Comparison tables: BBOB 2010 noisy testbed with BBOB 2009 as reference 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 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 [11, 7]. The experimental set-up is described in [10].

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 in BBOB-2009 (see [6]) if an algorithm from BBOB-2009 reached the given target function value. The ERT value is given otherwise ($\mathrm{ERT}_{\mathrm{best}}$ is noted as infinite). See [10] 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: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{101}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

101 Sphere moderate Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.2	7.4	8.8	10	12	13	14	15	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.2**	8.3	4.4	6.3	8.1	8.5	10	11	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	3.1	4.3	3.3	4.9	6.0	5.8	6.6	7.4	8.9	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	3.8	**2.9**	4.1	5.0	5.1	5.8	6.7	7.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	7.0	4.7	6.7	8.0	7.6	8.7	10	12	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	**2.8**	**2.8**	3.6	4.5	4.6	5.5	6.1	7.1	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.3**	**2.4**	**2.1**	**2.8**	4.0	4.1	4.5	5.1	6.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1.2**	**2.4**	**1.7**	**2.3**	**2.9**	**3.0**	**3.5**	**3.9**	**4.6**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	3.3	**2.7**	**2.1**	**2.7**	3.5	3.5	4.0	4.4	5.3	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**2.6**	**2.9**	**1.5**	**1.6**	**1.7**	**1.5**	**1.5**	**1.5**	**1.5**	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	41	61	22	13	14	17	16	18	20	24	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.2**	**3.0**	**3.0**	4.2	5.8	5.8	6.7	7.6	9.3	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.2**	3.3	3.4	4.7	6.0	6.0	6.9	7.8	9.3	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	7.3	12	19	23	24	27	31	37	CMA+DE-MOS [13]
NEWUOA	**1**	3.6	**2.5**	**1.6**	**2.1**	**2.5**	**2.6**	**2.9**	**3.0**	**3.1**	NEWUOA [16]
Basic RCGA	**1**	**1.1**	7.7	25	48	88	113	155	206	293	Basic RCGA [17]
SPSA	40	64	83	171	386	434	455	494	568	9667	SPSA [9]

Table 2: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{102}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

102 Sphere moderate unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.2	7.1	10	13	14	16	17	20	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.4**	9.2	5.8	6.2	6.5	7.7	9.1	10	11	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1.4**	3.9	3.3	3.6	4.2	4.9	5.4	6.0	6.8	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**2.4**	4.2	3.3	3.9	3.9	4.7	5.1	5.4	6.3	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**2.3**	4.1	5.2	6.4	6.6	8.0	8.6	9.3	10	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	3.2	**2.5**	**2.9**	**3.0**	3.7	4.2	4.6	5.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.7**	**2.4**	**2.4**	**2.7**	**2.7**	3.4	3.9	4.1	4.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	**2.3**	**1.7**	**2.1**	**2.3**	**2.7**	**3.0**	**3.2**	**3.7**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.6**	**2.8**	**2.1**	**2.4**	**2.7**	**3.2**	**3.4**	**3.6**	**4.4**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1.3**	**2.7**	**1.4**	**1.5**	**1.4**	**1.5**	**1.5**	**1.6**	**1.5**	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	45	79	21	14	14	14	16	18	18	20	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.4**	3.5	3.4	3.8	4.3	5.0	5.8	6.1	7.0	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.5**	3.4	3.1	4.1	4.2	5.1	6.0	6.5	7.3	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	5.7	12	17	18	20	22	25	27	CMA+DE-MOS [13]
NEWUOA	**1**	3.9	6.3	6.0	7.0	15	20	27	33	41	NEWUOA [16]
Basic RCGA	**1**	**1.2**	10	29	39	57	88	123	155	209	Basic RCGA [17]
SPSA	41	60	1987	4868	9895	9681	9199	11030	24495	*31e-3/1e5*	SPSA [9]

Table 3: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{103}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

103 Sphere moderate Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.2	5.5	6.0	6.0	6.3	6.4	7.0	23	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.5**	6.2	6.7	9.0	13	18	22	25	10	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**2.5**	3.4	3.8	5.5	8.4	10	13	15	6.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	3.8	3.6	5.4	7.5	9.4	12	13	5.4	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**2.1**	8.2	7.0	10	12	16	20	22	9.2	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.6**	**2.1**	3.0	**4.4**	6.5	8.5	10	12	5.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.3**	**2.6**	**2.8**	4.6	**6.3**	**7.8**	**10**	**11**	**4.4**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1.2**	**2.4**	**2.1**	**3.5**	**4.9**	**6.1**	**7.5**	**8.1**	**3.4**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.6**	**2.9**	**2.9**	4.8	6.7	**8.0**	**10**	**10**	**4.2**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**2.5**	**2.5**	**1.6**	**3.6**	**5.4**	13	26	42	34	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	32	57	20	15	20	27	30	37	42	20	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**2.9**	4.1	6.3	8.8	11	14	16	6.5	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.4**	3.6	4.0	6.6	9.4	12	15	17	7.1	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	7.6	13	28	38	48	60	72	30	CMA+DE-MOS [13]
NEWUOA	**1**	3.5	**2.4**	**1.9**	5.7	9.4	60	85	178	136	NEWUOA [16]
Basic RCGA	**1**	**1.3**	7.1	27	60	133	234	353	434	222	Basic RCGA [17]
SPSA	51	202	151	119	165	251	415	5261	93276	*42e-6/1e5*	SPSA [9]

