1	1	1	LSstep [28]
MA-LS-Chain	1	1.3	1	6.4	32	32	32	32	32	32	32	MA-LS-Chain [21]
MCS (Neum)	1	1	1.2	24	220	210	210	210	210	210	210	MCS (Neum) [18]
NELDER (Han)	1	1.3	5.4	280	1500	1500	1500	1500	1500	1500	1400	NELDER (Han) [16]
NELDER (Doe)	2.1	1	1.5	33	270	270	270	270	270	270	270	NELDER (Doe) [5]
NEWUOA	3	1.5	6.1	230	<i>40e-1/5e3</i>	.	.	.	.	.	.	NEWUOA [31]
(1+1)-ES	1.8	2.3	16	310	3900	3800	3800	3800	3800	3800	3800	(1+1)-ES [1]
POEMS	170	70	3.8	9.7	35	39	42	45	45	47	54	POEMS [20]
PSO	1.4	1.7	52	55	280	270	280	280	280	280	280	PSO [7]
PSO.Bounds	1.5	1.6	7.6	26	38	63	64	65	65	70	95	PSO.Bounds [8]
Monte Carlo	1	2.1	6800	<i>83e-1/1e6</i>	.	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	5.7	39	24	390	<i>70e-1/9e3</i>	.	.	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES	2.2	2.3	1.2	12	96	96	96	96	97	97	97	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1.6	2.5	2.5	5.2	11	11	11	12	16	22	40	VNS (Garcia) [11]

Table 4: 05-D, running time excess ERT/ERT_{best} on f_4 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

4 Skew Rastrigin-Bueche separable

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D											ERT_{best}/D
ALPS		1.1	4.4	7.1	28	59	58	58	58	59	63	ALPS [17]
AMaLgAM IDEA		1.8	3.4	5.8	2e4	<i>20e-1/1e6</i>	.	.	.	.	.	AMaLgAM IDEA [4]
avg NEWUOA		5.4	10	14	<i>50e-1/8e3</i>	.	.	.	.	.	.	avg NEWUOA [31]
BayEDA _c G		1.7	6.3	5.8	<i>69e-1/2e3</i>	.	.	.	.	.	.	BayEDA _c G [10]
BFGS		3	67	170	<i>24e+0/4e3</i>	.	.	.	.	.	.	BFGS [30]
Cauchy EDA		7.6	39	85	<i>78e-1/5e4</i>	.	.	.	.	.	.	Cauchy EDA [24]
BIPOP-CMA-ES		1.1	2.9	2.7	<i>20e-1/1e5</i>	.	.	.	.	.	.	BIPOP-CMA-ES [15]
(1+1)-CMA-ES		1	1.6	15	460	<i>30e-1/1e4</i>	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA		15	13	1	1.8	5.9	5.7	5.6	5.6	5.7	5.9	DASA [19]
DEPSO		1.8	5.2	3.3	<i>30e-1/2e3</i>	.	.	.	.	.	.	DEPSO [12]
DIRECT		1	2.5	190	110	250	<i>11e+0/2e4</i>	.	.	.	.	DIRECT [25]
EDA-PSO		1.1	3.5	14	2e3	<i>20e-1/1e5</i>	.	.	.	.	.	EDA-PSO [6]
full NEWUOA		3.9	2.8	12	<i>30e-1/1e4</i>	.	.	.	.	.	.	full NEWUOA [31]
G3-PCX		1.5	4.6	76	2200	<i>50e-1/5e4</i>	.	.	.	.	.	G3-PCX [26]
simple GA		1.9	5	18	20	26	33	41	49	58	190	simple GA [22]
GLOBAL		1.3	4.9	8.3	<i>11e+0/600</i>	.	.	.	.	.	.	GLOBAL [23]
iAMaLgAM IDEA		1.7	2.3	3.9	2.1e4	<i>20e-1/1e6</i>	.	.	.	.	.	iAMaLgAM IDEA [4]
LSfminbnd		21	3	7.8	<i>42e-1/5e3</i>	.	.	.	.	.	.	LSfminbnd [28]
LStep		320	58	2	1	1	1	1	1	1	1	LStep [28]
MA-LS-Chain		1.5	3.8	1.7	35	180	170	160	160	160	160	MA-LS-Chain [21]
MCS (Neum)		1	2.3	4.1	<i>20e-1/1e4</i>	.	.	.	.	.	.	MCS (Neum) [18]
NELDER (Han)		3.1	1.4	26	<i>30e-1/1e5</i>	.	.	.	.	.	.	NELDER (Han) [16]
NELDER (Doe)		1.9	1	7.1	900	870	840	810	790	780	770	NELDER (Doe) [5]
NEWUOA		4.1	27	27	300	<i>60e-1/7e3</i>	.	.	.	.	.	NEWUOA [31]
(1+1)-ES		3.3	2	25	3700	2e4	1.9e4	1.9e4	1.8e4	1.8e4	1.8e4	(1+1)-ES [1]
POEMS		210	67	4.5	17	45	47	47	49	52	57	POEMS [20]
PSO		1.7	2.7	3	140	4200	4e3	3900	3800	3700	3700	PSO [7]
PSO-Bounds		1.6	3.2	8	30	64	110	110	110	110	140	PSO-Bounds [8]
Monte Carlo		1.3	3.4	1.6e4	<i>12e+0/1e6</i>	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock		5.1	33	57	<i>99e-1/1e4</i>	.	.	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES		1.5	2.1	1	<i>37e-1/1e4</i>	.	.	.	.	.	.	IPOP-SEP-CMA-ES [29]
VNS (Garcia)		2	5.6	2.5	16	39	38	39	50	54	130	VNS (Garcia) [11]

Table 5: 05-D, running time excess ERT/ERT_{best} on f_5 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

		5 Linear slope											
Δf_{target} ERT_{best}/D		1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} ERT_{best}/D	
		0.2	0.293	2	2	2	2	2	2	2	2		
ALPS	1	1.5	64	130	160	160	160	160	160	160	160	ALPS [17]	
AMaLgAM IDEA	1	2	19	28	29	29	29	29	29	29	29	AMaLgAM IDEA [4]	
avg NEWUOA	1	4.1	1.8	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	avg NEWUOA [31]	
BayEDAacG	1	1.7	38	76	320	320	320	320	320	320	320	BayEDAacG [10]	
BFGS	1	5.9	1.9	3	3.1	3.1	3.1	3.1	3.1	3.1	3.1	BFGS [30]	
Cauchy-EDA	1	29	39	41	41	41	41	41	41	41	41	Cauchy-EDA [24]	
BIPOP-CMA-ES	1	2.5	4.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6	6.6	BIPOP-CMA-ES [15]	
(1+1)-CMA-ES	1	2	2.3	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	(1+1)-CMA-ES [2]	
DASA	1	45	28	36	40	43	49	52	55	63	63	DASA [19]	
DEPSO	1	2	22	37	41	41	41	41	41	41	41	DEPSO [12]	
DIRECT	1	4.5	9.2	12	13	13	13	13	13	13	13	DIRECT [25]	
EDA-PSO	1	1	10	16	16	16	16	17	17	17	17	EDA-PSO [6]	
full NEWUOA	1	1.5	2.2	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	full NEWUOA [31]	
G3-PCX	1	1.8	14	25	27	28	28	28	28	28	28	G3-PCX [26]	
simple GA	1	1.9	480	2100	4e3	6300	9200	1.2e4	1.7e4	3.4e4	3.4e4	simple GA [22]	
GLOBAL	1	2.3	32	33	34	34	34	34	34	34	34	GLOBAL [23]	
iAMaLgAM IDEA	1	1.4	7.1	11	12	12	12	12	12	12	12	iAMaLgAM IDEA [4]	
LSfimbnd	1	18	13	14	14	14	14	14	14	14	14	LSfimbnd [28]	
LSstep	1	180	140	160	160	160	160	160	160	160	160	LSstep [28]	
MA-LS-Chain	1	1.5	53	69	70	71	71	71	71	71	71	MA-LS-Chain [21]	
MCS (Neum)	1	3	1	1	1	1	1	1	1	1	1	MCS (Neum) [18]	
NELDER (Han)	1	3.9	2.5	4.1	4.2	4.2	4.2	4.2	4.2	4.2	4.2	NELDER (Han) [16]	
NELDER (Doe)	1	3.1	1.9	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	NELDER (Doe) [5]	
NEWUOA	1	2.9	1.3	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	NEWUOA [31]	
(1+1)-ES	1	3	2	2.4	2.5	2.6	2.6	2.6	2.6	2.6	2.6	(1+1)-ES [1]	
POEMS	1	350	150	200	210	220	220	220	220	220	220	POEMS [20]	
PSO	1	1.7	10	14	16	16	16	16	16	16	16	PSO [7]	
PSO_Bounds	1	1.6	9.2	15	16	16	16	16	16	16	16	PSO_Bounds [8]	
Monte Carlo	1	1.6	4300	<i>37e-1/1e6</i>	.	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	1	11	4	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2	Rosenbrock [27]	
IPOP-SEP-CMA-ES	1	5.7	4.8	6.6	6.8	6.9	6.9	6.9	6.9	6.9	6.9	IPOP-SEP-CMA-ES [29]	
VNS (Garcia)	1	2.2	13	15	15	15	15	15	15	15	15	VNS (Garcia) [11]	

