

Comparison tables: BBOB 2010 noisy testbed in 2-D

The BBOBies

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Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2010, see <http://coco.gforge.inria.fr/doku.php?id=bbob-2010>. 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 [10, 6]. The experimental set-up is described in [9].

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 [9] for details on how ERT is obtained. Bold entries in the table correspond to values below 3 or the top-three best values.

Table 1: 02-D, running time excess ERT/ERT_{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											
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
	0.50	0.50	2.1	5.6	10	13	14	16	17	18	
(1,2)-CMA-ES	1	1	1.7	1.8	2.0	2.8	4.1	5.0	5.7	7.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.6	1.7	2.3	3.2	4.2	4.6	6.1	7.6	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.0	1	2.1	3.0	3.6	4.2	5.2	6.8	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	2.0	2.3	3.1	3.6	6.8	7.2	8.3	9.4	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	2.2	1.8	2.4	3.0	3.5	4.1	4.6	5.6	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1.4	1.2	1.6	2.3	3.1	3.5	4.2	5.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.4	1.2	1.4	1.8	2.4	2.8	3.0	3.8	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	2.0	1.8	1.6	2.3	2.8	3.4	3.5	4.5	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	1.4	1.2	1.0	1.0	1	1	1	1	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	10	13	6.1	6.6	6.0	8.0	20	26	53	1541	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	2.3	1.8	1.8	3.3	4.1	4.7	5.7	7.1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1.5	2.3	2.8	3.2	4.2	4.9	6.3	7.5	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.0	2.2	5.0	10	15	19	22	28	CMA+DE-MOS [12]
NEWUOA	1	1	1.1	1.3	1	1	1.2	1.2	1.2	1.2	NEWUOA [15]
Basic RCGA	1	1	1	2.3	16	27	33	46	64	118	Basic RCGA [16]
SPSA	24	41	75	113	135	391	381	365	365	395	SPSA [8]

Table 2: 02-D, running time excess ERT/ERT_{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										
$\Delta\text{ftarget}$ ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 1.8	1e+00 7.4	1e-01 14	1e-02 25	1e-03 35	1e-04 41	1e-05 42	1e-07 44	$\Delta\text{ftarget}$ ERT_{best}/D
(1,2)-CMA-ES	1	1	2.8	1.5	2.0	1.9	1.8	2.3	2.7	3.5	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.7	1.3	1.2	1.6	1.8	1.9	2.2	3.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.6	1.0	1.6	1.7	1.7	1.9	2.3	3.1	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1.6	1.3	1.6	1.7	2.0	2.1	2.8	4.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	2.0	1.3	1.5	1.4	1.4	1.5	1.6	2.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	2.0	1.1	1.2	1.4	1.3	1.5	1.8	2.3	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.6	1.2	1	1	1.0	1.3	1.6	1.6	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1.7	1.1	1.2	1.0	1.1	1.1	1.3	1.8	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.2	2.0	1	1.0	1.5	1.1	1	1	1	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	13	16	8.2	3.4	15	12	13	12	207	1347	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	2.1	1.6	2.3	1.9	1.9	2.2	2.4	3.2	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1.4	1.6	2.2	1.7	1.6	2.0	2.3	3.0	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.2	2.0	4.1	5.6	6.7	7.2	9.5	12	CMA+DE-MOS [12]
NEWUOA	1	1	3.6	5.2	3.6	2.3	1.8	1.6	1.5	1.5	NEWUOA [15]
Basic RCGA	1	1	1	1.6	9.2	15	15	20	30	51	Basic RCGA [16]
SPSA	9.1	16	14	113	103	85	69	238	256	1437	SPSA [8]

Table 3: 02-D, running time excess ERT/ERT_{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											
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
	0.50	0.50	1.4	6.0	10	14	19	22	31	47	
(1,2)-CMA-ES	1	1	2.2	2.2	2.5	3.1	3.3	3.9	3.5	3.3	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	2.0	1.2	1.9	2.7	3.1	3.6	3.1	3.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.6	1.3	2.0	2.7	2.9	3.3	3.0	2.9	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	2.0	2.1	3.5	3.3	3.3	3.6	3.3	3.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	2.6	1.4	2.1	2.2	2.3	2.7	2.4	2.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1.8	1	1.7	2.1	2.2	2.6	2.2	2.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.5	1.1	1.3	1.6	1.7	1.9	1.7	1.6	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	2.8	1.5	1.7	1.8	2.0	2.2	2.0	1.8	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	2.0	1.2	1.0	1	1	1	1.1	1	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	12	19	12	4.5	5.6	6.5	8.5	17	13	27	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	2.1	1.6	2.1	2.8	2.9	3.6	3.2	3.0	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	2.5	2.2	2.7	2.9	3.3	3.8	3.5	3.3	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.6	1.7	6.4	10	13	14	13	14	CMA+DE-MOS [12]
NEWUOA	1	1	2.1	1.0	1	1.0	1.0	1.1	1	1.1	NEWUOA [15]
Basic RCGA	1	1	1	2.5	10	17	27	38	42	62	Basic RCGA [16]
SPSA	22	38	237	128	124	126	361	918	1785	1794	SPSA [8]

Table 4: 02-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											
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	1.5	2.5	7.9	42	113	212	242	260	271	297	ERT_{best}/D
(1,2)-CMA-ES	1.7	3.3	2.6	4.9	7.9	8.9	10	9.5	9.5	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	3.2	2.0	3.7	4.2	4.9	5.1	5.0	4.9	4.7	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.3	1.5	1.7	2.4	3.8	4.8	5.6	5.7	5.9	5.8	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.4	3.8	3.1	6.4	10	13	15	28	28	33	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.7	2.8	2.3	2.2	2.4	1.6	1.6	1.6	1.6	1.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.8	2.5	1.9	3.1	2.0	1.4	1.3	1.3	1.3	1.3	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1.0	1	1	1.3	1.5	1	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.1	1.3	1.2	2.0	2.5	2.1	2.0	1.9	1.9	1.8	(1,4s)-CMA-ES [3]
avg NEWUOA	2.1	2.2	1.5	1.3	1.1	2.0	2.7	3.1	3.2	3.8	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	18	14	6.9	3.3	22	41	102	95	144	174	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.1	1.7	1.2	1	1	1.0	1.1	1.1	1.1	1.2	IPOP-aCMA-ES [11]
IPOP-CMA-ES	2.1	2.6	1.7	2.5	2.3	1.8	2.0	2.0	2.1	2.0	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.8	2.2	1.9	2.6	2.4	2.6	2.8	3.1	3.3	CMA+DE-MOS [12]
NEWUOA	2.9	2.3	2.2	2.3	2.9	3.7	5.2	6.1	5.9	5.6	NEWUOA [15]
Basic RCGA	1.3	1.6	2.6	3.2	29	50	125	249	806	<i>10e-5/5e4</i>	Basic RCGA [16]
SPSA	244	232	287	294	3694	<i>39e-2/1e5</i>	.	.	.	.	SPSA [8]