Table 4: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{104}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

104 Rosenbrock moderate Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	3.8	11	35	155	257	315	354	385	408	457	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	7.1	7.7	3.9	13	54	222	*98e-3/1e4*	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**2.9**	8.2	3.3	4.3	13	14	13	13	12	11	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.2	**2.9**	**1.6**	9.3	14	24	24	22	21	18	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.0	8.0	3.5	13	50	98	410	*69e-3/1e4*	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**2.0**	3.7	**1.6**	4.2	4.9	4.2	6.6	6.1	5.8	5.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**2.3**	3.4	**1.5**	5.0	**3.3**	3.9	3.6	3.3	3.2	**2.9**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**2.1**	3.1	**1.3**	4.3	5.0	4.2	3.8	3.5	3.3	3.0	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1.6**	**2.7**	**1.3**	8.9	14	18	16	15	14	13	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.3**	**2.8**	**1.0**	5.0	7.6	14	23	21	20	24	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	22	13	5.5	583	448	367	327	300	284	254	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.2	**2.7**	**1.5**	**2.0**	**1.7**	**1.6**	**1.6**	**1.5**	**1.5**	**1.4**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**2.1**	**2.2**	**1.4**	**3.4**	**2.9**	**2.8**	**2.7**	**2.6**	**2.5**	**2.4**	IPOP-CMA-ES [15]
CMA+DE-MOS	6.0	8.4	5.1	4.0	3.6	**3.3**	**3.2**	**3.0**	**3.0**	**2.9**	CMA+DE-MOS [13]
NEWUOA	**1.1**	**2.8**	**1.2**	**3.4**	6.0	14	24	100	*14e-4/5e3*	.	NEWUOA [16]
Basic RCGA	7.1	7.8	10	381	432	1080	963	1891	*12e-1/5e4*	.	Basic RCGA [17]
SPSA	189	148	*36e+0/1e5*	.	.	.	.	.	.	.	SPSA [9]

Table 5: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{105}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

105 Rosenbrock moderate unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	3.6	12	33	287	1035	2000	2078	2129	2165	2240	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	8.3	4.9	3.1	7.8	19	35	70	69	*18e-2/1e4*	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	4.5	3.8	**2.1**	6.0	10	10	20	*88e-3/1e4*	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.4	4.4	**2.1**	3.5	5.0	23	*38e-3/1e4*	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	6.6	3.5	4.9	10	19	*14e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	3.6	6.0	**2.8**	12	14	16	34	70	*14e-2/1e4*	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**2.4**	6.0	**2.6**	5.9	12	21	34	33	67	64	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1.5**	**1.8**	**1.0**	4.3	8.7	23	69	67	66	64	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1.7**	**1.5**	**1.6**	6.6	16	22	70	68	*12e-2/1e4*	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.3**	3.7	**1.7**	**2.4**	**1.9**	4.4	14	47	46	*45e-4/7e3*	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	20	12	5.7	989	1355	702	675	659	648	626	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1.8**	5.3	**2.8**	**3.0**	**1.3**	**0.71**	**0.70**	**0.70**	**0.70**	**0.70**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**2.3**	**2.7**	**1.6**	3.8	**1.6**	**0.89**	**0.90**	**0.90**	**0.90**	**0.90**	IPOP-CMA-ES [15]
CMA+DE-MOS	6.3	6.9	4.8	5.9	**2.2**	**1.3**	**1.5**	**1.6**	**1.6**	**1.6**	CMA+DE-MOS [13]
NEWUOA	**0.91**	**2.8**	**1.7**	**2.7**	3.3	5.0	*38e-3/5e3*	.	.	.	NEWUOA [16]
Basic RCGA	8.4	11	13	106	121	183	177	*51e-2/5e4*	.	.	Basic RCGA [17]
SPSA	499	250	*36e+0/1e5*	.	.	.	.	.	.	.	SPSA [9]

Table 6: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{106}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