Table 6: 05-D, running time excess ERT/ERT_{best} on f_6 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	Δt_{target} ERT_{best}/D	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δt_{target} ERT_{best}/D
ALPS	31	3.2	20	22.8	28	40	41	39	39	34	37	ALPS [17]
AMaLGaM IDEA	6.6	5.7	3.2	4.3	4.3	5.7	5.7	5.2	5	4.3	4.5	AMaLGaM IDEA [4]
avg NEWUOA	1.2	2.6	1.3	1.6	1.6	2.6	2.6	2.6	2.6	2.4	2.5	avg NEWUOA [31]
BayEDAacG	8.8	10	250	<i>13e+0/2e3</i>								BayEDAacG [10]
BFGS	2.9	4.9	3	3.3	3.3	3.4	3	2.5	2.3	2	7.8	BFGS [30]
Cauchy EDA	49	230	92	69	69	68	58	47	43	35	34	Cauchy EDA [24]
BIPOP-CMA-ES	2.5	5.2	2.3	2.1	2.1	2.2	1.9	1.7	1.6	1.3	1.3	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1.6	3.3	1.4	1.4	1.4	1.6	1.7	1.6	1.5	1.6	1.8	(1+1)-CMA-ES [2]
DASA	21	21	7.8	9	9	50	99	110	100	81	150	DASA [19]
DEPSO	6.3	8.3	5.5	6.4	6.4	8	8	7.1	7	6.3	9.7	DEPSO [12]
DIRECT	2.5	2.2	2.3	28	28	790	1200	<i>22e-2/2e4</i>				DIRECT [25]
EDA-PSO	5	4.9	11	51	51	81	85	79	75	65	68	EDA-PSO [6]
full NEWUOA	1.5	7.2	1.2	1	1	1	1	1	1	1	1.4	full NEWUOA [31]
G3-PCX	60	81	66	150	150	4.8	5.1	4.7	5.6	5.1	5.5	G3-PCX [26]
simple GA	12	10	2.9	2.1	2.1	380	3700	1.2e4	9700	<i>24e-3/1e5</i>		simple GA [22]
GLOBAL	3	3.6	2.1	2.3	2.3	3.1	3.1	2.7	2.7	3.6	35	GLOBAL [23]
iAMaLGaM IDEA	9.1	14	96	110	110	130	150	110	110	82	65	iAMaLGaM IDEA [4]
LSfminbnd	160	200	410	290	290	300	420	600	490	<i>21e-2/1e4</i>		LSfminbnd [28]
LSstep	12	11	4.8	6.8	6.8	7.9	7.4	5.8	5.1	4.1	3.7	LSstep [28]
MA-LS-Chain	1	1	2.7	47	47	41	61	71	63	46	54	MA-LS-Chain [21]
MCS (Neum)	1.7	2.4	1	1.9	1.9	2.8	2.6	2.3	2.3	2	2.6	MCS (Neum) [18]
NELDER (Han)	2.3	11	5.1	5.6	5.6	4.9	5.3	6.6	6.6	5.6	8.5	NELDER (Han) [16]
NELDER (Doe)	1.4	2.8	1.7	2.4	2.4	3.6	3.6	3.3	3.2	2.7	2.9	NELDER (Doe) [5]
NEWUOA	1.7	3.4	1.6	1.5	1.5	1.7	1.5	1.3	1.2	1	1	NEWUOA [31]
(1+1)-ES	95	80	27	46	46	52	50	46	42	37	37	(1+1)-ES [1]
POEMS	5.2	5.3	4.7	9	9	11	12	11	12	10	11	POEMS [20]
PSO	4.4	4.4	14	49	49	85	100	98	92	78	92	PSO [7]
PSO_Bounds	290	480	300	5.7e4	5.7e4							PSO_Bounds [8]
Monte Carlo	3	2.6	2.2	2.8	2.8	2.4	2.2	4.3	3.8	2.8	2.4	Monte Carlo [3]
Rosenbrock	2.4	7	2.8	2.5	2.5	2.7	2.4	2.2	2	1.6	1.5	Rosenbrock [27]
IPOP-SEP-CMA-ES	2.4	7.7	12	3.7	3.7	2.9	2.5	2	1.8	1.5	1.4	IPOP-SEP-CMA-ES [29]
VNS (Garcia)												VNS (Garcia) [11]

Table 7: 05-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_7 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

7 Step-ellipsoid												
	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	$\text{ERT}_{\text{best}}/D$											$\text{ERT}_{\text{best}}/D$
ALPS	1.1	0.2	1.24	4.72	64.7	234	7.7	9	9	9	9.7	ALPS [17]
AMaLgAM IDEA	1.3	2.3	2.8	5.6	1	1.2	1.8	2.3	2.3	2.3	2.4	AMaLgAM IDEA [4]
avg NEWUOA	1.1	2.5	2.5	4.4	5.9	13	130	<i>17e-3/8e3</i>	.	.	.	avg NEWUOA [31]
BayEDAeG	1.5	2.4	2.4	20	31	120	99	<i>73e-2/2e3</i>	.	.	.	BayEDAeG [10]
BFGS	3	14	<i>32e+0/100</i>									BFGS [30]
Cauchy EDA	10	31	33	33	4.9	2.4	2.9	2.9	2.9	2.9	3.4	Cauchy EDA [24]
BIPOP-CMA-ES	1.7	2.2	2.2	5	1.5	1	1	1	1	1	1	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1.6	1.6	3.5	5.3	2	2.1	3.1	3.1	3.1	3.1	(1+1)-CMA-ES [2]
DASA	24	43	230	230	280	1100	2e4	<i>16e-3/8e5</i>	.	.	.	DASA [19]
DEPSO	1.2	6.5	14	14	3	5	7.2	8.3	8.3	8.3	8.5	DEPSO [12]
DIRECT	1	1	2.8	1.7	1.7	120	<i>41e-3/2e4</i>	.	.	.	.	DIRECT [25]
EDA-PSO	1.3	1.7	1.7	22	24	13	17	18	18	18	19	EDA-PSO [6]
full NEWUOA	1.7	3.3	3.3	1	1.2	4	14	24	24	24	23	full NEWUOA [31]
G3-PCX	1.3	2.5	2.5	19	18	45	150	410	410	410	410	G3-PCX [26]
simple GA	1.4	3.5	3.5	50	35	57	240	520	520	520	520	simple GA [22]
GLOBAL	1.6	2.9	2.9	12	5.7	10	<i>82e-2/400</i>	.	.	.	.	GLOBAL [23]
iAMaLgAM IDEA	1.2	2.3	2.3	3.8	1.9	3	2.9	3.7	3.7	3.7	3.7	iAMaLgAM IDEA [4]
LSfminbd	3.8	17	49	49	64	100	510	<i>40e-2/1e4</i>	.	.	.	LSfminbd [28]
LStep	28	190	370	370	700	640	<i>19e-1/1e4</i>	.	.	.	.	LStep [28]
MA-LS-Chain	1.1	3.5	8.4	8.4	3.2	13	13	24	24	24	24	MA-LS-Chain [21]
MCS (Neum)	1	1.3	2.8	2.8	5.9	13	140	<i>25e-3/1e4</i>	.	.	.	MCS (Neum) [18]
NELDER (Han)	1.1	1.6	2.7	27	33	56	120	310	310	310	300	NELDER (Han) [16]
NELDER (Doe)	1.4	1.3	1.4	9.9	7.5	15	39	71	71	71	71	NELDER (Doe) [5]
NEWUOA	1.5	2.2	2.2	9.9	13	60	<i>32e-2/6e3</i>	.	.	.	.	NEWUOA [31]
(1+1)-ES	1.9	2.6	2.6	5.6	6.8	100	370	810	810	810	790	(1+1)-ES [1]
POEMS	400	180	74	74	15	9.2	11	21	21	21	22	POEMS [20]
PSO	1.1	4	11	11	9.5	590	480	540	540	540	530	PSO [7]
PSO_Bounds	1.3	2.3	2.3	9.4	13	170	140	130	130	130	130	PSO_Bounds [8]
Monte Carlo	1.3	2.9	2.9	39	1200	<i>38e-2/1e6</i>	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	11	220	1200	1200	670	<i>13e+0/3e3</i>	.	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES	1.1	2.5	2.5	6	1.8	1.2	1.2	1.2	1.2	1.2	1.2	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	3.5	11	11	1.6	6.8	6.6	7.8	7.8	7.8	7.8	VNS (Garcia) [11]

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

	$\Delta\text{ftarget}$ $\text{ERT}_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta\text{ftarget}$ $\text{ERT}_{\text{best}}/D$
ALPS	11	32	51	49	54.6	67.3	150	78.2	80.2	82	84.4	ALPS [17]
AMaLgAm IDEA	3.1	4.3	5.2	6.1	6.1	7.7	8.1	8.5	8.9	9.1	9.7	AMaLgAm IDEA [4]
avg NEWUOA	1.3	1.6	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	avg NEWUOA [31]
BayEDA _{cG}	5.5	11	140	<i>45e-1/2e3</i>								BayEDA _{cG} [10]
BFGS	2.1	2.4	2.1	1.8	1.8	1.6	1.5	1.5	1.5	1.5	1.5	BFGS [30]
Cauchy EDA	24	32	49	31	31	33	33	34	36	37	40	Cauchy EDA [24]
BIPOP-CMA-ES	2.7	3.6	3.2	3.7	4.5	4.7	4.7	4.8	5	5.1	5.4	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	2.1	2.1	2.1	5.1	5	5	4.9	4.9	4.9	4.9	5	(1+1)-CMA-ES [2]
DASA	16	21	19	160	160	390	700	1e3	1500	2e3	3300	DASA [19]
DEPSO	4.7	7.2	12	18	18	<i>23e-2/2e3</i>						DEPSO [12]
DIRECT	2.5	2.8	4.1	5.7	22	22	56	100	150	190	290	DIRECT [25]
EDA-PSO	3.7	10	72	100	100	200	300	400	520	620	840	EDA-PSO [6]
full NEWUOA	2.3	2.2	1.6	1	1	1	1	1	1	1	1	full NEWUOA [31]
G3-PCX	5.5	5.3	4.6	20	20	18	17	17	16	16	16	G3-PCX [26]
simple GA	8.4	110	190	840		<i>78e-2/1e5</i>						simple GA [22]
GLOBAL	11	7.4	5	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	GLOBAL [23]
iAMaLgAm IDEA	2.3	2.8	3.4	7.5	290	450	7.7	7.7	8	8.1	8.4	iAMaLgAm IDEA [4]
LSfminbnd	5.5	9.1	10	290	290	7.6	7.7	<i>34e-1/1e4</i>				LSfminbnd [28]
LSstep	78	64	64	95	95	330	910	1800	1800	<i>53e-2/1e4</i>		LSstep [28]
MA-LS-Chain	5.8	7.3	8.7	7.2	7.2	9.6	10	11	11	11	12	MA-LS-Chain [21]
MCS (Neum)	1	1.4	1.5	1	1	1	1	1.1	1.1	1.1	1.1	MCS (Neum) [18]
NELDER (Han)	1.3	1.6	1.6	3.7	3.7	3.3	3.2	3.1	3.1	3.1	3.2	NELDER (Han) [16]
NELDER (Doe)	1.1	2.3	2.1	2.4	2.4	2.4	2.3	2.3	2.3	2.4	2.4	NELDER (Doe) [5]
NEWUOA	1	1	1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	NEWUOA [31]
(1+1)-ES	2.7	22	15	240	240	230	240	260	290	320	380	(1+1)-ES [1]
POEMS	67	40	69	180	180	200	390	750	2100	5500	1.8e4	POEMS [20]
PSO	3.8	7.1	13	150	150	200	310	470	620	780	1100	PSO [7]
PSO-Bounds	5.1	12	30	470	470	920	1200	1400	3e3	<i>12e-5/1e5</i>		PSO-Bounds [8]
Monte Carlo	10	220	2e4									Monte Carlo [3]
Rosenbrock	2.3	53	32	23	23	22	23	25	27	30	36	Rosenbrock [27]
IPOP-SEP-CMA-ES	1.7	2.8	3.5	5.8	5.8	6.8	6.7	6.8	6.8	6.9	7.1	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	8.9	5.9	5.1	6.6	6.6	7.7	21	46	48	47	46	VNS (Garcia) [11]