Table 5: 02-D, running time excess ERT/ERT_{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										
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
(1,2)-CMA-ES	2.4	2.6	1.8	4.8	8.8	12	17	28	33	30	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	2.0	1.9	2.9	2.3	2.2	5.6	9.3	18	18	17	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.1	1.1	3.2	8.7	12	16	20	18	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	2.0	1.8	2.9	4.8	4.2	11	23	60	60	71	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.8	2.2	1.4	4.7	2.8	3.2	3.4	3.2	3.1	2.9	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.1	1.3	1	3.0	1.8	2.4	2.1	2.2	2.1	2.0	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	2.3	1.5	1.4	2.3	2.5	3.0	2.9	3.0	3.3	3.0	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.4	3.3	1.3	3.3	3.0	4.1	3.9	3.9	3.8	3.5	(1,4s)-CMA-ES [3]
avg NEWUOA	2.7	2.1	1.7	1.8	2.2	5.8	16	28	96	177	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	21	12	4.5	2.3	39	159	515	1122	1659	3153	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	3.5	1.8	1.6	1.1	1	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	2.7	2.1	1.4	2.2	2.2	3.6	3.1	2.9	2.9	2.8	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.3	1.5	1	1.6	1.9	1.8	1.9	2.0	2.2	CMA+DE-MOS [12]
NEWUOA	2.6	1.5	1.9	2.2	3.0	4.2	12	21	20	52	NEWUOA [15]
Basic RCGA	1.4	2.2	2.0	1.5	13	33	89	236	569	<i>18e-5/5e4</i>	Basic RCGA [16]
SPSA	217	170	78	204	1418	5355	<i>34e-2/1e5</i>	.	.	.	SPSA [8]

Table 6: 02-D, running time excess ERT/ERT_{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										
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
(1,2)-CMA-ES	3.3	4.3	11	19	10	8.5	8.0	7.5	7.2	6.7	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	2.1	2.8	2.6	4.4	3.6	3.5	3.7	3.5	3.6	3.5	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.6	1.9	2.1	1.4	3.6	2.8	3.0	3.0	2.9	2.8	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	2.0	2.0	1.5	30	23	19	18	20	19	21	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	2.3	1.9	2.4	3.9	2.0	1.5	1.5	1.4	1.4	1.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.2	1	1.6	2.2	1.5	1.2	1.3	1.2	1.3	1.3	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	2.0	1.8	1.2	1	1	1	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.2	1.0	1	3.4	2.2	1.7	1.6	1.5	1.5	1.4	(1,4s)-CMA-ES [3]
avg NEWUOA	1.9	1.3	1.4	1.6	1.6	1.9	3.1	3.3	4.7	7.8	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	23	21	37	32	11	8.8	8.3	7.6	39	39	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.4	2.1	3.2	2.7	1.6	1.6	1.5	1.5	1.5	1.6	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.3	1.3	1.5	3.2	2.5	2.4	2.5	2.5	2.5	2.6	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.3	2.4	4.4	2.9	3.2	3.6	3.5	3.9	4.4	CMA+DE-MOS [12]
NEWUOA	1.3	1.2	1.0	2.2	1.5	2.1	3.2	3.1	5.3	7.6	NEWUOA [15]
Basic RCGA	1	1.9	2.6	4.2	14	94	295	381	726	2913	Basic RCGA [16]
SPSA	426	532	1013	2191	2546	9115	<i>40e-2/1e5</i>	.	.	.	SPSA [8]

Table 7: 02-D, running time excess ERT/ERT_{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											
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 1.6	1e+00 12	1e-01 22	1e-02 37	1e-03 59	1e-04 75	1e-05 141	1e-07 206	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1	17	8.1	6.3	6.0	6.8	10	10	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	2.5	2.9	2.6	2.8	2.2	2.1	1.3	1.6	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.3	1.2	1.2	2.2	2.1	2.5	1.5	2.0	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	3.1	1.4	3.3	9.2	10	12	6.9	9.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	5.9	2.0	4.9	3.9	2.9	2.8	1.9	1.9	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	4.1	1.2	2.8	2.3	1.8	1.7	1.5	1.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.2	1	1	1	1	1.3	1.2	1.2	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	3.4	6.3	5.0	3.6	3.3	2.8	1.8	2.0	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	7.7	18	15	20	21	41	40	82	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	9.2	14	11	3.9	7.1	5.5	34	112	138	311	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	2.9	1.5	1.7	2.0	1.5	1.6	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	3.1	1.1	1.7	1.9	1.5	1.6	1.0	1.0	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.4	1.1	3.9	6.9	8.0	7.8	5.1	4.6	CMA+DE-MOS [12]
NEWUOA	1	1	15	12	20	27	27	50	74	85	NEWUOA [15]
Basic RCGA	1	1	1	1.1	5.8	13	13	12	12	20	Basic RCGA [16]
SPSA	16	21	272	814	2429	6194	5209	18783	<i>27e-3/1e5</i>	.	SPSA [8]