106 Rosenbrock moderate Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	3.6	14	18	106	210	354	533	556	577	617	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	5.4	7.0	7.0	13	8.6	5.7	4.1	4.0	3.9	3.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	4.4	3.8	4.0	3.1	**2.5**	**1.8**	**1.3**	**1.3**	**1.3**	**1.3**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**2.2**	**2.4**	3.2	3.2	**2.4**	**1.7**	**1.2**	**1.2**	**1.2**	**1.2**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	7.1	6.6	7.9	8.5	6.8	4.7	3.4	3.4	3.4	3.4	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**2.3**	**2.4**	**2.7**	3.6	**2.4**	**1.6**	**1.2**	**1.2**	**1.1**	**1.1**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1.8**	**1.3**	**2.0**	**2.8**	**2.0**	**1.4**	**0.96**	**0.96**	**0.96**	**0.95**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1.6**	**0.92**	**1.3**	**2.0**	**1.4**	**0.96**	**0.68**	**0.68**	**0.68**	**0.67**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**2.4**	**1.2**	**2.1**	**1.8**	**1.5**	**1.0**	**0.74**	**0.74**	**0.74**	**0.73**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.9**	**0.85**	**0.85**	**1.5**	**2.4**	5.8	9.1	30	200	*21e-5/8e3*	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	16	7.9	8.4	7.5	4.9	22	15	15	14	14	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**2.0**	**1.7**	**2.3**	**1.9**	**1.6**	**1.2**	**0.87**	**0.89**	**0.90**	**0.92**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**2.1**	**2.1**	3.1	**2.5**	**2.2**	**1.7**	**1.2**	**1.3**	**1.3**	**1.3**	IPOP-CMA-ES [15]
CMA+DE-MOS	5.9	4.6	8.3	5.3	4.0	**2.8**	**2.0**	**2.1**	**2.2**	**2.3**	CMA+DE-MOS [13]
NEWUOA	**1.1**	**0.73**	**0.93**	**2.2**	5.0	27	59	*79e-4/7e3*	.	.	NEWUOA [16]
Basic RCGA	7.6	7.2	21	363	476	490	662	*44e-2/5e4*	.	.	Basic RCGA [17]
SPSA	609	1375	2049	*26e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 7: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{107}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

107 Sphere Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	8.0	46	91	138	188	234	275	370	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.3**	17	43	329	*18e-2/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	3.8	7.7	6.7	28	76	315	*91e-5/1e4*	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	6.3	7.7	21	44	141	292	527	*17e-4/1e4*	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	12	44	451	*23e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.9**	13	8.9	13	24	57	109	*62e-5/1e4*	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	3.3	6.4	6.9	5.3	**7.1**	13	**14**	28	392	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	5.1	4.8	5.2	8.4	**12**	26	70	392	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.1**	14	10	26	80	123	605	*66e-4/1e4*	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**2.7**	68	317	*14e-1/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	52	72	4.7	**2.5**	**4.9**	11	50	124	272	1086	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.2**	**1.9**	**2.8**	**1.9**	**1.6**	**1.4**	**1.4**	**1.3**	**1.4**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**2.0**	**2.1**	**0.98**	**1.1**	**1.3**	**1.3**	**1.2**	**1.2**	**1.1**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	3.1	24	20	17	18	19	19	18	CMA+DE-MOS [13]
NEWUOA	**1**	**2.7**	60	194	*17e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.5**	**1.6**	10	10	11	13	15	**17**	**17**	Basic RCGA [17]
SPSA	50	82	8500	*88e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 8: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{108}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

108 Sphere unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	17	1029	2894	4930	6187	8237	11726	16133	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.7**	43	*23e-1/1e4*	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**2.7**	27	22	*18e-1/1e4*	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.1**	32	44	*19e-1/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**2.8**	90	69	*22e-1/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.7**	**5.9**	15	51	*11e-1/1e4*	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.4**	25	**7.7**	*84e-2/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	3.7	15	13	*94e-2/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**2.7**	25	69	*15e-1/1e4*	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	3.0	155	44	*27e-1/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	5825	9728	290	14	**7.8**	**7.2**	**8.6**	**10**	**13**	**46**	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	12	11	**0.68**	**0.64**	**0.64**	**0.64**	**0.75**	**0.66**	**0.94**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.7**	9.1	**0.80**	**0.67**	**0.64**	**0.77**	**0.70**	**0.62**	**0.69**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	**2.5**	95	125	157	267	201	141	*89e-2/1e5*	CMA+DE-MOS [13]
NEWUOA	**1**	48	77	64	*41e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**0.79**	13	30	70	*16e-2/5e4*	.	.	.	Basic RCGA [17]
SPSA	436	1305	89	10	242	*15e-2/1e5*	.	.	.	.	SPSA [9]

Table 9: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{109}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

109 Sphere Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.2	11	43	75	114	139	175	189	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**2.7**	5.5	**2.8**	**1.8**	**1.9**	**1.9**	**2.5**	**2.5**	3.4	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	3.3	4.1	**2.5**	**1.2**	**1.1**	**1.0**	**1.1**	**1.0**	**1.3**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.3**	3.4	**2.1**	**1.0**	**0.86**	**0.77**	**0.89**	**0.89**	**1.1**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	5.8	3.5	**2.0**	**2.0**	**2.2**	**2.4**	**2.4**	3.4	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.1**	3.4	**2.2**	**1.0**	**0.98**	**1.0**	**1.1**	**1.1**	**1.4**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**2.9**	**1.4**	**0.79**	**0.82**	**0.81**	**0.88**	**0.93**	**1.2**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1.6**	**1.9**	**1.1**	**0.57**	**0.52**	**0.50**	**0.53**	**0.52**	**0.67**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.2**	**3.0**	**1.3**	**0.79**	**0.76**	**0.68**	**0.68**	**0.66**	**0.88**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1.5**	4.3	3.6	26	47	*67e-4/6e3*	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	41	62	21	8.3	3.1	110	2422	*17e-4/1e5*	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.1**	3.1	**1.9**	**1.1**	**1.0**	**0.92**	**1.1**	**1.2**	**1.5**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**2.9**	**2.2**	**1.2**	**1.1**	**1.0**	**1.1**	**1.1**	**1.5**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	6.1	8.7	4.9	4.9	4.7	5.2	5.3	7.4	CMA+DE-MOS [13]
NEWUOA	**1**	**1.7**	4.8	13	83	885	*41e-3/5e3*	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.3**	9.0	20	12	14	16	20	25	53	Basic RCGA [17]
SPSA	50	101	138	953	3515	*13e-2/1e5*	.	.	.	.	SPSA [9]