Table 9: 05-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_9 , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$\Delta\text{ftarget}$ $\text{ERT}_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta\text{ftarget}$ $\text{ERT}_{\text{best}}/D$
ALPS	140	0.2	0.2	6.92	25.4	42.8	200	260	310	370	560	ALPS [17]
AMaLgAM IDEA	53	140	9.1	9.1	23	18	17	16	16	16	15	AMaLgAM IDEA [4]
avg NEWUOA	20	56	2.4	2.4	3.1	2.1	1.8	1.7	1.6	1.6	1.5	avg NEWUOA [31]
BayEDA-cG	81	350	38	38	<i>39e-1/2e3</i>	2	1.8	1.6	1.5	1.5	1.4	BayEDA-cG [10]
BFGS	31	84	3.6	3.6	3	2	1.8	1.6	1.5	1.5	1.4	BFGS [30]
Cauchy EDA	400	910	71	71	54	45	42	41	41	42	43	Cauchy EDA [24]
BIPOP-CMA-ES	28	98	5.8	5.8	8.7	7.2	6.7	6.4	6.2	6.3	6.2	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	30	86	4.2	4.2	7.7	5.9	5.3	5	4.9	4.9	4.7	(1+1)-CMA-ES [2]
DASA	330	7500	230	230	6700	4800	4600	4800	5300	6600	8900	DASA [19]
DEPSO	100	370	22	22	150	<i>10e-1/2e3</i>	2	1.8	1.5	1.5	1.4	DEPSO [12]
DIRECT	1	1	3.2	3.2	4.2	48	56	130	140	150	310	DIRECT [25]
EDA-PSO	70	410	250	250	210	270	470	700	1100	1300	2800	EDA-PSO [6]
full NEWUOA	33	72	2.6	2.6	2.7	1.9	1.7	1.5	1.5	1.4	1.3	full NEWUOA [31]
G3-PCX	94	380	14	14	18	14	12	11	11	10	9.8	G3-PCX [26]
simple GA	100	3800	420	420	5.6e4	<i>17e-1/1e5</i>	3	2.8	2.7	2.7	2.7	simple GA [22]
GLOBAL	210	340	11	11	4.6	3.2	3	2.8	2.7	2.7	2.7	GLOBAL [23]
iAMaLgAM IDEA	42	120	7	7	22	15	14	13	12	12	12	iAMaLgAM IDEA [4]
LSfminbnd	60	330	13	13	130	180	440	<i>25e-3/1e4</i>	2.7	2.7	2.7	LSfminbnd [28]
LSstep	2e3	1.3e4	520	520	5600	<i>19e-1/1e4</i>	3	2.8	2.7	2.7	2.7	LSstep [28]
MA-LS-Chain	84	260	18	18	20	17	17	17	16	16	16	MA-LS-Chain [21]
MCS (Neum)	1	1	1	1	1	1	1	1	1	1	1	MCS (Neum) [18]
NELDER (Han)	13	62	3.1	3.1	1.3	8.2	6.9	6.2	5.9	5.8	5.4	NELDER (Han) [16]
NELDER (Doe)	21	56	2.4	2.4	3.1	2.5	2.3	2.1	2.1	2.1	2	NELDER (Doe) [5]
NEWUOA	16	28	1.8	1.8	3.6	2.5	2.1	1.9	1.9	1.9	1.7	NEWUOA [31]
(1+1)-ES	29	64	2.9	2.9	100	80	99	130	160	200	270	(1+1)-ES [1]
POEMS	1200	1700	140	140	130	290	590	1100	1900	1.1e4	<i>39e-6/1e5</i>	POEMS [20]
PSO	66	290	25	25	940	680	790	1100	1400	2400	2800	PSO [7]
PSO-Bounds	69	360	220	220	1500	1600	1800	4e3	1.1e4	2.2e4	2e4	PSO-Bounds [8]
Monte Carlo	180	1.3e4	4.1e4	4.1e4	<i>58e-1/1e6</i>	2	1.8	1.6	1.5	1.5	1.4	Monte Carlo [3]
Rosenbrock	32	150	5.3	5.3	9.8	10	14	14	14	14	14	Rosenbrock [27]
IPOP-SEP-CMA-ES	43	230	9.8	9.8	11	9.9	8.8	8.3	8	8	7.7	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	60	250	11	11	18	14	12	11	11	11	10	VNS (Garcia) [11]

9 Rosenbrock rotated

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D	34.1	69.9	320	890	115	121	125	129	166	176	ERT_{best}/D
ALPS	29	54	88	320	890	115	121	125	129	166	176	ALPS [17]
AMaLGaM IDEA	2.7	2.6	1.9	1.9	2	2.3	2.3	2.5	2.7	2.3	2.6	AMaLGaM IDEA [4]
avg NEWUOA	1.2	2.2	3.1	4.6	6.6	8.1	8.1	10	12	11	14	avg NEWUOA [31]
BayEDAacG	400	840	<i>28e+2/2e3</i>									BayEDAacG [10]
BFGS	1.7	1.5	1	1	1	1	1	1	1	1.1	23	BFGS [30]
Cauchy EDA	16	16	11	9	9.4	11	11	12	13	11	13	Cauchy EDA [24]
BIPOP-CMA-ES	5.1	5.1	3.5	2.9	2.7	2.7	2.7	2.8	2.8	2.3	2.4	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	3.2	3.8	2.5	2.2	2	2.1	2.1	2.1	2.1	1.7	1.7	(1+1)-CMA-ES [2]
DASA	99	1100	6900	1.8e4	3.9e4	5.9e4	5.9e4	1.2e5	1.1e5	9e4	<i>47e-1/1e6</i>	DASA [19]
DEPSO	18	78	210	<i>88e+0/2e3</i>								DEPSO [12]
DIRECT	8.8	57	110	140	280	<i>15e-2/2e4</i>						DIRECT [25]
EDA-PSO	71	130	890	1400	3900	1.2e4	<i>21e-1/1e5</i>					EDA-PSO [6]
full NEWUOA	1	2	3.6	6.2	8.7	10	10	13	15	13	17	full NEWUOA [31]
G3-PCX	3.3	7.2	22	27	36	41	41	49	57	51	64	G3-PCX [26]
simple GA	130	500	2400	<i>15e+0/1e5</i>								simple GA [22]
GLOBAL	3.8	3	1.9	1.6	1.8	1.9	1.9	2	2.2	1.7	1.7	GLOBAL [23]
iAMaLGaM IDEA	2.2	2.2	1.8	1.6	1.7	1.7	1.9	2	2.2	1.8	2	iAMaLGaM IDEA [4]
LSfminbnd	160	780	<i>25e+1/1e4</i>									LSfminbnd [28]
LSStep	1200	<i>25e+2/1e4</i>										LSStep [28]
MA-LS-Chain	7.1	9.9	9	9.3	8.6	8.6	8.6	8.8	8.7	6.9	6.9	MA-LS-Chain [21]
MCS (Neum)	53	110	280	<i>17e+0/1e4</i>								MCS (Neum) [18]
NELDER (Han)	1.1	1.2	1.4	1.3	1.4	1.4	1.4	1.5	1.5	1.2	1.2	NELDER (Han) [16]
NELDER (Doe)	1	1	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1	1	NELDER (Doe) [5]
NEWUOA	1.5	2.6	3.1	5.5	8.1	11	11	14	17	16	21	NEWUOA [31]
(1+1)-ES	34	130	700	2500	4500	5900	5900	1.4e4	5.8e4	<i>67e-5/1e6</i>		(1+1)-ES [1]
POEMS	41	170	790	2500	<i>45e-1/1e5</i>							POEMS [20]
PSO	15	120	1700	3300	<i>10e+0/1e5</i>							PSO [7]
PSO_Bounds	290	1200	3800	1.5e4	<i>20e+0/1e5</i>							PSO_Bounds [8]
Monte Carlo	990	4.7e4	<i>10e+1/1e6</i>									Monte Carlo [3]
Rosenbrock	11	25	24	44	40	38	38	37	36	29	37	Rosenbrock [27]
IPOP-SEP-CMA-ES	10	12	7.4	5.6	5.1	5	5	5	5	4	3.9	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	6.6	6.2	4.5	3.5	3.4	3.4	3.4	3.5	3.5	2.8	2.8	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D											ERT_{best}/D
ALPS	15	23	54	28.5	340	300	540	810	1100	1800	2.2e4	ALPS [17]
AMaLGaM IDEA	4.5	5.4	2.1	2.7	2.7	1	1	1	1	1	1.1	AMaLGaM IDEA [4]
avg NEWUOA	11	15	5.4	7.2	<i>15e+0/2e3</i>	2.7	2.6	2.8	2.9	3.1	3.4	avg NEWUOA [31]
BayEDAeG	9.1	15	160									BayEDAeG [10]
BFGS	2.1	1.8	1	1	1	1.1	1.9	8.2	21	200	<i>32e-6/8e3</i>	BFGS [30]
Cauchy EDA	25	51	18	17	17	6	5.5	5.3	5.4	5.6	5.9	Cauchy EDA [24]
BIPOP-CMA-ES	6.4	15	8.4	7.2	7.2	2.2	1.8	1.6	1.5	1.4	1.3	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	4	7	6.5	6.6	6.6	2.1	1.8	1.5	1.4	1.3	1.2	(1+1)-CMA-ES [2]
DASA	11	12	1900	5200	<i>10e+0/2e3</i>	2300	2800	3200	4200	9700	4.5e4	DASA [19]
DEPSO	11	22	140									DEPSO [12]
DIRECT	5.8	15	87		2200	<i>19e-1/2e4</i>						DIRECT [25]
EDA-PSO	8.9	30	110	650	650	970	2400	6200	5500	<i>70e-3/1e5</i>		EDA-PSO [6]
full NEWUOA	2.7	20	11	14	14	5.4	4.9	5.3	5.5	5.9	6.5	full NEWUOA [31]
G3-PCX	7.6	7.9	55	340	110	45	44	49	52	56	61	G3-PCX [26]
simple GA	15	34	340	7100	7100	9400	<i>21e-1/1e5</i>					simple GA [22]
GLOBAL	13	10	4	5.5	5.5	3.5	5.1	5	4.8	5	8.5	GLOBAL [23]
iAMaLGaM IDEA	6.1	6.6	3.4	3.8	3.8	1.2	1.1	1	1	1	1	iAMaLGaM IDEA [4]
LSfminbd	2.7	320	<i>61e+0/1e4</i>									LSfminbd [28]
LSstep	3.6	750	4900		<i>73e+0/1e4</i>							LSstep [28]
MA-LS-Chain	7.9	8.7	15	19	19	6.7	5.6	4.9	4.4	4.2	3.8	MA-LS-Chain [21]
MCS (Neum)	1	1	82	460	460	<i>13e-1/1e4</i>						MCS (Neum) [18]
NELDER (Han)	2.9	2.7	3.2	5	5	1.7	1.6	1.5	1.5	1.5	1.6	NELDER (Han) [16]
NELDER (Doe)	4.4	3.4	4.5	4.7	4.7	1.5	1.4	1.2	1.2	1.1	1.2	NELDER (Doe) [5]
NEWUOA	1.7	5.9	3.5	4.7	4.7	1.8	1.7	1.8	1.8	2	2.2	NEWUOA [31]
(1+1)-ES	2.8	6700	6400	9300	9300	3700	3800	6700	2.8e4	<i>90e-5/1e6</i>		(1+1)-ES [1]
POEMS	88	61	230	510	510	270	350	630	800	940	2200	POEMS [20]
PSO	8.2	13	91	240	240	120	140	160	190	240	390	PSO [7]
PSO_Bounds	7.2	21	430	1400	1400	1e3	1e3	1100	1600	1500	1400	PSO_Bounds [8]
Monte Carlo	7.4	30	730	1.1e5	1.1e5	<i>11e-1/1e6</i>						Monte Carlo [3]
Rosenbrock	2.2	12	120	88	88	26	21	18	16	14	13	Rosenbrock [27]
IPOP-SEP-CMA-ES	18	33	16	14	14	4.2	3.4	2.9	2.6	2.5	2.2	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	11	34	11	8.7	8.7	2.5	2.1	1.8	1.6	1.6	1.5	VNS (Garcia) [11]