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Table 8: 02-D, running time excess ERT/ERT_{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											
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	0.50	0.50	2.1	15	164	586	1170	2574	3799	6046	ERT_{best}/D
(1,2)-CMA-ES	1	1.2	7.4	13	3.4	4.5	21	<i>26e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	13	17	5.5	7.9	60	<i>29e-4/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	13	7.8	3.4	13	56	<i>60e-4/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	7.3	12	6.1	11	<i>56e-4/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	21	12	2.5	2.6	11	55	37	<i>61e-5/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	37	13	3.6	2.9	6.9	18	<i>50e-5/1e4</i>	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	5.9	14	3.7	7.0	8.3	17	<i>48e-5/1e4</i>	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	62	26	5.4	4.6	7.0	18	39	<i>51e-5/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	37	42	13	22	24	<i>14e-3/6e3</i>	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	1612	6028	1734	309	88	82	78	61	183	243	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1.2	2.4	5.9	2.2	1	1	1	1	1.0	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1.6	3.8	1	1.2	1.4	1.0	1.1	1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.0	1	1.4	2.1	2.4	4.2	4.3	4.9	CMA+DE-MOS [12]
NEWUOA	1	1	52	56	15	27	36	<i>13e-3/6e3</i>	.	.	NEWUOA [15]
Basic RCGA	1	1	1	1.3	7.2	24	31	28	45	<i>21e-5/5e4</i>	Basic RCGA [16]
SPSA	27	126	88	100	62	107	<i>28e-4/1e5</i>	.	.	.	SPSA [8]

Table 9: 02-D, running time excess ERT/ERT_{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											
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
	0.50	0.50	1.5	6.5	18	32	46	65	85	114	
(1,2)-CMA-ES	1	1.5	1.5	2.5	1.6	1.6	3.1	2.8	2.9	3.9	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.6	1.4	1.0	1.5	1.7	1.7	1.8	2.3	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	1.0	1	1.2	1.4	1.3	1.3	1.6	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	3.9	2.7	1.8	6.7	6.9	5.5	4.6	6.5	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	2.6	1.6	1.1	1.0	1.3	1.3	1.4	1.6	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	3.1	1.9	1.4	1.1	1.4	1.4	1.3	1.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.5	1.4	1.1	1.0	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1.3	1	1.0	1	1.2	1.1	1.1	1.1	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	2.0	1.9	5.5	7.3	6.6	8.3	8.3	13	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	14	21	13	5.1	3.9	7.4	85	71	503	12353	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.9	1.5	1.2	1.2	1.5	1.8	1.7	2.0	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1.2	1.1	1.4	1.2	1.5	1.6	1.9	2.3	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.4	1.7	3.1	6.2	6.5	8.0	8.1	10	CMA+DE-MOS [12]
NEWUOA	1	1	2.0	2.7	4.3	5.9	7.6	10	12	15	NEWUOA [15]
Basic RCGA	1	1	1.1	1.9	5.4	10	14	18	20	28	Basic RCGA [16]
SPSA	19	32	169	97	98	365	1216	1808	5210	<i>72e-6/1e5</i>	SPSA [8]

Table 10: 02-D, running time excess ERT/ERT_{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											
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
(1,2)-CMA-ES	1.4	1	7.5	5.9	2.3	3.7	3.6	9.2	36	<i>22e-5/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	6.2	4.3	2.5	3.2	1.4	2.0	2.3	3.4	4.9	17	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.3	2.0	1.7	3.1	1	1.9	4.3	5.0	18	36	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	2.2	9.2	5.3	10	2.8	2.9	3.3	5.5	8.0	34	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.3	1.3	1.2	3.4	2.7	3.6	2.9	2.9	3.7	5.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	2.0	1.8	1.0	1	1.1	1	1	1	1.2	1.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	2.1	1.4	2.3	2.9	1.4	2.6	2.1	2.5	2.8	3.7	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.7	1.6	1.2	4.5	1.9	2.0	1.5	1.7	3.0	3.0	(1,4s)-CMA-ES [3]
avg NEWUOA	1.6	6.1	3.4	2.8	1.6	1.8	3.6	7.1	6.2	<i>12e-4/5e3</i>	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	88	71	29	13	8.6	121	650	<i>99e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.4	1.4	1.2	2.0	4.0	3.2	1.7	1.1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	3.1	2.1	1.5	4.5	2.7	3.1	1.7	1.2	1.1	1.1	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.3	2.1	159	11	9.0	4.8	3.2	2.8	2.9	CMA+DE-MOS [12]
NEWUOA	9.4	8.7	5.3	8.1	1.9	2.7	4.8	22	<i>19e-4/5e3</i>	.	NEWUOA [15]
Basic RCGA	1	1.2	1	2.3	3.4	13	17	24	58	174	Basic RCGA [16]
SPSA	222	118	109	464	908	<i>38e-2/1e5</i>	.	.	.	.	SPSA [8]

Table 11: 02-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											
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
(1,2)-CMA-ES	7.1	6.4	5.5	5.5	3.1	3.1	<i>21e-3/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.4	7.3	8.3	2.3	2.9	13	<i>30e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	7.9	15	10	5.8	1.9	5.9	<i>17e-3/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	14	6.9	8.2	6.8	1.7	5.9	<i>15e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	25	19	11	3.1	1.4	1.8	1.3	2.0	3.8	<i>61e-4/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	23	13	10	4.3	1.5	1.4	2.8	<i>47e-4/1e4</i>	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	7.9	4.8	3.4	2.9	1.6	3.5	2.8	<i>12e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.5	14	10	5.0	2.3	1.7	1.9	<i>17e-4/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	29	43	42	19	13	17	<i>26e-2/6e3</i>	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	228	538	181	42	5.6	7.3	8.5	42	37	<i>22e-4/1e5</i>	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.8	2.4	6.9	2.2	1	1.6	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.3	3.8	4.6	2.2	1.2	1	1.1	1.1	1.1	1.1	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.2	1.9	1.4	11	12	3.2	2.5	2.6	2.6	CMA+DE-MOS [12]
NEWUOA	55	29	19	16	4.8	5.3	<i>68e-3/6e3</i>	.	.	.	NEWUOA [15]
Basic RCGA	1	1	1	1	2.3	2.0	1.5	6.6	19	<i>32e-5/5e4</i>	Basic RCGA [16]
SPSA	29	20	48	99	44	273	<i>51e-3/1e5</i>	.	.	.	SPSA [8]