Table 10: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{110}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

110 Rosenbrock Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	10	48	190	6725	24004	1.12e5	1.19e5	1.19e5	1.21e5	1.22e5	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	18	8.0	32	*69e-1/1e4*	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	3.1	3.9	3.4	**2.3**	**2.8**	**0.61**	*10e-1/1e4*	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	6.2	3.2	**2.1**	**1.5**	**2.9**	**1.3**	*67e-2/1e4*	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	26	21	46	*92e-1/1e4*	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	8.3	5.0	**3.0**	**1.3**	6.0	**1.3**	*74e-2/1e4*	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	4.5	3.6	**1.5**	**0.66**	**1.0**	**1.3**	*37e-2/1e4*	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1.6**	**2.0**	**1.6**	**1.1**	**1.0**	**1.3**	*28e-2/1e4*	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.8	**2.4**	3.6	**1.6**	**2.8**	*79e-2/1e4*	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	20	34	241	*27e+0/6e3*	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	62	37	13	*33e-1/1e5*	.	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1.1**	**1.1**	**0.54**	4.3	3.2	**0.82**	**0.79**	**0.79**	**0.79**	**0.79**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**0.81**	**0.65**	**0.73**	8.3	3.4	**0.75**	**0.72**	**0.73**	**0.73**	**0.74**	IPOP-CMA-ES [15]
CMA+DE-MOS	3.1	4.6	10	36	65	14	**13**	**13**	**13**	**13**	CMA+DE-MOS [13]
NEWUOA	17	23	118	10	*13e+0/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**2.3**	3.1	4.8	35	30	6.5	*18e-1/5e4*	.	.	.	Basic RCGA [17]
SPSA	92	288	7418	*31e+0/1e5*	.	.	.	.	.	.	SPSA [9]

Table 11: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{111}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

111 Rosenbrock unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	14	214	1371	1.22e5	1.77e6	4.59e6	4.61e6	4.62e6	6.20e6	6.26e6	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	48	115	*12e+1/1e4*	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	27	26	*71e+0/1e4*	.	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	45	35	*72e+0/1e4*	.	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	64	81	*10e+1/1e4*	.	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	23	11	54	*20e+0/1e4*	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	10	8.2	22	*18e+0/1e4*	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	12	11	30	*22e+0/1e4*	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	23	22	104	*42e+0/1e4*	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	142	60	*20e+1/6e3*	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	121	39	22	12	*36e-1/1e5*	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**3.6**	**1.6**	**0.54**	**7.3**	**7.9**	*88e-2/1e6*	.	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**2.5**	**1.1**	**0.78**	15	**3.9**	**3.2**	**3.2**	**3.2**	**2.4**	**2.4**	IPOP-CMA-ES [15]
CMA+DE-MOS	6.5	34	16	**2.8**	**0.89**	*20e-1/1e5*	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	78	97	*36e+1/5e3*	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**2.8**	**2.6**	**2.4**	**6.0**	*26e-1/5e4*	.	.	.	.	.	Basic RCGA [17]
SPSA	79	60	1064	*20e+0/1e5*	.	.	.	.	.	.	SPSA [9]

Table 12: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{112}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

112 Rosenbrock Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	3.6	14	21	337	684	832	900	963	1026	1119	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	4.7	8.9	8.0	9.3	7.0	7.8	7.8	7.7	7.4	7.1	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**2.8**	**2.1**	**2.2**	**2.7**	**2.1**	**2.0**	**2.1**	**2.0**	**2.0**	**1.9**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.6	**3.0**	**2.7**	**1.7**	**1.4**	**1.3**	**1.3**	**1.3**	**1.3**	**1.2**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	10	6.5	6.4	8.6	11	11	14	14	13	12	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**2.4**	**1.8**	**1.8**	**2.4**	**1.8**	**1.7**	**1.7**	**1.7**	**1.6**	**1.6**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**2.7**	**1.9**	**2.0**	**1.2**	**1.0**	**1.0**	**1.1**	**1.0**	**1.0**	**1.0**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**2.0**	**2.3**	**2.1**	**1.1**	**0.81**	**0.76**	**0.76**	**0.74**	**0.72**	**0.70**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1.6**	**1.8**	**1.8**	**1.5**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.0**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.4**	**1.8**	3.1	4.9	23	110	*14e-2/7e3*	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	22	7.7	7.1	828	962	*20e-1/1e5*	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**2.9**	**2.0**	**2.2**	**1.2**	**1.0**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**2.9**	**2.0**	**2.1**	**1.4**	**1.4**	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**	IPOP-CMA-ES [15]
CMA+DE-MOS	6.3	4.9	7.3	**2.6**	**2.2**	**2.3**	**2.4**	**2.5**	**2.5**	**2.7**	CMA+DE-MOS [13]
NEWUOA	**0.94**	**0.71**	**1.9**	7.7	105	*44e-2/5e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	7.6	8.1	25	130	174	859	*70e-2/5e4*	.	.	.	Basic RCGA [17]
SPSA	331	364	1070	*45e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 13: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{113}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