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

12 Bent cigar												
	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT _{best} /D											ERT _{best} /D
ALPS	100	13.3	120	130	170	540	1400	4200	1.4e4	2.7e4	<i>24e-5/1e6</i>	ALPS [17]
AMaLGaM IDEA	8.8	9.2	9.2	10	6.7	8.6	9.8	11	4.9	5.1	5.2	AMaLGaM IDEA [4]
avg NEWUOA	1.1	1.8	1.8	3.5	2.8	2.8	2.9	3	1.3	1.3	1.4	avg NEWUOA [31]
BayEDAacG	46	46	46	96	260	390	<i>71e-1/2e3</i>	.	.	.	.	BayEDAacG [10]
BFGS	1.1	1.1	1.1	1.1	1	1	1	1	1.3	2	49	BFGS [30]
Cauchy EDA	66	75	79	41	35	37	37	38	17	17	17	Cauchy EDA [24]
BIPOP-CMA-ES	5.1	6.3	11	7.4	7.4	7.5	7.5	7.7	3.4	3.3	3.3	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	2.8	3.4	4	2.9	3.5	3.5	3.9	4.1	1.9	1.9	1.9	(1+1)-CMA-ES [2]
DASA	17	17	1.2e4	5.4e4	5.9e4	1.8e5	<i>32e-1/1e6</i>	.	.	.	.	DASA [19]
DEPSO	23	33	55	47	120	<i>95e-2/2e3</i>	.	.	.	.	.	DEPSO [12]
DIRECT	6.6	8	8.5	8.7	19	39	110	96	380	<i>21e-6/2e4</i>	.	DIRECT [25]
EDA-PSO	310	390	1100	3e3	8900	<i>21e-1/1e5</i>	.	.	.	.	.	EDA-PSO [6]
full NEWUOA	1	1.5	3.7	2.6	2.7	3	3.3	3.3	1.6	1.6	1.7	full NEWUOA [31]
G3-PCX	4	4.2	14	11	13	13	13	12	5.3	5.2	5.1	G3-PCX [26]
simple GA	520	620	930	2400	1.9e4	<i>11e-1/1e5</i>	.	.	.	.	.	simple GA [22]
GLOBAL	5.6	5	4.6	2.7	2.4	3	3	5	3	3.1	3.4	GLOBAL [23]
iAMaLGaM IDEA	5.5	6.1	6.9	4.3	4	4.3	4.3	4.7	2.1	2.1	2.3	iAMaLGaM IDEA [4]
LSfminbnd	3.4	3.6	310	1200	1900	<i>68e-1/1e4</i>	.	.	.	.	.	LSfminbnd [28]
LSstep	23	26	460	1200	<i>57e-1/1e4</i>	.	.	.	.	.	.	LSstep [28]
MA-LS-Chain	11	11	11	13	16	15	15	16	6.9	6.7	6.5	MA-LS-Chain [21]
MCS (Neum)	1.2	1.1	1.1	1	18	17	15	22	22	26	56	MCS (Neum) [18]
NELDER (Han)	1.4	1.7	2.3	2.2	2.2	2.2	2.2	2.3	1	1	1	NELDER (Han) [16]
NELDER (Doe)	1.6	2.4	4.4	2.9	2.7	2.7	2.7	2.7	1.2	1.1	1.2	NELDER (Doe) [5]
NEWUOA	1.1	1.5	3.5	2.6	2.5	2.5	2.5	2.6	1.1	1.1	1.1	NEWUOA [31]
(1+1)-ES	2.6	1200	2.1e4	6.1e4	1.9e5	<i>23e-1/1e6</i>	.	.	.	.	.	(1+1)-ES [1]
POEMS	180	210	1900	2900	8900	<i>17e-1/1e5</i>	.	.	.	.	.	POEMS [20]
PSO	28	35	750	3800	5400	7900	1.5e4	1.5e4	<i>41e-1/1e5</i>	.	.	PSO [7]
PSO_Bounds	120	180	1900	2500	5500	1.7e4	<i>46e-1/1e5</i>	.	.	.	.	PSO_Bounds [8]
Monte Carlo	.	.	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	1.4	1.4	98	63	91	100	100	95	46	42	48	Rosenbrock [27]
IPOP-SEP-CMA-ES	4.6	6.2	12	11	9.1	8.7	8.7	8.6	3.7	3.5	3.3	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	6.9	9	19	12	10	9.7	9.7	9.4	4	3.8	3.6	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D											ERT_{best}/D
ALPS	2.7	43	43	50	83	280	440	570	2300	3900	<i>76e-7/1e6</i>	ALPS [17]
AMaLGaM IDEA	3.3	5.8	4.2	4.2	4.6	4.9	4.9	1.5	1.5	1.4	1.4	AMaLGaM IDEA [4]
avg NEWUOA	4	1	4.5	8.1	42	42	67	68	450	390	<i>15e-4/9e3</i>	avg NEWUOA [31]
BayEDAeG	1.9	38	170	350	<i>19e+0/2e3</i>							BayEDAeG [10]
BFGS	4.6	1.2	1	1	1	1	1	4.8	24	140	<i>37e-6/1e4</i>	BFGS [30]
Cauchy EDA	54	31	21	24	25	25	25	7.4	7.5	7.3	7.3	Cauchy EDA [24]
BiPOP-CMA-ES	3.4	3.8	3.9	5.4	5.9	6.1	6.3	1.6	1.6	1.5	1.7	BiPOP-CMA-ES [15]
(1+1)-CMA-ES	2.6	2.1	4.4	6.3	6.1	6.1	6.3	1.9	2.9	3.2	3.1	(1+1)-CMA-ES [2]
DASA	54	51	200	640	2500	7800	5e3	1.4e4		<i>23e-4/1e6</i>		DASA [19]
DEPSO	2.1	8.7	11	350	280	240	240	<i>21e-1/2e3</i>				DEPSO [12]
DIRECT	1.6	4.7	7	21	34	34	140	42	57	120	<i>12e-6/2e4</i>	DIRECT [25]
EDA-PSO	3.4	47	150	390	2e3	1e4	1e4	<i>64e-3/1e5</i>				EDA-PSO [6]
full NEWUOA	5.5	1	1.8	6.7	23	23	85	97	<i>19e-4/1e4</i>			full NEWUOA [31]
G3-PCX	3.3	3.9	120	240	730	4400	340	120	260	590	<i>15e-5/5e4</i>	G3-PCX [26]
simple GA	2.6	120	240	240	2.2e4	2.2e4	2.2e4	<i>20e-2/1e5</i>				simple GA [22]
GLOBAL	3.4	7.4	4.2	6.1	11	11	<i>19e-2/300</i>					GLOBAL [23]
iAMaLGaM IDEA	1.9	3.1	2.6	3	3.2	3.2	3.3	1	1	1	1	iAMaLGaM IDEA [4]
LSfminbd	14	15	33	150	540	1100	1100	<i>19e-2/1e4</i>				LSfminbd [28]
LSstep	250	140	550	1100	2900	2900	<i>22e+0/1e4</i>					LSstep [28]
MA-LS-Chain	1.8	9.9	8.3	21	24	19	19	5.1	4.8	5.3	4.9	MA-LS-Chain [21]
MCS (Neum)	1	1.6	41	210	460	2300	2300	<i>21e-2/1e4</i>				MCS (Neum) [18]
NELDER (Han)	2.2	1.2	2	3.8	5.3	5.3	4.9	1.3	1.3	1.2	1.3	NELDER (Han) [16]
NELDER (Doe)	2.9	1.7	2.4	2.4	5.3	5.3	6.1	1.9	2.5	3.9	5	NELDER (Doe) [5]
NEWUOA	2.6	1.8	3.1	9.3	35	35	55	54	120	330	<i>17e-4/8e3</i>	NEWUOA [31]
(1+1)-ES	4.3	11	20	30	110	110	250	160	350	1500	7200	(1+1)-ES [1]
POEMS	310	57	87	660	5600	1e4	1e4	<i>22e-2/1e5</i>				POEMS [20]
PSO	3	8.7	1600	1e4	2.8e4	<i>57e-1/1e5</i>						PSO [7]
PSO_Bounds	1.3	20	350	2400	5700	5700	1e4	5400	<i>81e-2/1e5</i>			PSO_Bounds [8]
Monte Carlo	1.9	960	<i>30e+0/1e6</i>									Monte Carlo [3]
Rosenbrock	8.6	3.1	7.6	13	26	26	49	39	56	63	290	Rosenbrock [27]
IPOP-SEFP-CMA-ES	3.1	2.9	9	11	12	12	11	2.8	2.7	2.5	2.3	IPOP-SEFP-CMA-ES [29]
VNS (Garcia)	1.9	6.2	4.8	5.6	6.6	6.6	6.2	1.9	1.9	1.9	2.1	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D	0.2	0.2	1.96	8.17	11.6	72	27.7	42.2	50.3	95.1	ERT_{best}/D
ALPS	1	1.3	2.5	2.1	3.2	6.6	75	130	390	390	1e4	ALPS [17]
AMaLGaM IDEA	1	1.5	2.1	2.1	4.5	6.1	6.6	5.8	5	5.2	3.8	AMaLGaM IDEA [4]
avg NEWUOA	1	1.7	2.1	1	1	1	1	1.2	1.8	5	1e3	avg NEWUOA [31]
BayEDAacG	1	1.4	3	1.00	1.00	2.20	250	1e3	<i>12e-2/2e3</i>			BayEDAacG [10]
BFGS	1	3.4	2.2	1.7	1.8	1.8	1.5	1.3	1	1	350	BFGS [30]
Cauchy EDA	1	18	23	29	40	40	40	33	28	28	19	Cauchy EDA [24]
BIPOP-CMA-ES	1	1.3	1.1	2.8	3.7	4	4	4.6	4.3	5.4	4.5	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	2.2	1.8	1.9	2.3	2.3	2.3	2.6	3.3	4	3.2	(1+1)-CMA-ES [2]
DASA	1	18	19	18	20	20	21	49	460	3500	<i>12e-7/1e6</i>	DASA [19]
DEPSO	1	1.5	2.6	2.6	6.9	8.9	11	17	45	<i>47e-6/2e3</i>		DEPSO [12]
DIRECT	1	1	1	3.7	4.8	7.4	7.4	23	370	1900	<i>62e-6/2e4</i>	DIRECT [25]
EDA-PSO	1	1.5	1.4	7.1	96	190	190	210	190	300	<i>22e-7/1e5</i>	EDA-PSO [6]
full NEWUOA	1	2.8	2.7	1.1	1.1	1.1	1	1	1.4	3.2	26	full NEWUOA [31]
G3-PCX	1	1.1	1.7	3.5	3.5	3.6	3.6	5	9.7	26	390	G3-PCX [26]
simple GA	1	1.8	2.1	91	270	310	310	350	3300	<i>13e-5/1e5</i>		simple GA [22]
GLOBAL	1.1	1.7	2.2	7.7	5.9	4.4	4.4	3.3	2.6	3.6	<i>59e-7/300</i>	GLOBAL [23]
iAMaLGaM IDEA	1	1.3	1.4	2.7	4.3	4.3	4.5	4.1	3.5	3.6	2.7	iAMaLGaM IDEA [4]
LSfminbnd	1	3.7	5.9	4.5	4.3	7.4	7.4	70	1700	<i>35e-5/1e4</i>		LSfminbnd [28]
LSstep	1	28	120	96	97	180	180	<i>35e-4/1e4</i>				LSstep [28]
MA-LS-Chain	1	1.3	2	7.2	11	11	11	11	13	16	12	MA-LS-Chain [21]
MCS (Neum)	1	1	1.4	2.8	2.7	2.5	2.5	2.8	3.4	230	<i>10e-6/1e4</i>	MCS (Neum) [18]
NELDER (Han)	1	1.3	1.1	1.2	1.5	1.5	1.5	1.4	1.2	1.3	1	NELDER (Han) [16]
NELDER (Doe)	1	2.3	1.1	1.1	1.4	1.4	1.6	1.7	1.6	1.6	1.3	NELDER (Doe) [5]
NEWUOA	1	1.8	1.7	1	1	1	1	1.2	1.9	5.5	2500	NEWUOA [31]
(1+1)-ES	1	3	2.1	1.8	2.1	2.1	2.2	5.6	66	1100	<i>12e-7/1e6</i>	(1+1)-ES [1]
POEMS	1	180	110	42	81	130	130	140	130	630	<i>31e-7/1e5</i>	POEMS [20]
PSO	1	1.4	1.9	5.6	15	21	21	30	50	220	<i>90e-8/1e5</i>	PSO [7]
PSO_Bounds	1	1.7	1.9	12	45	74	74	140	200	410	<i>14e-7/1e5</i>	PSO_Bounds [8]
Monte Carlo	1	1.1	1.2	100	7.6e4	<i>93e-3/1e6</i>						Monte Carlo [3]
Rosenbrock	1	7.9	2.4	1.2	1.3	1.5	1.5	4.6	23	26	43	Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1.5	1.6	3	3.6	3.6	3.6	5.3	9	9.5	6.4	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1.2	3.3	5.5	5.4	5.3	5.3	5.3	5.4	7	5.5	VNS (Garcia) [11]