Table 12: 02-D, running time excess ERT/ERT_{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											
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
(1,2)-CMA-ES	2.4	2.4	2.3	5.8	10	6.8	7.2	7.9	10	8.9	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.2	1.4	8.4	19	6.2	4.8	5.9	5.8	5.6	5.2	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.8	2.1	1.9	10	3.3	2.9	3.1	3.1	3.0	2.9	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.7	3.9	2.0	24	14	21	34	50	47	80	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	2.5	2.2	1.2	2.5	1.3	1.3	1.4	1.5	1.5	1.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	2.8	2.2	1.1	1	1	1.0	1.1	1.2	1.2	1.2	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1.6	1.4	1.6	3.4	1.4	1	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.2	1.3	1.1	2.9	1.8	1.3	1.4	1.4	1.4	1.3	(1,4s)-CMA-ES [3]
avg NEWUOA	1.8	1.5	1.3	2.5	1.8	6.5	30	164	<i>19e-4/5e3</i>	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	14	16	6.8	10	8.0	113	428	<i>12e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.2	1	1.2	3.7	1.6	1.3	1.3	1.3	1.3	1.3	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.0	1.3	1	1.2	1.0	1.3	1.6	1.6	1.6	1.8	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.3	1.7	2.6	1.7	2.5	2.9	3.1	3.4	3.8	CMA+DE-MOS [12]
NEWUOA	2.0	1.5	1.2	3.0	1.9	2.5	14	156	146	<i>70e-5/5e3</i>	NEWUOA [15]
Basic RCGA	1.8	1.7	2.2	2.1	6.7	61	118	158	348	645	Basic RCGA [16]
SPSA	4746	2169	744	766	1076	3836	3379	<i>21e-2/1e5</i>	.	.	SPSA [8]

Table 13: 02-D, running time excess ERT/ERT_{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											
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	0.63	1.7	5.3	59	277	482	643	643	643	841	ERT_{best}/D
(1,2)-CMA-ES	1.5	5.3	3.6	2.0	2.0	3.3	4.7	4.7	4.7	6.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.8	2.9	2.0	1.1	1.2	1.1	1.4	1.4	1.4	2.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	2.2	3.1	2.0	1.8	1.8	2.7	3.0	3.0	3.0	2.6	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	11	5.3	4.4	2.5	2.1	2.6	5.3	5.3	5.3	5.8	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.6	1.2	1.3	3.9	2.1	1.9	2.2	2.2	2.2	2.2	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.4	10	3.9	1.7	1.9	1.7	2.2	2.2	2.2	1.8	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	2.7	2.4	1.6	1.9	2.4	1.7	1.4	1.4	1.4	1.1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	2.3	3.5	5.7	2.2	2.6	2.5	1.9	1.9	1.9	2.1	(1,4s)-CMA-ES [3]
avg NEWUOA	1.6	7.9	4.3	1.6	1.5	2.7	4.5	4.5	4.5	6.9	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	28	18	7.6	11	55	142	160	160	160	289	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.9	1.9	1	2.7	2.7	1.7	1.9	1.9	1.9	1.5	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.6	1.7	5.0	2.3	1.5	1.3	1.3	1.3	1.2	IPOP-CMA-ES [14]
CMA+DE-MOS	1.1	1.3	1.4	1.0	1	1	1	1	1	1	CMA+DE-MOS [12]
NEWUOA	1.9	5.4	5.4	1.5	2.6	4.2	5.7	5.7	5.7	7.2	NEWUOA [15]
Basic RCGA	1.2	1	2.1	1	13	26	29	29	29	27	Basic RCGA [16]
SPSA	14	12	8.3	278	142	512	393	393	393	396	SPSA [8]

Table 14: 02-D, running time excess ERT/ERT_{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										
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
	0.70	1.5	5.0	81	572	904	2236	2236	2236	3587	
(1,2)-CMA-ES	1.1	15	6.2	4.1	3.9	13	30	30	30	40	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	12	23	13	3.2	2.8	8.5	8.3	8.3	8.3	<i>32e-4/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	6.3	22	23	5.0	3.5	9.0	20	20	20	<i>63e-4/1e4</i>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	12	18	11	3.4	5.1	10	9.3	9.3	9.3	19	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.4	24	15	3.1	2.3	5.6	5.7	5.7	5.7	20	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.1	10	6.8	4.0	3.5	8.7	6.1	6.1	6.1	10	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	3.2	38	28	5.3	2.7	4.6	8.3	8.3	8.3	12	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	24	12	5.1	4.3	17	9.1	9.1	9.1	5.7	(1,4s)-CMA-ES [3]
avg NEWUOA	1.0	36	26	4.3	16	29	40	40	40	25	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	441	329	187	52	37	45	25	25	25	54	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.3	7.5	7.6	2.7	1.7	2.3	2.0	2.0	2.0	1.6	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.4	2.3	2.3	1.5	1	1	1	1	1	1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.5	1.2	1	5.5	5.8	2.7	2.7	2.7	6.1	CMA+DE-MOS [12]
NEWUOA	1.4	22	61	14	23	97	39	39	39	<i>21e-2/6e3</i>	NEWUOA [15]
Basic RCGA	1.3	1	1	1.7	11	30	24	24	24	21	Basic RCGA [16]
SPSA	71	147	95	49	50	120	141	141	141	<i>63e-4/1e5</i>	SPSA [8]

Table 15: 02-D, running time excess ERT/ERT_{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											
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
(1,2)-CMA-ES	1.7	2.0	1.6	1.8	2.1	4.2	6.7	6.7	6.7	19	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.3	2.0	1.3	1.8	2.3	5.3	5.3	5.3	16	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.6	1.1	1.7	1.3	1.6	2.9	5.8	5.8	5.8	13	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1.4	1	1.7	1.9	1.8	7.3	8.8	8.8	8.8	18	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.2	1.2	1.5	1.3	1.2	2.2	2.4	2.4	2.4	3.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.9	1.3	1	1.3	1.5	2.2	2.2	2.2	2.2	2.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1.6	1.2	1.1	1.5	1.0	1.2	1.9	1.9	1.9	1.8	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	2.1	2.3	1.9	1	1	1.9	2.1	2.1	2.1	2.6	(1,4s)-CMA-ES [3]
avg NEWUOA	1.2	1.5	2.1	1.9	3.2	6.0	6.9	6.9	6.9	12	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	11	6.4	4.5	4.5	111	319	535	535	535	1214	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.1	1.7	1.2	1.4	1.5	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	2.3	2.4	1.7	3.7	2.5	2.4	2.4	2.4	2.4	2.2	IPOP-CMA-ES [14]
CMA+DE-MOS	1.2	1.1	1.3	1.5	2.1	2.0	6.2	6.2	6.2	5.2	CMA+DE-MOS [12]
NEWUOA	1.7	1.4	1.4	3.0	3.2	4.4	11	11	11	11	NEWUOA [15]
Basic RCGA	1.3	1.0	1.7	15	27	99	110	110	110	134	Basic RCGA [16]
SPSA	39	26	35	113	169	263	756	756	756	2395	SPSA [8]