113 Step-ellipsoid Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	1.9	27	377	1616	4804	4826	4826	4826	4880	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	4.4	24	20	51	*11e-1/1e4*	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1.9**	15	7.1	3.1	13	31	*12e-2/1e4*	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1.1**	6.3	6.1	3.4	26	30	*18e-2/1e4*	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1.1**	17	21	37	*91e-2/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1.4**	6.2	8.8	3.3	11	14	29	29	29	*19e-2/1e4*	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1.3**	4.7	**4.5**	**2.8**	**4.9**	14	14	14	14	14	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1.8**	**1.9**	6.7	4.0	8.2	14	14	14	14	14	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	16	6.0	6.4	10	15	15	15	15	15	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.7**	23	14	31	55	*13e-1/6e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	67	13	19	132	251	*58e-2/1e5*	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**2.9**	4.7	**4.4**	**0.78**	**0.77**	**0.27**	**0.32**	**0.32**	**0.32**	**0.32**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1.4**	**2.0**	**3.7**	**1.4**	**1.4**	**0.61**	**0.67**	**0.67**	**0.67**	**0.67**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1.5**	**1.8**	26	12	7.5	**3.6**	**4.0**	**4.0**	**4.0**	**4.2**	CMA+DE-MOS [13]
NEWUOA	**2.1**	15	13	44	*18e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1.7**	**1.9**	10	22	23	18	35	35	35	48	Basic RCGA [17]
SPSA	72	23	1892	*56e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 14: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{114}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

114 Step-ellipsoid unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	2.3	153	2944	11262	15778	16654	16654	16654	16990	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1.3**	144	101	*11e+0/1e4*	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1.5**	87	25	*63e-1/1e4*	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1.3**	139	54	*79e-1/1e4*	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	38	56	56	*73e-1/1e4*	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**2.3**	55	18	*46e-1/1e4*	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**2.3**	**17**	14	*30e-1/1e4*	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	53	26	19	50	*21e-1/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1.4**	23	21	*53e-1/1e4*	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.3**	112	74	*11e+0/6e3*	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1787	721	152	61	*19e-1/1e5*	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1.3**	35	**3.3**	**0.61**	**0.49**	**0.62**	**0.60**	**0.60**	**0.60**	**0.61**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1.3**	41	**3.2**	**0.45**	**0.48**	**0.80**	**0.79**	**0.79**	**0.79**	**0.80**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1.5**	**2.5**	60	130	34	**33**	**48**	**48**	**48**	**47**	CMA+DE-MOS [13]
NEWUOA	**1**	150	43	*89e-1/5e3*	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1.2**	**1.2**	**12**	**16**	**31**	*41e-2/5e4*	.	.	.	.	Basic RCGA [17]
SPSA	1025	531	181	245	*29e-1/1e5*	.	.	.	.	.	SPSA [9]

Table 15: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}\ 2009}$ on f_{115}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

115 Step-ellipsoid Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.20	2.0	13	97	366	455	510	510	510	594	$\mathrm{ERT}_{\mathrm{best}}$/D
(1,2)-CMA-ES	**2.2**	3.8	5.3	5.7	66	*13e-2/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1.7**	**2.5**	**1.9**	**2.4**	6.6	54	137	137	137	240	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**2.9**	**3.0**	**2.3**	**1.6**	7.5	44	88	88	88	247	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1.3**	3.1	4.7	11	50	*17e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1.9**	**1.7**	**1.7**	**1.7**	5.5	23	134	134	134	119	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1.6**	**1.4**	**1.2**	**1.3**	**2.6**	**13**	26	26	26	70	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1.7**	**1.4**	**2.9**	**1.7**	4.6	26	49	49	49	55	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1.7**	**1.6**	**1.9**	**1.8**	6.9	45	89	89	89	*11e-3/1e4*	(1,4s)-CMA-ES [3]
avg NEWUOA	**1.1**	**1.6**	**1.1**	4.2	28	*10e-2/6e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	63	13	8.6	422	1803	3116	2779	2779	2779	*31e-2/1e5*	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1.2**	**2.0**	**1.8**	**0.81**	**1.1**	**1.1**	**1.4**	**1.4**	**1.4**	**1.5**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1.3**	**1.2**	**1.7**	**2.4**	**2.7**	**2.9**	**3.1**	**3.1**	**3.1**	**2.7**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1.5**	**2.5**	5.3	18	31	25	**23**	**23**	**23**	**20**	CMA+DE-MOS [13]
NEWUOA	**2.1**	**1.2**	**2.9**	14	42	*34e-2/4e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	**1.4**	**1.7**	74	68	108	769	703	703	703	604	Basic RCGA [17]
SPSA	58	64	222	1640	3866	*12e-1/1e5*	.	.	.	.	SPSA [9]

Table 16: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{116}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