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

15 Rastrigin														
	Δ ftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δ ftarget		
	ERT _{best} /D											ERT _{best} /D		
ALPS	1.1	1.9	2.6	102	9	26	26	26	25	25	25	ALPS [17]		
AMaLgAM IDEA	1.3	2.7	2.7	1.7	2.6	5.3	5.2	5.2	5.1	5.1	5	AMaLgAM IDEA [4]		
avg NEWUOA	1.3	2	2	5.8	46	30e-1/6e3						avg NEWUOA [31]		
BayEDAacG	1.2	2.7	4.8	4.8	61e-1/2e3							BayEDAacG [10]		
BFGS	2.2	46	87	13e+0/3e3								BFGS [30]		
Cauchy EDA	8.7	36	12	190	24e-1/5e4							Cauchy EDA [24]		
BIPOP-CMA-ES	1	2.3	1.6	1.6	1.5	1.2	1.2	1.2	1.2	1.2	1.2	BIPOP-CMA-ES [15]		
(1+1)-CMA-ES	1.4	2	2	10	80	30e-1/1e4						(1+1)-CMA-ES [2]		
DASA	15	26	230	1700	20e-1/1e6							DASA [19]		
DEPSO	1	5.7	7.9	41e-1/2e3								DEPSO [12]		
DIRECT	1	1.2	5.4	9.4	99e-2/2e4							DIRECT [25]		
EDA-PSO	1.1	2	20	7.5	24	23	23	24	24	24	24	EDA-PSO [6]		
full NEWUOA	1.9	2.9	6.3	55	50e-1/7e3							full NEWUOA [31]		
G3-PCX	1.3	2.2	130	370	50e-1/5e4							G3-PCX [26]		
simple GA	1.1	1.9	35	91	370	360	360	360	350	350	15e-1/1e5	simple GA [22]		
GLOBAL	1	2	6	90e-1/500								GLOBAL [23]		
iAMaLgAM IDEA	1.1	1.8	1	7	9.2	9.1	9.1	9	8.9	8.8	8.6	iAMaLgAM IDEA [4]		
LSfminbnd	1	4	35	60e-1/1e4								LSfminbnd [28]		
LSstep	1.1	80	1400	80	24e+0/1e4							LSstep [28]		
MA-LS-Chain	1.1	2.3	2.6	5.3	6	5.9	5.9	5.8	5.7	5.6	5.5	MA-LS-Chain [21]		
MCS (Neum)	1	1	4	25	38	38	38	37	36	36	20e-1/1e4	MCS (Neum) [18]		
NELDER (Han)	1.7	2.5	20	43	83	81	80	80	79	77	75	NELDER (Han) [16]		
NELDER (Doe)	1.3	5	4.5	20	73	72	71	70	69	69	67	NELDER (Doe) [5]		
NEWUOA	1.9	7.8	5.8	41	30e-1/5e3							NEWUOA [31]		
(1+1)-ES	1.3	1.7	28	100	250	240	240	240	230	230	220	(1+1)-ES [1]		
POEMS	1	80	15	130	370	370	370	360	360	350	340	POEMS [20]		
PSO	1.1	1.5	16	220	370	360	350	350	350	340	330	PSO [7]		
PSO_Bounds	1.3	2.3	170	120	20e-1/1e5							PSO_Bounds [8]		
Monte Carlo	1.2	1.7	6900	83e-1/1e6								Monte Carlo [3]		
Rosenbrock	4.4	190	310	16e+0/1e4								Rosenbrock [27]		
IPOP-SEP-CMA-ES	1.5	1.7	1.6	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [29]		
VNS (Garcia)	1	3.1	2.4	5.9	680	690	690	680	690	680	670	VNS (Garcia) [11]		

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

16 Weierstrass															
Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}				
ERT_{best}/D	0.2	0.24	24.1	122	532	2030	2090	2280	2330	2420	ERT_{best}/D				
ALPS [17]	1	1.7	2.5	8.6	6.3	6.7	13	60	160	830	ALPS [17]				
AMaLGaM IDEA [4]	1	1.4	3	15	12	5	4.9	5.6	5.5	5.4	AMaLGaM IDEA [4]				
avg NEWUOA [31]	1	1.2	2.6	12	47	<i>35e-2/8e3</i>	.	.	.	.	avg NEWUOA [31]
BayEDA _c G [10]	1	1.2	5.7	<i>35e-1/2e3</i>	.	.	.	.	.	.	BayEDA _c G [10]
BFGS [30]	1	4.2	150	960	<i>49e-1/8e3</i>	.	.	.	.	.	BFGS [30]
Cauchy EDA [24]	1	3.4	5.6	1200	<i>15e-1/5e4</i>	.	.	.	.	.	Cauchy EDA [24]
BiPOP-CMA-ES [15]	1	1.1	3	3.6	2.6	1.1	1.3	1.3	1.4	1.4	BiPOP-CMA-ES [15]				
(1+1)-CMA-ES [2]	1	1	2.5	10	17	21	31	62	60	<i>70e-3/1e4</i>	(1+1)-CMA-ES [2]				
DASA [19]	1	6.6	4.8	310	980	1200	<i>24e-3/1e6</i>	.	.	.	DASA [19]				
DEPSO [12]	1	1.2	11	<i>42e-1/2e3</i>	.	.	.	.	.	.	DEPSO [12]
DIRECT [25]	1	2	1.2	1.6	3.4	2.1	5.9	10	19	40	DIRECT [25]				
EDA-PSO [6]	1	1.4	4.6	210	82	38	53	49	61	61	EDA-PSO [6]				
full NEWUOA [31]	1	2.3	2.7	12	29	32	<i>12e-2/1e4</i>	.	.	.	full NEWUOA [31]				
G3-PCX [26]	1	1.2	1	22	44	32	350	320	<i>60e-4/5e4</i>	.	G3-PCX [26]				
simple GA [22]	1	1.3	2.1	84	93	71	150	630	620	600	simple GA [22]				
GLOBAL [23]	1	1.3	1.4	1	1	1.3	3.5	7	6.8	6.6	GLOBAL [23]				
iAMaLGaM IDEA [4]	1	1.4	1.9	8.6	5.5	4.4	5.9	6.5	6.4	6.8	iAMaLGaM IDEA [4]				
LSfminbnd [28]	1	1.3	3.2	28	130	71	<i>37e-2/1e4</i>	.	.	.	LSfminbnd [28]				
LSstep [28]	1	1.1	1.4	280	<i>13e-1/1e4</i>	.	.	.	.	.	LSstep [28]
MA-LS-Chain [21]	1	1.1	2.7	8.2	18	11	26	51	50	75	MA-LS-Chain [21]				
MCS (Neum) [18]	1	1.8	1.9	18	130	<i>30e-2/1e4</i>	.	.	.	.	MCS (Neum) [18]
NELDER (Han) [16]	1	1.5	4.4	28	23	25	95	200	300	600	NELDER (Han) [16]				
NELDER (Doe) [5]	1	1.3	1.6	4.8	9.8	6.3	13	27	59	120	NELDER (Doe) [5]				
NEWUOA [31]	1	1.2	2.1	29	<i>50e-2/7e3</i>	.	.	.	.	.	NEWUOA [31]
(1+1)-ES [1]	1	1.1	37	88	340	590	2200	6200	<i>73e-4/1e6</i>	.	(1+1)-ES [1]				
POEMS [20]	1	130	12	74	76	58	57	53	52	54	POEMS [20]				
PSO [7]	1	1.2	2.4	6.2	59	55	89	310	300	580	PSO [7]				
PSO_Bounds [8]	1	1.2	2.4	36	140	140	320	620	<i>16e-3/1e5</i>	.	PSO_Bounds [8]				
Monte Carlo [3]	1	1.1	3.5	510	<i>30e-2/1e6</i>	.	.	.	.	.	Monte Carlo [3]
Rosenbrock [27]	1	1.8	40	1200	<i>36e-1/1e4</i>	.	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES [29]	1	1.1	2.1	5	3.5	1	1	1	1	1	IPOP-SEP-CMA-ES [29]				
VNS (Garcia) [11]	1	1.2	2.8	12	12	9.1	12	16	34	45	VNS (Garcia) [11]				