Table 16: 02-D, running time excess ERT/ERT_{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											
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	4.7	15	114	527	1491	1573	1917	1974	2050	2169	ERT_{best}/D
(1,2)-CMA-ES	8.3	5.6	2.8	2.2	1.6	4.6	7.4	16	33	66	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.4	4.3	4.8	2.6	2.5	8.4	8.3	13	16	21	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	2.0	2.4	1	1.8	4.5	6.4	16	34	69	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	9.2	18	3.4	2.5	2.0	11	<i>12e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.3	1	3.3	1.9	1.8	2.9	3.0	3.0	4.1	3.9	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.3	1.1	2.1	2.4	1.8	3.2	3.5	3.8	4.5	5.0	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	2.0	3.7	3.1	1.9	1.1	2.2	2.5	3.1	3.5	3.9	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.8	1.1	1.4	2.3	1.6	3.2	3.6	4.2	4.9	5.9	(1,4s)-CMA-ES [3]
avg NEWUOA	5.5	2.9	2.7	1.4	1.7	6.4	9.0	40	<i>14e-3/5e3</i>	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	46	61	110	103	187	416	733	<i>34e-2/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	2.2	1.3	5.3	2.1	1	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.2	1.8	6.0	4.0	1.9	2.3	2.2	2.2	2.1	2.1	IPOP-CMA-ES [14]
CMA+DE-MOS	1.5	1.7	7.2	7.9	3.6	3.6	3.1	3.2	3.2	3.3	CMA+DE-MOS [12]
NEWUOA	3.8	2.1	1.4	1.7	2.0	7.0	41	<i>50e-3/5e3</i>	.	.	NEWUOA [15]
Basic RCGA	1.3	2.1	1	10	25	56	116	176	170	337	Basic RCGA [16]
SPSA	14	8.8	13	29	60	297	780	<i>43e-3/1e5</i>	.	.	SPSA [8]

Table 17: 02-D, running time excess ERT/ERT_{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										
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
(1,2)-CMA-ES	8.3	7.1	5.4	1.8	3.0	<i>12e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	5.9	6.2	4.9	1.6	3.1	22	16	<i>11e-2/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	8.0	6.4	6.0	1.1	3.8	<i>14e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	9.2	7.0	5.8	2.6	7.3	<i>31e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	10	7.7	6.0	1.2	1.1	10	<i>36e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	13	5.1	4.4	1	3.3	10	<i>12e-2/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	13	11	5.8	1.4	1.8	6.1	15	<i>59e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	7.1	7.2	2.9	1.4	1.5	3.9	16	<i>33e-3/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	14	27	15	3.1	4.6	<i>78e-2/6e3</i>	.	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	45	93	70	10	34	104	154	<i>17e-2/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	4.9	4.6	3.1	1.1	1	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	2.9	3.9	6.2	1.4	1.1	1.5	1.4	1.4	1.6	1.5	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1	1.1	2.3	4.3	3.6	3.9	3.9	4.6	CMA+DE-MOS [12]
NEWUOA	39	21	18	3.7	14	<i>97e-2/6e3</i>	.	.	.	.	NEWUOA [15]
Basic RCGA	1.6	1.3	3.6	6.7	8.5	13	17	<i>73e-3/5e4</i>	.	.	Basic RCGA [16]
SPSA	52	34	48	39	72	216	158	<i>35e-2/1e5</i>	.	.	SPSA [8]

Table 18: 02-D, running time excess ERT/ERT_{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										
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
(1,2)-CMA-ES	3.6	5.3	20	9.3	8.5	7.9	7.9	8.5	8.5	8.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.3	2.4	16	8.8	7.8	6.9	6.6	6.1	6.1	5.7	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	2.1	4.8	7.3	4.1	3.6	4.1	4.2	4.2	4.0	3.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1.5	5.9	47	26	30	35	38	35	33	29	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1.7	2.8	4.4	2.3	1.9	2.0	2.0	1.8	1.9	1.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1.7	2.8	3.2	1.7	1.8	1.7	1.7	1.8	1.7	1.8	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1.7	3.1	2.1	1	1	1	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.1	1.7	1.7	1.4	1.5	1.4	1.4	1.4	1.4	1.3	(1,4s)-CMA-ES [3]
avg NEWUOA	1.1	1	1	1.9	5.7	13	32	338	<i>90e-5/5e3</i>	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	20	61	22	22	247	897	2123	1886	6047	5147	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1.4	3.5	2.8	1.6	1.7	1.6	1.8	1.8	1.8	1.9	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1.8	2.8	4.4	2.4	2.6	3.5	3.8	3.6	3.6	3.5	IPOP-CMA-ES [14]
CMA+DE-MOS	1.2	4.4	3.1	2.3	2.8	2.9	3.4	3.8	4.2	5.1	CMA+DE-MOS [12]
NEWUOA	1	1.1	2.0	2.0	5.1	15	54	109	312	<i>11e-4/5e3</i>	NEWUOA [15]
Basic RCGA	1.9	2.3	27	49	214	370	432	1652	1517	<i>16e-3/5e4</i>	Basic RCGA [16]
SPSA	29	171	434	369	2051	8144	<i>20e-2/1e5</i>	.	.	.	SPSA [8]