116 Ellipsoid Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	23	268	1146	2894	4462	5249	5374	5521	6066	6332	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	30	22	*42e+0/1e4*	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	8.2	5.0	8.0	16	*37e-1/1e4*	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	10	8.3	27	50	*17e+0/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	40	36	126	*72e+0/1e4*	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	7.2	5.3	6.6	15	*57e-1/1e4*	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	5.0	**2.8**	**3.9**	11	*33e-1/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	6.0	4.2	4.0	**6.0**	32	27	27	*28e-1/1e4*	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	9.2	5.6	10	*86e-1/1e4*	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	29	35	*95e+0/6e3*	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	565	5262	*33e+1/1e5*	.	.	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**2.7**	**1.1**	**0.88**	**0.62**	**0.57**	**0.59**	**0.73**	**0.73**	**0.68**	**0.68**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**3.7**	3.8	**3.1**	**2.3**	**1.9**	**1.7**	**1.8**	**1.8**	**1.7**	**1.7**	IPOP-CMA-ES [15]
CMA+DE-MOS	**2.1**	**1.4**	8.3	6.1	**4.9**	**5.3**	**5.2**	**5.1**	**4.7**	**4.5**	CMA+DE-MOS [13]
NEWUOA	27	20	*74e+0/5e3*	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	4.4	20	29	55	161	*22e-1/5e4*	.	.	.	.	Basic RCGA [17]
SPSA	2007	5359	*74e+1/1e5*	.	.	.	.	.	.	.	SPSA [9]

Table 17: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{117}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

117 Ellipsoid unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	34	865	5337	15210	21947	25722	27362	30258	34557	38341	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	92	82	*32e+1/1e4*	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	28	49	*19e+1/1e4*	.	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	45	170	*31e+1/1e4*	.	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	103	167	*31e+1/1e4*	.	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	11	28	*13e+1/1e4*	.	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	13	**10**	*82e+0/1e4*	.	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	12	35	*13e+1/1e4*	.	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	21	24	*14e+1/1e4*	.	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	38	100	*30e+1/6e3*	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	721	308	135	*14e+1/1e5*	.	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	8.1	**1.8**	**0.65**	**0.48**	**0.44**	**0.44**	**0.47**	**0.45**	**0.43**	**0.46**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**6.5**	**1.5**	**1.1**	**0.95**	**0.77**	**0.70**	**0.73**	**0.71**	**0.67**	**0.69**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1.8**	28	15	**8.5**	**8.8**	**7.6**	**7.2**	**6.5**	**6.7**	**6.1**	CMA+DE-MOS [13]
NEWUOA	41	*41e+1/5e3*	.	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**4.9**	10	**12**	48	*45e-1/5e4*	.	.	.	.	.	Basic RCGA [17]
SPSA	629	226	*13e+1/1e5*	.	.	.	.	.	.	.	SPSA [9]

Table 18: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{118}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

118 Ellipsoid Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	6.6	11	86	243	311	355	400	441	486	583	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	6.1	15	9.2	6.5	6.4	7.3	7.8	7.9	8.2	8.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	6.1	10	4.6	**2.4**	**2.2**	**2.2**	**2.2**	**2.0**	**2.0**	**1.8**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	5.0	7.2	**2.6**	**1.6**	**1.8**	**1.8**	**1.7**	**1.6**	**1.5**	**1.4**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	6.6	16	18	10	16	17	19	24	39	44	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	3.4	7.0	**2.3**	**1.4**	**1.3**	**1.4**	**1.3**	**1.3**	**1.3**	**1.2**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**2.6**	5.7	**2.0**	**1.2**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.0**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**2.0**	**4.1**	**1.1**	**0.71**	**0.77**	**0.78**	**0.75**	**0.73**	**0.70**	**0.65**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.6	7.2	**1.9**	**1.0**	**0.96**	**0.97**	**0.95**	**0.92**	**0.88**	**0.84**	(1,4s)-CMA-ES [3]
avg NEWUOA	**0.92**	**0.97**	**1.8**	8.3	64	*18e-2/7e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	27	689	337	622	889	3954	*21e-1/1e5*	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**2.5**	6.1	**1.7**	**0.88**	**0.91**	**0.91**	**0.91**	**0.92**	**0.91**	**0.90**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**3.0**	9.0	3.2	**2.0**	**1.9**	**2.0**	**2.0**	**1.9**	**1.9**	**1.7**	IPOP-CMA-ES [15]
CMA+DE-MOS	7.6	17	3.7	**1.8**	**1.7**	**1.8**	**2.1**	**2.3**	**2.5**	**2.8**	CMA+DE-MOS [13]
NEWUOA	**0.80**	**1.3**	4.3	10	116	*30e-2/5e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	5.4	520	495	1424	*45e-1/5e4*	.	.	.	.	.	Basic RCGA [17]
SPSA	46	255	2588	*18e+0/1e5*	.	.	.	.	.	.	SPSA [9]