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT _{best} /D											ERT _{best} /D
ALPS	1	1.1	2.4	1.04	43	8	4.8	7.1	10	21	68	ALPS [17]
AMaLGaM IDEA	1	1.1	3.9	1.5	1.5	2.7	2.6	2.7	3.5	3.4	3.5	AMaLGaM IDEA [4]
avg NEWUOA	1	1.2	3.1	42	410	410	<i>24e-2/1e4</i>					avg NEWUOA [31]
BayEDAacG	1	1.3	2.2	6.7	6.7	5.4	4.1	7.5	15	<i>47e-4/2e3</i>		BayEDAacG [10]
BFGS	1	3.4	120	650	650	<i>19e-1/4e3</i>						BFGS [30]
Cauchy EDA	1	1	44	13	13	7	3.8	4.3	4.3	5.3	13	Cauchy EDA [24]
BIPOP-CMA-ES	1	2.3	3.4	4.5	27	110	<i>17e-2/1e4</i>		1	1	1.2	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1.1	25	170	380	730	1800					(1+1)-CMA-ES [2]
DASA	1	1	1	1	1	1	1	1.9e4	<i>82e-4/1e6</i>			DASA [19]
DEPSO	1	1	7.6	3.5	3.5	2.8	3.1	4.5	5.6	12	<i>31e-4/2e3</i>	DEPSO [12]
DIRECT	1	1	1	1.4	1.7	1.7	2.7	4.4	6.7	9.5	10	DIRECT [25]
EDA-PSO	1	1.1	2.4	27	28	28	16	18	18	17	19	EDA-PSO [6]
full NEWUOA	1	1.1	4.9	25	25	76	250	<i>13e-2/1e4</i>				full NEWUOA [31]
G3-PCX	1	1.1	2.2	130	130	290	<i>60e-3/5e4</i>					G3-PCX [26]
simple GA	1	1.3	5.4	46	5	36	52	190	320	550	<i>13e-4/1e5</i>	simple GA [22]
GLOBAL	1	1.3	3.5	3.5	5	3.8	<i>47e-2/600</i>					GLOBAL [23]
iAMaLGaM IDEA	1	1	2.7	240	64	180	260	<i>16e-2/1e4</i>	5	6.3	6.8	iAMaLGaM IDEA [4]
LSfminbd	1	1.3	1.1	150	680	180	260					LSfminbd [28]
LSStep	1	1.1	1.1	3.8	3.1	3.1	4.1					LSStep [28]
MA-LS-Chain	1	1.1	3.8	2.8	2.8	3.1	4.1	9.3	7.5	7.3	11	MA-LS-Chain [21]
MCS (Neum)	1	1	1.9	24	63	63	<i>87e-3/1e4</i>					MCS (Neum) [18]
NELDER (Han)	1	2	55	170	290	290	2500	<i>54e-3/1e5</i>				NELDER (Han) [16]
NELDER (Doe)	1	1.1	1.9	10	48	48	<i>36e-3/2e4</i>					NELDER (Doe) [5]
NEWUOA	1	1.2	2.3	40	620	620	<i>32e-2/7e3</i>					NEWUOA [31]
(1+1)-ES	1	2	1200	7900	3.8e4	3.8e4	<i>48e-2/1e6</i>					(1+1)-ES [1]
POEMS	1	140	170	15	21	14	21	19	17	29	41	POEMS [20]
PSO	1	1.1	3.3	170	140	140	160	550	420	510	420	PSO [7]
PSO_Bounds	1	1.1	3.4	7.9	7.9	52	35	51	49	61	120	PSO_Bounds [8]
Monte Carlo	1	1.3	4	840	840							Monte Carlo [3]
Rosenbrock	1	1	2700	<i>57e-1/1e4</i>								Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1.1	3.8	3.4	3.4	1.3	1	1	1.1	1.1	1	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1	6.6	4.8	4.8	4.8	4.8	7.9	9.8	18	82	VNS (Garcia) [11]

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

	Δf_{target}	ERT_{best}/D	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
			0.2	0.24	8.1	75.5	794	1690	1860	2080	2180	2490	ERT_{best}/D
ALPS	1	1.5	8.1	1.6	8.1	14	3.3	1.4	49	240	420	<i>53e-7/1e6</i>	ALPS [17]
AMaLGaM IDEA	1.1	2.1	1.6	1.7	2	1.7	2	1.5	2.4	3.1	3.4	3.1	AMaLGaM IDEA [4]
avg NEWUOA	1	5.4	10	270	270	<i>57e-2/3e4</i>							avg NEWUOA [31]
BayEDAeG	1	2.6	4.4	9.6	11			8.7	<i>14e-2/2e3</i>				BayEDAeG [10]
BFGS	1.8	100	57	<i>51e-1/4e3</i>									BFGS [30]
Cauchy EDA	2.5	83	13	12	12	2.4	2.1	2.1	2.7	2.8	3.7	8.6	Cauchy EDA [24]
BIPOP-CMA-ES	1	2.8	1	3.4	1	1	1	1	1	1.1	1.2	1.3	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	2.9	4.9	270	930	1600	84	<i>37e-2/1e4</i>					(1+1)-CMA-ES [2]
DASA	1.9	47	2.6	2.6	2.2	2.2	4.1	<i>64e-3/1e6</i>					DASA [19]
DEPSO	1.1	2.4	2.6	5.5	2.2	2.2	6.2	<i>57e-3/2e3</i>					DEPSO [12]
DIRECT	1	1	1.4	2.9	8.8	17	6.5	<i>44e-6/2e4</i>					DIRECT [25]
EDA-PSO	1	1.3	3.6	41	8.8	6.4	17	<i>78e-2/1e4</i>					EDA-PSO [6]
full NEWUOA	1	8.6	10	84	90								full NEWUOA [31]
G3-PCX	1	1.7	130	800	<i>12e-1/5e4</i>								G3-PCX [26]
simple GA	1.1	2.3	22	59	34	130		<i>15e-3/1e5</i>					simple GA [22]
GLOBAL	1.1	2.4	3.9	15	14	<i>12e-1/500</i>							GLOBAL [23]
iAMaLGaM IDEA	1.2	2	1.1	1	1.4	1.6	1.9	1.9	1.9	2.3	3.1	4.8	iAMaLGaM IDEA [4]
LSfminbd	1	3.2	64	71	<i>31e-2/1e4</i>								LSfminbd [28]
LSstep	1.1	160	150	400	86	<i>60e-1/1e4</i>							LSstep [28]
MA-LS-Chain	1	1.8	2.5	4.9	1.3	23	88	84	160	140			MA-LS-Chain [21]
MCS (Neum)	1	1.5	19	150	<i>75e-2/1e4</i>								MCS (Neum) [18]
NELDER (Han)	1.1	2.9	45	230	320	<i>17e-2/1e5</i>							NELDER (Han) [16]
NELDER (Doe)	1	2.2	4.3	28	43	<i>15e-2/2e4</i>							NELDER (Doe) [5]
NEWUOA	1.2	5.7	31	1400	<i>11e-1/2e4</i>								NEWUOA [31]
(1+1)-ES	1	1.9	3100	3.1e4	<i>22e-1/1e6</i>								(1+1)-ES [1]
POEMS	41	560	18	24	14	71	150	200	300	570			POEMS [20]
PSO	1	2.6	2.8	6.6	110	250	<i>53e-3/1e5</i>						PSO [7]
PSO_Bounds	1.1	2.5	3.8	21	69	72	120	<i>10e-3/1e5</i>					PSO_Bounds [8]
Monte Carlo	1	1.2	18	9.4e4	<i>15e-1/1e6</i>								Monte Carlo [3]
Rosenbrock	1.1	2600	3400	<i>16e+0/1e4</i>									Rosenbrock [27]
IPOP-SEP-CMA-ES	1	3	1.3	5	1.6	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1.5	2.2	4.9	3.6	8.6	26	46	300	1200			VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	$\text{ERT}_{\text{best}}/D$	0.2	0.2	0.2	0.2	48.4	21000	24100	24200	24200	24400	$\text{ERT}_{\text{best}}/D$
ALPS	1	1.1	58	5100	15	39	4.2	40	4.2	40	40	ALPS [17]
AMaLGaM IDEA	1	1.3	38	1100	360	4.5	55e-3/1e5	4.2	4.2	4.2	4.2	AMaLGaM IDEA [4]
avg NEWUOA	1	1	24	1.6e4	1e3	55e-3/1e5	.	.	.	.	.	avg NEWUOA [31]
BayEDAeG	1	1.1	37	2100	45e-2/2e3	.	.	.	.	.	.	BayEDAeG [10]
BFGS	1	2.2	1700	2.2e4	1800	62e-2/6e3	.	.	.	.	.	BFGS [30]
Cauchy EDA	1	9.4	300	2.1e4	48e-2/5e4	1	1	1	1	1	1	Cauchy EDA [24]
BIPOP-CMA-ES	1	1	20	2800	160	19e-2/1e4	.	.	.	.	.	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1	20	4100	970	13e-2/1e6	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1	4.8	290	6.7e4	4.7e4	.	.	.	.	.	.	DASA [19]
DEPSO	1	1	93	3100	71e-2/2e3	.	.	.	.	.	.	DEPSO [12]
DIRECT	1	1	1	1	1.1	4.2	3.7	16e-3/2e4	.	.	.	DIRECT [25]
EDA-PSO	1	1.2	37	6700	1600	71	66e-3/1e5	.	.	.	.	EDA-PSO [6]
full NEWUOA	1	2.7	31	1.1e4	860	6.9	19e-2/1e4	.	.	.	.	full NEWUOA [31]
G3-PCX	1	1.1	39	9.5e4	1.4e4	50e-2/5e4	.	.	.	.	.	G3-PCX [26]
simple GA	1	1.1	35	1.2e4	700	.	60	59e-3/1e5	.	.	.	simple GA [22]
GLOBAL	1	1.3	46	7300	10e-1/900	.	.	.	.	.	.	GLOBAL [23]
iAMaLGaM IDEA	1	1.1	28	1100	370	10	12	12	12	12	12	iAMaLGaM IDEA [4]
LSfminbd	1	5.9	54	3e3	38e-2/1e4	.	.	.	.	.	.	LSfminbd [28]
LSstep	1	29	910	9500	1500	23e-2/1e4	.	.	.	.	.	LSstep [28]
MA-LS-Chain	1	1.2	32	1300	250	8.4	47e-3/2e4	.	.	.	.	MA-LS-Chain [21]
MCS (Neum)	1	1	1	1	1	16e-3/1e4	.	.	.	.	.	MCS (Neum) [18]
NELDER (Han)	1	1.3	12	2900	590	59e-3/1e5	.	.	.	.	.	NELDER (Han) [16]
NELDER (Doe)	1	1.2	12	340	110	14	47e-3/2e4	.	.	.	.	NELDER (Doe) [5]
NEWUOA	1	1.9	14	2.7e4	1400	79e-3/1e5	.	.	.	.	.	NEWUOA [31]
(1+1)-ES	1	1.3	100	4.1e5	2.9e5	49e-2/1e6	.	.	.	.	.	(1+1)-ES [1]
POEMS	1	200	1e3	7200	1.4e4	18e-2/1e5	.	.	.	.	.	POEMS [20]
PSO	1	1.1	35	3400	2400	67	60	60	60	61	61	PSO [7]
PSO-Bounds	1	1.4	27	1.6e4	2500	70	80e-3/1e5	.	.	.	.	PSO-Bounds [8]
Monte Carlo	1	1.3	38	1.4e5	36e-2/1e6	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	1	3.2	1.3e4	7.1e5	38e-1/1e4	.	.	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1.1	22	1900	160	2.2	3	3	3	3	3	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1	55	7600	1300	20	75	81	130	260	260	VNS (Garcia) [11]