Table 19: 02-D, running time excess ERT/ERT_{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 diff powers Gauss										
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
	0.50	0.53	0.97	12	50	117	366	1153	1602	2770	
(1,2)-CMA-ES	1	1.1	1.8	1.8	4.5	5.0	5.5	6.1	11	52	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.9	2.3	3.8	2.9	2.1	1.7	1.8	4.9	25	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1.1	1.4	2.4	2.0	1.8	2.9	2.5	4.3	16	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.5	1.6	2.2	3.1	5.2	6.8	12	91	<i>90e-6/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	2.0	2.4	1.8	2.8	1.4	1.6	1.2	2.8	16	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1.5	3.1	1.6	1.1	2.1	1.7	2.4	11	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1.8	2.1	2.5	1	1.2	1	1.1	1.9	25	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1.3	2.1	5.8	2.6	2.3	1.4	1.8	3.2	16	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.3	2.1	8.1	5.7	11	8.4	5.4	10	<i>67e-6/5e3</i>	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	12	19	12	1.7	1.3	10	115	68	273	<i>34e-6/1e5</i>	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.2	3.0	1.2	1	1.1	1.4	1.5	1.4	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.6	2.8	3.6	1.6	1.1	1.6	2.1	2.4	3.4	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.1	1.4	1.3	3.6	4.3	2.2	1	1	1	CMA+DE-MOS [12]
NEWUOA	1	2.4	2.2	6.9	6.1	17	10	16	48	28	NEWUOA [15]
Basic RCGA	1	1.1	1	1	2.3	6.6	6.5	8.8	15	35	Basic RCGA [16]
SPSA	15	30	25	418	820	1984	1191	<i>21e-3/1e5</i>	.	.	SPSA [8]

Table 20: 02-D, running time excess ERT/ERT_{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 diff powers unif										
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 1.1	1e+00 9.1	1e-01 445	1e-02 1182	1e-03 3214	1e-04 8792	1e-05 16925	1e-07 53115	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1.7	12	21	2.5	8.0	<i>76e-4/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.1	12	12	2.0	15	<i>12e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	2.9	13	12	2.1	8.7	<i>52e-4/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.1	7.4	20	3.9	14	46	<i>15e-3/1e4</i>	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1.3	1.6	26	1.9	7.8	13	<i>56e-4/1e4</i>	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.5	22	16	2.1	4.6	44	<i>25e-4/1e4</i>	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1.5	10	16	2.1	4.6	<i>54e-4/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	5.9	1.6	8.4	<i>79e-4/1e4</i>	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	9.5	23	46	17	16	<i>94e-3/6e3</i>	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	423	709	383	139	15	70	220	<i>53e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1.2	1.2	5.4	1	1	1	1	1.2	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.5	2.2	15	1.5	1.6	1.3	1.1	1	1.1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.3	1.2	2.8	1.3	4.7	15	16	9.2	10	CMA+DE-MOS [12]
NEWUOA	1	3.1	30	38	17	36	<i>98e-3/6e3</i>	.	.	.	NEWUOA [15]
Basic RCGA	1	1.3	1.3	1	2.9	14	17	24	42	<i>31e-5/5e4</i>	Basic RCGA [16]
SPSA	57	173	94	94	45	270	<i>13e-3/1e5</i>	.	.	.	SPSA [8]

Table 21: 02-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 diff powers Cauchy										
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.60	1e+01 1.2	1e+00 7.0	1e-01 20	1e-02 49	1e-03 113	1e-04 270	1e-05 398	1e-07 601	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1.3	1.4	1.9	2.6	6.0	9.5	8.2	11	14	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.1	1.3	1.3	2.1	1.6	2.2	4.1	5.0	7.0	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1.1	1.5	1.7	1.0	1.6	1.9	2.4	3.1	3.9	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.1	2.5	2.5	1.8	5.0	23	25	42	119	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1.9	1.6	1.5	1.5	1.3	1.2	1.5	2.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.3	1.7	1.6	1.6	1.9	1.9	2.0	1.8	2.0	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.3	1	1	1	1.0	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1.4	1.6	1.4	1.1	1.1	1	1.0	1.0	1.1	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.3	1.6	2.9	4.5	9.3	31	49	<i>31e-5/5e3</i>	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	15	21	13	16	10	15	88	472	3535	<i>13e-5/1e5</i>	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1.1	1.6	1.6	1.5	1.7	1.9	1.6	1.7	1.9	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.7	2.5	1.9	1.6	1.5	2.3	2.8	3.1	3.7	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.3	2.1	5.9	5.5	5.6	4.1	4.1	4.6	CMA+DE-MOS [12]
NEWUOA	1	1.3	1.6	2.2	3.1	11	20	80	170	<i>40e-5/5e3</i>	NEWUOA [15]
Basic RCGA	1	1.1	1	1.0	8.3	9.1	20	21	51	147	Basic RCGA [16]
SPSA	33	50	76	407	2835	2575	2803	<i>13e-3/1e5</i>	.	.	SPSA [8]

Table 22: 02-D, running time excess ERT/ERT_{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											
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
	0.50	0.50	3.1	56	212	548	840	1164	1950	2867	
(1,2)-CMA-ES	1	2.9	6.8	4.3	6.0	15	81	<i>53e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.3	1.1	2.8	2.0	6.2	13	27	36	<i>98e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1.7	5.8	3.2	3.9	5.3	50	<i>32e-4/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.6	11	3.6	8.7	28	<i>16e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1.3	2.7	5.1	4.1	4.0	6.3	20	36	<i>23e-5/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.1	2.2	3.2	3.1	3.6	4.4	8.6	8.5	52	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1.4	15	1.9	2.6	3.1	7.8	20	22	<i>38e-5/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1.9	17	3.8	7.0	9.4	26	39	75	<i>32e-4/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.3	6.7	8.3	40	70	<i>11e-2/5e3</i>	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	12	16	7.6	18	46	117	261	<i>53e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1.3	1.7	1	1	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.3	14	3.3	3.0	1.5	1.4	1.4	1.1	1.2	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.4	1	26	25	13	10	8.4	5.7	4.8	CMA+DE-MOS [12]
NEWUOA	1	1.7	4.7	14	37	70	<i>99e-3/5e3</i>	.	.	.	NEWUOA [15]
Basic RCGA	1	1	1.1	8.6	27	18	28	36	50	<i>25e-6/5e4</i>	Basic RCGA [16]
SPSA	21	38	29	688	<i>44e-2/1e5</i>	.	.	.	.	.	SPSA [8]