Table 19: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.3	131	227	473	2074	6191	7059	9949	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.1**	15	7.8	86	*12e-2/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**2.5**	6.4	**2.5**	6.1	70	*16e-3/1e4*	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**2.6**	5.0	**2.7**	15	67	*18e-3/1e4*	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	11	34	10	626	*20e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.1**	10	**2.2**	11	29	*62e-4/1e4*	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.9**	15	**1.1**	**3.7**	**7.8**	22	23	*42e-4/1e4*	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**2.1**	8.9	**1.9**	5.6	13	68	*55e-4/1e4*	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	6.0	4.0	12	88	*23e-3/1e4*	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	3.4	19	23	*42e-2/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	62	92	14	9.3	26	129	99	*23e-4/1e5*	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**2.4**	**1.5**	**0.55**	**0.58**	**0.75**	**0.55**	**0.51**	**0.49**	**0.61**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1.1**	**0.35**	**0.70**	**0.78**	**0.83**	**0.79**	**1.0**	**1.4**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.2**	**2.6**	50	33	22	6.6	**3.3**	**3.3**	**2.5**	CMA+DE-MOS [13]
NEWUOA	**1**	**1.7**	26	35	*90e-2/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.2**	**1.4**	6.3	11	8.2	**6.1**	20	*20e-5/5e4*	.	Basic RCGA [17]
SPSA	51	67	3075	*32e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 20: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	3.2	580	3740	6898	14488	35436	66660	1.10e5	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.5**	77	33	*14e-1/1e4*	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	34	46	79	40	*11e-1/1e4*	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.7**	34	26	*10e-1/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	63	51	34	*14e-1/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	11	36	16	*77e-2/1e4*	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**2.9**	13	**6.6**	*66e-2/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	56	64	10	*69e-2/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.9**	38	15	*83e-2/1e4*	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	42	94	49	*15e-1/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1223	2182	675	85	33	24	49	*13e-3/1e5*	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**2.3**	18	**0.76**	**0.65**	**0.82**	**0.83**	**0.53**	**0.43**	**0.66**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.1**	**6.0**	**1.6**	**0.68**	**0.73**	**0.69**	**0.46**	**0.55**	**0.83**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.2**	**2.5**	63	130	71	**34**	**22**	**24**	**15**	CMA+DE-MOS [13]
NEWUOA	**1**	34	130	55	*24e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.3**	**0.87**	17	**12**	**23**	*50e-3/5e4*	.	.	.	Basic RCGA [17]
SPSA	194	1082	276	165	*84e-2/1e5*	.	.	.	.	.	SPSA [9]

Table 21: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	1.7	22	55	107	317	525	774	1239	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.3**	4.5	**2.9**	**1.9**	3.3	**2.9**	3.8	4.5	9.0	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1.6**	**2.4**	**1.2**	**0.94**	**1.2**	**1.1**	**1.7**	**1.9**	**2.8**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.1**	**2.7**	**1.1**	**0.87**	**0.84**	**0.90**	**1.0**	**1.2**	**1.3**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	4.4	5.3	**2.9**	**2.2**	**2.8**	5.7	5.5	9.4	27	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**2.1**	**1.7**	**1.2**	**0.91**	**1.1**	**0.96**	**1.1**	**1.2**	**1.3**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.7**	3.4	**1.2**	**0.86**	**1.1**	**0.91**	**0.93**	**1.0**	**1.2**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1.2**	**2.0**	**0.72**	**0.57**	**0.70**	**0.51**	**0.58**	**0.60**	**0.56**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	3.1	**2.6**	**0.98**	**0.75**	**0.86**	**0.62**	**0.70**	**0.77**	**0.80**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	3.3	4.3	3.3	45	788	*38e-3/6e3*	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	46	62	16	4.3	**2.9**	482	4519	*55e-4/1e5*	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	3.3	3.0	**1.1**	**1.1**	**1.1**	**0.78**	**0.79**	**0.84**	**0.82**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.6**	**1.9**	**1.1**	**1.0**	**1.1**	**1.1**	**1.7**	**2.1**	**2.3**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.2**	3.5	4.9	4.0	4.0	**2.3**	**2.4**	**2.3**	**2.5**	CMA+DE-MOS [13]
NEWUOA	**1**	3.9	4.8	15	76	*86e-3/4e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.3**	**2.1**	11	11	11	30	1408	*22e-5/5e4*	.	Basic RCGA [17]
SPSA	42	74	119	6850	*11e-1/1e5*	.	.	.	.	.	SPSA [9]

Table 22: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{122}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

122 Schaffer F7 Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.0	345	1838	4316	6017	8140	10749	22299	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.2**	11	30	*80e-2/1e4*	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1.1**	6.0	**4.7**	*34e-2/1e4*	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.4**	7.1	6.2	*57e-2/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1.1**	38	40	*96e-2/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.1**	8.7	11	*53e-2/1e4*	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	5.3	5.2	*38e-2/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	4.9	4.8	*35e-2/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	20	12	*57e-2/1e4*	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1.5**	6.1	34	*11e-1/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	33	46	13	7.1	28	81	*62e-3/3e4*	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.1**	**2.9**	**1.4**	**0.71**	**0.53**	**0.48**	**0.42**	**0.66**	**0.58**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.3**	4.8	**0.94**	**0.44**	**0.51**	**0.56**	**0.57**	**0.68**	**0.67**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	**1.8**	110	65	35	26	19	**15**	**10**	CMA+DE-MOS [13]
NEWUOA	**1**	**1.9**	14	91	*18e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.1**	**2.4**	8.0	**3.7**	**5.4**	**10**	**19**	*72e-5/5e4*	.	Basic RCGA [17]
SPSA	53	87	117	*46e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 23: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{123}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