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

		20 Schwefel $x*\sin(x)$										
		1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δ ftarget
ERT _{best} /D	ERT _{best} /D	2.71	2.96	3.2	170	7620	10300	10900	10900	11000	11100	ERT _{best} /D
ALPS	ALPS [17]	5.3	15	18	7	1.3	1	1	1.1	1.1	1.3	ALPS [17]
AMaLgAM IDEA	AMaLgAM IDEA [4]	3.2	3.8	3.9	29	24	18	17	17	17	17	AMaLgAM IDEA [4]
avg NEWUOA	avg NEWUOA [31]	1.2	1.1	1	8.4	12	8.6	8.2	8.1	8.1	8	avg NEWUOA [31]
BayEDAacG	BayEDAacG [10]	2.5	4	8	<i>20e-1/2e3</i>	10	7.6	7.2	7.2	7.1	7.1	BayEDAacG [10]
BFGS	BFGS [30]	1.1	1.5	1.8	2.5	10	7.6	7.2	7.2	7.1	7.1	BFGS [30]
Cauchy EDA	Cauchy EDA [24]	44	49	48	460	<i>11e-1/5e4</i>	10	7.2	7.2	7.1	7.1	Cauchy EDA [24]
BIPOP-CMA-ES	BIPOP-CMA-ES [15]	2.2	2.9	3.3	8.2	2.8	2.2	2.1	2.2	2.2	2.2	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	(1+1)-CMA-ES [2]	1.5	2.1	2.4	6.4	5.9	4.4	4.1	4.1	4.1	4.1	(1+1)-CMA-ES [2]
DASA	DASA [19]	24	29	32	13	47	35	33	33	33	33	DASA [19]
DEPSO	DEPSO [12]	3.6	7.7	8.6	3.2	<i>24e-2/2e3</i>	·	·	·	·	·	DEPSO [12]
DIRECT	DIRECT [25]	4.5	4.1	3.8	1.5	<i>47e-2/2e4</i>	·	·	·	·	·	DIRECT [25]
EDA-PSO	EDA-PSO [6]	3.3	4.9	5.7	13	2.5	2	2	2.1	2.3	2.5	EDA-PSO [6]
full NEWUOA	full NEWUOA [31]	1.6	1.5	1.4	6.4	<i>47e-2/6e3</i>	·	·	·	·	·	full NEWUOA [31]
G3-PCX	G3-PCX [26]	3.2	7.7	7.4	36	88	66	62	62	61	61	G3-PCX [26]
simple GA	simple GA [22]	5.5	22	47	21	1	1	1.3	2.2	2.6	5	simple GA [22]
GLOBAL	GLOBAL [23]	4.8	12	17	18	<i>13e-1/500</i>	·	·	·	·	·	GLOBAL [23]
iAMaLgAM IDEA	iAMaLgAM IDEA [4]	2.1	3	3.2	30	25	19	18	18	18	18	iAMaLgAM IDEA [4]
LSfmmbnd	LSfmmbnd [28]	5.8	7	8.2	18	<i>65e-2/1e4</i>	·	·	·	·	·	LSfmmbnd [28]
LStep	LStep [28]	110	190	230	41	18	14	13	13	13	13	LStep [28]
MA-LS-Chain	MA-LS-Chain [21]	2.9	5.6	5.8	4.1	1.4	1.1	1	1	1	1	MA-LS-Chain [21]
MCS (Neum)	MCS (Neum) [18]	2.5	2.8	2.7	1	9.1	6.8	6.4	6.4	6.4	6.3	MCS (Neum) [18]
NELDER (Han)	NELDER (Han) [16]	1.1	1.5	1.5	25	<i>24e-2/1e5</i>	·	·	·	·	·	NELDER (Han) [16]
NELDER (Doe)	NELDER (Doe) [5]	1.8	2.1	2.2	8.5	37	28	26	26	26	26	NELDER (Doe) [5]
NEWUOA	NEWUOA [31]	1	1	1	3.3	<i>43e-2/6e3</i>	·	·	·	·	·	NEWUOA [31]
(1+1)-ES	(1+1)-ES [1]	3.4	3.9	4	16	43	32	30	30	30	30	(1+1)-ES [1]
POEMS	POEMS [20]	83	80	78	8.5	14	10	9.9	9.9	10	10	POEMS [20]
PSO	PSO [7]	2.5	6	8.7	3.1	27	20	19	19	19	18	PSO [7]
PSO-Bounds	PSO-Bounds [8]	3.1	7	8.1	8.6	21	16	15	15	15	16	PSO-Bounds [8]
Monte Carlo	Monte Carlo [3]	6.7	20	29	9200	<i>99e-2/1e6</i>	·	·	·	·	·	Monte Carlo [3]
Rosenbrock	Rosenbrock [27]	2.6	2.8	2.9	4.6	<i>47e-2/1e4</i>	·	·	·	·	·	Rosenbrock [27]
IPOP-SEP-CMA-ES	IPOP-SEP-CMA-ES [29]	2.1	3	3.3	6.6	2.3	1.7	1.7	1.7	1.7	1.7	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	VNS (Garcia) [11]	3.7	11	10	7.8	4.3	3.9	4.3	4.5	4.6	5.7	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D	0.2	0.2	8.2	231	335	338	341	344	346	351	ERT_{best}/D
ALPS	1	1	1	3.4	2.2	2.9	3.9	4.7	5.6	6.4	8.1	ALPS [17]
AMaLGaM IDEA	1	1	1	3	37	34	35	36	38	38	38	AMaLGaM IDEA [4]
avg NEWUOA	1	1	1	1.7	2.5	3.6	3.5	3.5	3.5	3.5	3.5	avg NEWUOA [31]
BayEDAeG	1	1	1	4.1	8.6	40	85	84	84	83	82	BayEDAeG [10]
BFGS	1	1	1	3.8	1.4	1.9	1.9	1.9	1.9	1.9	2	BFGS [30]
Cauchy EDA	1	1	1	20	27	190	430	420	420	420	410	Cauchy EDA [24]
BIPOP-CMA-ES	1	1	1	2.3	14	24	25	25	25	25	25	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1	1	4.2	4.6	6.6	6.6	6.5	6.5	6.5	6.4	(1+1)-CMA-ES [2]
DASA	1	1	1	10	210	320	320	320	310	310	310	DASA [19]
DEPSO	1	1	1	4.2	5.5	4.2	4.7	5	5.3	6.2	6.7	DEPSO [12]
DIRECT	1	1	1	1	1	1.1	1.8	2.1	2.9	19	19	DIRECT [25]
EDA-PSO	1	1	1	4	160	110	110	120	120	120	120	EDA-PSO [6]
full NEWUOA	1	1	1	2.4	2.3	2.8	2.8	2.8	2.7	2.7	2.7	full NEWUOA [31]
G3-PCX	1	1	1	2.1	4.7	6.8	6.7	6.7	6.7	6.7	6.6	G3-PCX [26]
simple GA	1	1	1	4.6	5.5	61	68	70	77	140	290	simple GA [22]
GLOBAL	1	1	1	2.3	1.1	1	1	1	1	1	1	GLOBAL [23]
iAMaLGaM IDEA	1	1	1	2.2	27	22	22	22	22	22	22	iAMaLGaM IDEA [4]
LSfmnbnd	1	1	1	30	38	39	45	44	44	44	44	LSfmnbnd [28]
LSstep	1	1	1	560	120	120	120	130	130	130	130	LSstep [28]
MA-LS-Chain	1	1	1	3.6	22	16	16	16	16	16	16	MA-LS-Chain [21]
MCS (Neum)	1	1	1	1	3.9	5.1	5.1	5	5	5	5	MCS (Neum) [18]
NELDER (Han)	1	1	1	12	8.4	10	10	10	10	9.9	9.8	NELDER (Han) [16]
NELDER (Doe)	1	1	1	2.9	1.5	1.2	1.2	1.2	1.2	1.2	1.2	NELDER (Doe) [5]
NEWUOA	1	1	1	1.1	2.2	1.8	1.8	1.8	1.8	1.8	1.9	NEWUOA [31]
(1+1)-ES	1	1	1	45	19	18	18	18	18	18	18	(1+1)-ES [1]
POEMS	1	1	1	34	330	290	290	290	290	290	290	POEMS [20]
PSO	1	1	1	2	380	260	260	260	260	260	250	PSO [7]
PSO_Bounds	1	1	1	3.5	380	340	340	340	340	340	340	PSO_Bounds [8]
Monte Carlo	1	1	1	3.2	8.5	270	<i>1.4e4</i>	<i>1.4e-3/1e6</i>	.	.	.	Monte Carlo [3]
Rosenbrock	1	1	1	9.7	7.9	15	15	15	15	15	15	Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1	1	3.6	14	9.9	10	10	10	10	10	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1	1	2.4	7.5	6.5	6.6	6.9	7.8	8.3	9.1	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D											ERT_{best}/D
ALPS	0.2	1	1	6.6	9.3	8.8	13	17	21	24	34	ALPS [17]
AMaLGaM IDEA	1	1	1	3	19	59	69	69	69	68	67	AMaLGaM IDEA [4]
avg NEWUOA	1	1	1	3.4	2.6	2.3	2.3	2.3	2.3	2.4	2.4	avg NEWUOA [31]
BayEDA-cG	1	1	1	13	75	<i>22e-1/2e3</i>	2.3	2.3	2.3	2.4	2.4	BayEDA-cG [10]
BFGS	1	1	1	3.1	2.9	2.1	2.1	2	2	2	2.6	BFGS [30]
Cauchy EDA	1	1	1	11	280	780	1700	3500	3400	3400	3300	Cauchy EDA [24]
BIPOP-CMA-ES	1	1	1	6.9	20	45	43	42	42	41	40	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1	1	2.8	7.1	4.7	4.6	4.5	4.5	4.4	4.4	(1+1)-CMA-ES [2]
DASA	1	1	1	96	270	130	130	130	140	140	150	DASA [19]
DEPSO	1	1	1	6.5	6.3	7.5	10	11	14	16	32	DEPSO [12]
DIRECT	1	1	1	1	1	12	19	22	62	130	400	DIRECT [25]
EDA-PSO	1	1	1	6.7	12	89	90	92	95	98	100	EDA-PSO [6]
full NEWUOA	1	1	1	4.3	3.7	3	2.9	2.9	3	3	3.1	full NEWUOA [31]
G3-PCX	1	1	1	12	15	13	12	12	12	12	12	G3-PCX [26]
simple GA	1	1	1	6	18	390	650	1500	6900	6800	<i>24e-3/1e5</i>	simple GA [22]
GLOBAL	1	1	1	3.6	1.3	1	1	1	1	1	1	GLOBAL [23]
iAMaLGaM IDEA	1	1	1	1.8	22	40	41	41	41	41	40	iAMaLGaM IDEA [4]
LSfmimbnd	1	1	1	13	47	29	60	62	120	120	220	LSfmimbnd [28]
LSstep	1	1	1	190	180	380	<i>11e-1/1e4</i>	1	1	1	1	LSstep [28]
MA-LS-Chain	1	1	1	3.3	15	22	22	22	22	22	22	MA-LS-Chain [21]
MCS (Neum)	1	1	1	1.1	1.1	12	11	11	11	11	15	MCS (Neum) [18]
NELDER (Han)	1	1	1	19	13	13	13	13	12	12	12	NELDER (Han) [16]
NELDER (Doe)	1	1	1	2.5	2.5	2.1	2	2	2	2	2.1	NELDER (Doe) [5]
NEWUOA	1	1	1	2.1	2.1	2	2	2.1	2.2	2.3	2.4	NEWUOA [31]
(1+1)-ES	1	1	1	21	37	30	29	29	29	29	30	(1+1)-ES [1]
POEMS	1	1	1	470	1100	1300	1200	1200	1200	1200	1200	POEMS [20]
PSO	1	1	1	2.6	330	470	450	440	430	430	420	PSO [7]
PSO_Bounds	1	1	1	510	870	820	820	810	820	820	820	PSO_Bounds [8]
Monte Carlo	1	1	1	7.6	73	390	7500	7.1e4	7e4	<i>93e-4/1e6</i>	.	Monte Carlo [3]
Rosenbrock	1	1	1	19	13	10	10	10	10	10	11	Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1	1	7.5	23	60	58	57	57	56	55	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1	1	5.8	1.6	18	18	18	18	19	20	VNS (Garcia) [11]