Table 23: 02-D, running time excess ERT/ERT_{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											
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
	0.50	0.50	3.0	386	2371	6690	13816	22782	33525	78413	
(1,2)-CMA-ES	1	1.8	13	1.9	62	<i>24e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1.2	2.8	9.3	1.3	10	<i>13e-2/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1.1	6.1	16	2.0	61	<i>23e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.2	25	2.7	30	<i>18e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1.8	11	2.3	4.7	<i>83e-3/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.3	3.8	1.3	14	<i>13e-2/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	2.0	15	1.7	6.0	22	<i>98e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	2.8	40	1.9	15	<i>11e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	10	34	6.6	38	<i>46e-2/6e3</i>	.	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	261	1354	288	34	27	46	<i>48e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	2.0	10	1.5	1.2	1	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.6	9.0	1	1	1.3	1.4	1.1	1.1	1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.5	1	11	52	33	21	13	12	7.2	CMA+DE-MOS [12]
NEWUOA	1	1	29	8.8	38	<i>44e-2/6e3</i>	.	.	.	.	NEWUOA [15]
Basic RCGA	1	1.5	1.5	5.8	31	<i>11e-2/5e4</i>	.	.	.	.	Basic RCGA [16]
SPSA	32	64	71	21	296	<i>22e-2/1e5</i>	.	.	.	.	SPSA [8]

Table 24: 02-D, running time excess ERT/ERT_{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											
$\Delta\text{ftarget}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta\text{ftarget}$
ERT_{best}/D	0.50	0.53	2.1	33	108	274	1110	1849	4139	9115	ERT_{best}/D
(1,2)-CMA-ES	1	2.0	3.3	13	20	32	62	<i>60e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.7	2.5	3.3	2.8	5.6	11	<i>98e-5/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1.8	2.6	2.7	6.6	6.8	7.6	77	<i>89e-5/1e4</i>	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.6	13	11	19	55	<i>16e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	3.6	2.8	7.5	6.5	7.9	7.2	24	<i>23e-5/1e4</i>	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.3	2.7	4.4	2.1	3.4	2.9	10	34	<i>23e-5/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1.7	22	4.9	2.6	2.0	1.5	11	35	<i>23e-5/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1.1	1.4	1.6	10	6.7	6.2	7.2	79	<i>42e-5/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.6	10	9.0	32	76	<i>98e-3/5e3</i>	.	.	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	14	19	30	11	55	176	203	764	<i>19e-4/1e5</i>	.	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1.7	1.9	1	1.3	1.9	1	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1.3	3.0	1.2	1	1	1.1	1.3	1.3	1.2	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1.4	1.6	3.0	21	25	9.1	5.8	5.3	3.6	CMA+DE-MOS [12]
NEWUOA	1	2.1	4.7	6.3	20	57	<i>33e-3/5e3</i>	.	.	.	NEWUOA [15]
Basic RCGA	1	1	1	2.9	33	31	29	52	88	<i>19e-5/5e4</i>	Basic RCGA [16]
SPSA	48	84	3825	818	683	2545	<i>37e-3/1e5</i>	.	.	.	SPSA [8]

Table 25: 02-D, running time excess ERT/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										
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 0.50	1e+00 1.9	1e-01 12	1e-02 86	1e-03 269	1e-04 1246	1e-05 2703	1e-07 3541	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1	5.6	3.7	4.2	3.8	8.7	4.0	4.3	<i>63e-7/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	1.5	2.1	1.4	6.0	3.0	3.9	13	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	1	1.4	2.3	7.3	4.4	5.0	20	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1.1	2.8	5.5	2.7	12	4.4	5.4	41	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	1.2	1	1.6	12	5.1	5.7	13	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1.1	1.5	2.0	2.2	8.5	3.5	2.7	4.3	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	1.4	2.4	2.7	7.3	2.1	2.2	6.9	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1.2	1.3	1.3	1.6	13	5.9	4.4	19	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	2.3	1.8	1.9	1.6	5.7	2.4	1.6	6.6	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	14	20	25	8.9	3.5	4.3	12	6.7	10	43	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.1	1.2	2.1	1.2	3.3	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1.2	1.5	1.4	1.8	4.2	1.3	1.3	1.5	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.1	1.5	1.8	1	1	3.3	1.5	1.2	CMA+DE-MOS [12]
NEWUOA	1	1	2.0	1.6	3.1	1.2	5.7	2.1	1.8	11	NEWUOA [15]
Basic RCGA	1	1	1.2	1.7	2.3	1.6	5.8	4.6	3.6	14	Basic RCGA [16]
SPSA	22	32	37	16	6.8	1.9	209	227	246	<i>45e-5/1e5</i>	SPSA [8]

Table 26: 02-D, running time excess ERT/ERT_{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											
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 0.50	1e+00 1.7	1e-01 23	1e-02 88	1e-03 1671	1e-04 3483	1e-05 5350	1e-07 27651	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1	2.3	15	6.4	12	7.0	19	27	<i>75e-5/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.1	1.2	3.0	11	4.9	5.9	8.2	<i>23e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	1	5.0	6.8	9.1	7.7	28	<i>81e-5/1e4</i>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1.1	11	5.3	16	8.6	12	26	<i>12e-4/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	1.8	7.2	7.6	3.7	8.8	12	5.1	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	2.1	2.4	5.7	4.0	3.7	5.8	<i>64e-6/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.1	12	2.4	3.9	3.1	3.5	5.7	5.2	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	3.5	5.5	5.9	4.9	4.6	<i>18e-5/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	26	27	14	26	12	7.6	<i>18e-4/6e3</i>	.	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	284	472	608	203	34	99	23	40	38	<i>32e-6/1e5</i>	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1	1.3	4.9	3.3	1.4	1	1	1	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1	1.2	1.6	3.2	1.1	1.9	2.2	1.0	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.1	1.1	1.0	1	12	17	21	13	CMA+DE-MOS [12]
NEWUOA	1	1	2.1	58	13	26	54	<i>32e-4/6e3</i>	.	.	NEWUOA [15]
Basic RCGA	1	1	1.1	1.3	1	1.2	1	1.3	1.5	1.3	Basic RCGA [16]
SPSA	16	50	86	56	40	151	113	93	83	<i>18e-4/1e5</i>	SPSA [8]

Table 27: 02-D, running time excess ERT/ERT_{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										
Δf_{target} ERT_{best}/D	1e+03 0.50	1e+02 0.50	1e+01 0.50	1e+00 1.6	1e-01 8.3	1e-02 83	1e-03 520	1e-04 1883	1e-05 2428	1e-07 2506	Δf_{target} ERT_{best}/D
(1,2)-CMA-ES	1	1	1	3.0	3.2	2.8	5.9	3.0	3.8	7.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.1	2.0	2.4	1.3	2.3	1.0	1.2	2.3	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	1.5	2.0	1.3	3.1	1.7	1.9	2.3	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1.2	3.3	5.1	2.8	9.3	3.8	5.2	28	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	1.1	1	3.0	4.0	2.3	1.8	2.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	1.3	1.2	2.9	3.5	1.8	1.9	2.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.1	1.3	1.2	3.1	3.0	1.3	1.1	1.4	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	1	4.9	2.4	2.8	1	1.0	1	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	1.3	2.2	4.3	1.8	4.0	1.9	3.4	<i>16e-6/5e3</i>	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	12	17	19	8.6	4.2	1.7	2.5	5.0	16	96	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.4	1.9	2.3	2.7	3.0	1.2	1.1	1.2	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1	1.3	4.7	1.3	1.9	1.1	1	2.3	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.1	1.2	1.9	1	1	1.6	3.6	5.1	CMA+DE-MOS [12]
NEWUOA	1	1	2.1	1.9	5.7	2.0	5.6	4.1	3.9	13	NEWUOA [15]
Basic RCGA	1	1	1.2	1.1	2.5	1.6	4.6	2.8	3.5	42	Basic RCGA [16]
SPSA	26	39	94	195	296	140	206	176	<i>40e-5/1e5</i>	.	SPSA [8]

Table 28: 02-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											
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
	0.50	0.50	0.70	37	247	618	706	759	771	783	
(1,2)-CMA-ES	1	1	5.3	5.4	2.6	1.6	1.9	2.0	2.1	2.7	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.2	3.1	1.7	1.4	1.7	1.6	1.8	2.2	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	2.1	1.5	1	1.0	1.3	1.5	1.7	1.9	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	9.4	4.9	1.5	1	1.9	2.7	4.0	4.2	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	2.1	12	3.9	1.6	1.9	1.8	1.8	1.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	2.7	6.8	3.2	1.8	1.7	1.6	1.5	1.8	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	2.3	8.0	2.7	1.1	1	1	1	1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1.6	3.7	2.7	1.5	1.4	2.0	2.2	2.1	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	3.8	12	2.5	2.0	2.0	2.4	3.7	13	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	13	19	20	9.1	12	5.0	13	21	94	223	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	2.6	14	4.3	2.0	3.1	5.1	5.1	5.4	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1	5.2	2.9	2.3	2.0	2.0	2.0	2.1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.8	20	23	13	11	11	11	11	CMA+DE-MOS [12]
NEWUOA	1	1	2.4	9.5	2.6	2.5	2.7	4.4	5.3	8.0	NEWUOA [15]
Basic RCGA	1	1	1.4	1	4.9	4.0	8.1	18	22	59	Basic RCGA [16]
SPSA	10	22	45	173	179	206	609	567	<i>83e-4/1e5</i>	.	SPSA [8]

Table 29: 02-D, running time excess ERT/ERT_{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										
$\frac{\Delta f_{\text{target}}}{ERT_{\text{best}}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{\text{target}}}{ERT_{\text{best}}/D}$
	0.50	0.50	0.73	21	621	1124	2090	3863	9428	17273	
(1,2)-CMA-ES	1	1	11	13	2.4	3.0	4.5	7.0	4.9	8.5	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	2.2	17	1.7	1.8	2.1	6.2	15	<i>12e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.6	17	1.9	2.5	1.8	5.1	2.6	8.5	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	22	13	1.1	2.5	3.9	2.6	3.3	<i>60e-6/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1.5	13	1.6	1.9	1.8	1.9	1.0	2.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	2.0	11	1.0	1	1.3	2.0	1.2	2.6	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	2.0	17	1.6	1.2	1.9	2.2	1.8	4.1	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	12	1	1.7	1.7	2.1	3.5	<i>31e-6/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	63	40	5.6	6.3	4.3	11	9.3	5.1	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	288	439	335	144	9.4	22	18	29	18	85	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.9	21	2.3	1.5	1	1	1	1.7	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	2.1	12	2.2	2.2	2.5	3.4	1.5	1	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.8	2.2	2.3	11	13	8.5	3.6	2.1	CMA+DE-MOS [12]
NEWUOA	1	1	30	36	3.7	6.0	8.7	11	10	<i>37e-4/6e3</i>	NEWUOA [15]
Basic RCGA	1	1	1.0	1	2.4	3.6	5.8	4.5	7.4	42	Basic RCGA [16]
SPSA	5.1	48	118	156	12	25	25	34	47	<i>86e-6/1e5</i>	SPSA [8]

Table 30: 02-D, running time excess ERT/ERT_{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

130 Gallagher Cauchy											
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
	0.50	0.50	0.93	24	97	637	1328	1341	1365	1392	
(1,2)-CMA-ES	1	1	1.6	38	34	7.1	3.8	3.8	5.0	5.1	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1.2	29	16	3.4	1.7	1.7	1.8	1.8	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1.2	13	15	4.2	2.2	2.8	2.7	2.8	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	2.1	39	55	12	5.9	6.0	6.2	6.9	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1.6	20	13	2.4	1.3	1.3	1.3	1.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	2.0	15	10	2.7	1.4	1.4	1.4	1.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1.2	6.1	9.1	2.0	1	1	1.2	1.2	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1.1	8.6	13	2.1	1.0	1.0	1	1	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	2.6	7.8	3.8	1	1.1	2.4	4.9	11	avg NEWUOA [15]
CMA-EGS (IPOP,r1)	8.8	12	9.0	7.4	23	7.1	9.0	44	84	202	CMA-EGS (IPOP,r1) [7]
IPOP-aCMA-ES	1	1	1.2	6.3	6.7	15	7.8	7.7	7.8	53	IPOP-aCMA-ES [11]
IPOP-CMA-ES	1	1	1	7.9	18	3.4	1.7	1.9	1.9	1.9	IPOP-CMA-ES [14]
CMA+DE-MOS	1	1	1.4	1	1	3.9	7.1	12	12	25	CMA+DE-MOS [12]
NEWUOA	1	1	2.3	9.3	5.5	1.4	1.1	2.2	3.0	10	NEWUOA [15]
Basic RCGA	1	1	1.7	1.1	8.7	8.0	11	27	41	121	Basic RCGA [16]
SPSA	22	34	69	630	523	116	73	175	315	496	SPSA [8]

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