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

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D	0.2	0.2	0.6	104	2850	5580	6330	6480	6610	6850	ERT_{best}/D
ALPS	1	1	2.2	21	29	100	1	3100	<i>54e-4/1e6</i>	.	.	ALPS [17]
AMaLgAM IDEA	1	1	1.7	7	1.8	1.8	1	1	1	1	1	AMaLgAM IDEA [4]
avg NEWUOA	1	1	6	2.5	14	<i>15e-2/9e3</i>	.	.	.	.	.	avg NEWUOA [31]
BayEDAacG	1	1	1.8	62	<i>12e-1/2e3</i>	.	.	.	.	.	.	BayEDAacG [10]
BFGS	1	1	11	31	<i>69e-2/5e3</i>	.	.	.	.	.	.	BFGS [30]
Cauchy EDA	1	1	2.2	230	<i>68e-2/5e4</i>	.	.	.	.	.	.	Cauchy EDA [24]
BIPOP-CMA-ES	1	1	1.7	13	3.7	2.1	1.8	1.8	1.8	1.8	1.8	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	1	1	4.2	3.3	3.3	7.5	26	<i>11e-2/1e4</i>	.	.	.	(1+1)-CMA-ES [2]
DASA	1	1	9	20	360	<i>88e-3/1e6</i>	.	.	.	.	.	DASA [19]
DEPSO	1	1	2	66	<i>15e-1/2e3</i>	.	.	.	.	.	.	DEPSO [12]
DIRECT	1	1	1.5	3.5	5.7	3.7	6	<i>93e-4/2e4</i>	.	.	.	DIRECT [25]
EDA-PSO	1	1	2.4	28	<i>59e-2/1e5</i>	.	.	.	.	.	.	EDA-PSO [6]
full NEWUOA	1	1	5.4	2	3.8	<i>87e-3/1e4</i>	.	.	.	.	.	full NEWUOA [31]
G3-PCX	1	1	2.6	2.4	8.6	60	<i>44e-3/5e4</i>	.	.	.	.	G3-PCX [26]
simple GA	1	1	1.5	59	<i>49e-2/1e5</i>	.	.	.	.	.	.	simple GA [22]
GLOBAL	1	1	1.6	1	4.8	<i>23e-2/1e3</i>	.	.	.	.	.	GLOBAL [23]
iAMaLgAM IDEA	1	1	2.6	7.8	2.1	1.3	1.2	1.2	1.2	1.1	1.1	iAMaLgAM IDEA [4]
LSfminbnd	1	1	1.8	11	<i>45e-2/1e4</i>	.	.	.	.	.	.	LSfminbnd [28]
LSstep	1	1	1.4	6.6	51	<i>31e-2/1e4</i>	.	.	.	.	.	LSstep [28]
MA-LS-Chain	1	1	2.6	2.5	1.7	4	3.6	3.6	3.5	3.4	3.3	MA-LS-Chain [21]
MCS (Neum)	1	1	3.4	2.4	51	<i>16e-2/1e4</i>	.	.	.	.	.	MCS (Neum) [18]
NELDER (Han)	1	1	2.9	3.5	2.7	3.2	4	4	4.6	4.6	5.6	NELDER (Han) [16]
NELDER (Doe)	1	1	1.5	1	1	3.6	15	15	46	<i>38e-4/2e4</i>	.	NELDER (Doe) [5]
NEWUOA	1	1	6.2	2.4	7.1	<i>20e-2/7e3</i>	.	.	.	.	.	NEWUOA [31]
(1+1)-ES	1	1	3.1	4.8	52	590	<i>14e-3/1e6</i>	.	.	.	.	(1+1)-ES [1]
POEMS	1	1	13	23	26	22	25	33	33	33	32	POEMS [20]
PSO	1	1	2.1	20	240	<i>15e-2/1e5</i>	.	.	.	.	.	PSO [7]
PSO_Bounds	1	1	2.2	58	240	<i>30e-2/1e5</i>	.	.	.	.	.	PSO_Bounds [8]
Monte Carlo	1	1	2.3	49	<i>38e-2/1e6</i>	.	.	.	.	.	.	Monte Carlo [3]
Rosenbrock	1	1	1.6	1.8	4.6	13	<i>17e-2/5e3</i>	.	.	.	.	Rosenbrock [27]
IPOP-SEP-CMA-ES	1	1	3.1	9.7	3.7	1.9	1.7	1.7	1.7	1.7	1.6	IPOP-SEP-CMA-ES [29]
VNS (Garcia)	1	1	1	9.6	15	26	23	26	26	25	24	VNS (Garcia) [11]

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

	Δf_{target}	ERT_{best}/D	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	ERT_{best}/D	0.2	0.2	324	43300	1.27e6	1.92e6	1.92e6	1.92e6	1.92e6	2.57e6	2.57e6	ERT_{best}/D
ALPS	ALPS [17]	1	5	8.1	9.6	<i>75e-2/1e6</i>							ALPS [17]
AMaLGaM IDEA	AMaLGaM IDEA [4]	1	5.3	3.3	2.4	2.1		3.8	3.7	3.7	5.6	5.6	AMaLGaM IDEA [4]
avg NEWUOA	avg NEWUOA [31]	1	14	2	2.2	<i>30e-1/7e3</i>							avg NEWUOA [31]
BayEDAcG	BayEDAcG [10]	1	5.4	15	<i>11e+0/2e3</i>								BayEDAcG [10]
BFGS	BFGS [30]	1	160	69	<i>17e+0/3e3</i>								BFGS [30]
Cauchy EDA	Cauchy EDA [24]	1.1	75	30	<i>81e-1/5e4</i>								Cauchy EDA [24]
BIPOP-CMA-ES	BIPOP-CMA-ES [15]	1	7.8	2.1	1.6	1	1	1	1	1	1	1	BIPOP-CMA-ES [15]
(1+1)-CMA-ES	(1+1)-CMA-ES [2]	1	76	6.7	1.7	<i>39e-1/1e4</i>							(1+1)-CMA-ES [2]
DASA	DASA [19]	1	79	250	<i>32e-1/1e6</i>								DASA [19]
DEPSO	DEPSO [12]	1	5	29	<i>14e+0/2e3</i>								DEPSO [12]
DIRECT	DIRECT [25]	1	1	7.5	1.9	<i>72e-1/2e4</i>							DIRECT [25]
EDA-PSO	EDA-PSO [6]	1	3.6	9.7	<i>61e-1/1e5</i>								EDA-PSO [6]
full NEWUOA	full NEWUOA [31]	1	21	2.5	1.1	<i>31e-1/7e3</i>							full NEWUOA [31]
G3-PCX	G3-PCX [26]	1	4.9	44	<i>61e-1/5e4</i>								G3-PCX [26]
simple GA	simple GA [22]	1	7.3	21	<i>54e-1/1e5</i>								simple GA [22]
GLOBAL	GLOBAL [23]	1	6.3	4.2	<i>91e-1/1e3</i>								GLOBAL [23]
iAMaLGaM IDEA	iAMaLGaM IDEA [4]	1	6.3	3.1	2.2	2.2	7.5	7.5	7.5	7.5	5.6	5.6	iAMaLGaM IDEA [4]
LSfminbd	LSfminbd [28]	1	30	9.1	<i>63e-1/1e4</i>								LSfminbd [28]
LSstep	LSstep [28]	3	360	200	<i>15e+0/1e4</i>								LSstep [28]
MA-LS-Chain	MA-LS-Chain [21]	1	3.8	2.1	<i>52e-1/2e4</i>								MA-LS-Chain [21]
MCS (Neum)	MCS (Neum) [18]	1	1	7	3.5	<i>37e-1/1e4</i>							MCS (Neum) [18]
NELDER (Han)	NELDER (Han) [16]	1	10	11	5.6	<i>12e-1/1e5</i>							NELDER (Han) [16]
NELDER (Doe)	NELDER (Doe) [5]	1	4.3	1	1.4	<i>15e-1/2e4</i>							NELDER (Doe) [5]
NEWUOA	NEWUOA [31]	1	12	2.9	2.1	<i>26e-1/6e3</i>							NEWUOA [31]
(1+1)-ES	(1+1)-ES [1]	1	14	31	68	<i>14e-1/1e6</i>							(1+1)-ES [1]
POEMS	POEMS [20]	1	620	47	<i>70e-1/1e5</i>								POEMS [20]
PSO	PSO [7]	1	6.5	5.7	<i>63e-1/1e5</i>								PSO [7]
PSO_Bounds	PSO_Bounds [8]	1	5.2	10	33	<i>60e-1/1e5</i>							PSO_Bounds [8]
Monte Carlo	Monte Carlo [3]	1	4.1	2900	<i>96e-1/1e6</i>								Monte Carlo [3]
Rosenbrock	Rosenbrock [27]	1	200	210	<i>19e+0/1e4</i>								Rosenbrock [27]
IPOP-SEP-CMA-ES	IPOP-SEP-CMA-ES [29]	1	7.5	1.8	1	<i>53e-1/1e4</i>							IPOP-SEP-CMA-ES [29]
VNS (Garcia)	VNS (Garcia) [11]	1	3.4	3.3	49	13	16	46	200	<i>69e-4/3e7</i>			VNS (Garcia) [11]

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