123 Schaffer F7 unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	2.2	3213	16301	45479	67138	90334	1.34e5	4.43e5	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1.1**	75	*28e-1/1e4*	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	61	44	*22e-1/1e4*	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.1**	75	*29e-1/1e4*	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	33	87	*26e-1/1e4*	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1.2**	40	44	*15e-1/1e4*	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	9.1	39	**21**	*15e-1/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	39	46	*18e-1/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	69	46	*14e-1/1e4*	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**2.5**	80	*26e-1/6e3*	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1886	2342	1444	43	*14e-1/4e4*	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.3**	28	**0.94**	**0.66**	**0.46**	**0.67**	**0.62**	**0.56**	**0.60**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.4**	**23**	**0.62**	**0.52**	**0.46**	**0.74**	**0.80**	**0.65**	**0.45**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	**1.7**	71	**96**	*18e-1/1e5*	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	**1**	**1.3**	65	*37e-1/5e3*	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.1**	**2.1**	30	*11e-1/5e4*	.	.	.	.	.	Basic RCGA [17]
SPSA	77217	77493	12178	*71e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 24: 05-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best\ 2009}}$ on f_{124}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

124 Schaffer F7 Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.20	0.20	1.9	40	208	1795	4096	5279	9067	19040	$\mathrm{ERT}_{\mathrm{best}}$/D
(1,2)-CMA-ES	**1**	**1.1**	11	127	700	*52e-2/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1.1**	3.4	**2.7**	30	83	*65e-3/1e4*	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1.3**	4.3	5.5	22	*60e-3/1e4*	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1.8**	96	277	*88e-2/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	3.1	**2.8**	21	119	*13e-2/1e4*	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1.1**	**2.4**	**2.5**	15	39	*41e-3/1e4*	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1.3**	**1.8**	7.6	18	79	*46e-3/1e4*	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1.7**	17	19	72	*10e-2/1e4*	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**2.1**	6.1	89	*63e-2/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	54	76	19	5.7	80	*44e-3/6e4*	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1.3**	**2.6**	**1.2**	**2.1**	**0.85**	**0.93**	**0.93**	**0.94**	**0.59**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1.8**	**2.8**	**1.3**	**4.0**	**1.0**	**1.2**	**1.1**	**0.93**	**0.65**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1.1**	**1.7**	5.9	**15**	**3.5**	**2.4**	**2.2**	**3.3**	**1.9**	CMA+DE-MOS [13]
NEWUOA	**1**	**1.1**	**3.0**	158	*11e-1/4e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1.1**	**2.4**	63	41	10	11	66	*55e-5/5e4*	.	Basic RCGA [17]
SPSA	59	96	516	16583	*39e-1/1e5*	.	.	.	.	.	SPSA [9]

Table 25: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{125}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

125 Griewank-Rosenbrock Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	0.20	0.20	0.20	25031	47750	48260	48600	49199	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	**1**	120	59424	*92e-3/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	**1.3**	69	14809	*69e-3/1e4*	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	**1**	36	32993	*81e-3/1e4*	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	**1**	247	1.04e5	*11e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	**1**	**21**	12610	*58e-3/1e4*	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**1**	24	12571	*58e-3/1e4*	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	**1**	**20**	12034	*54e-3/1e4*	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	**1**	48	23166	*82e-3/1e4*	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	**2.0**	81	9966	*36e-3/6e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	49	65	70	153	3423	5.7	*10e-3/1e5*	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**1**	26	3142	**0.75**	**0.53**	**0.56**	**0.57**	**0.57**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1**	27	**2599**	**0.79**	**0.78**	**1.3**	**1.3**	**1.3**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**1.2**	34	**810**	5.0	**16**	**16**	**16**	**16**	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	3.9	**15**	6088	**2.8**	*40e-3/5e3*	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**1.1**	26	**1574**	**1.3**	*82e-4/5e4*	.	.	.	Basic RCGA [17]
SPSA	41	60	35786	35837	52690	56	*51e-3/1e5*	.	.	.	SPSA [9]

Table 26: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{126}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

126 Griewank-Rosenbrock unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	0.20	0.20	0.20	1.75e5	∞	∞	∞	∞	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	**1.1**	2015	7.40e5	*25e-2/1e4*	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	**1**	618	*22e-2/1e4*	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	**1**	719	*20e-2/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	32	585	7.17e5	*26e-2/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	**1**	532	*15e-2/1e4*	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**1**	356	2.33e5	*12e-2/1e4*	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	**1**	82	1.14e5	*12e-2/1e4*	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	**1.2**	282	3.57e5	*18e-2/1e4*	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	22	1636	4.54e5	*26e-2/6e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1548	1777	5228	7914	99874	8.3	*23e-3/1e5*	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**1**	**62**	**7882**	**1.4**	*51e-4/4e5*	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1**	63	10254	**1.2**	**1.21e7**	**1.87e7**	**1.88e7**	**1.89e7**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**1.2**	**34**	**568**	*23e-3/1e5*	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	**1.2**	1053	3.47e5	*26e-2/5e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**1.1**	**33**	**1409**	**0.59**	*11e-3/5e4*	.	.	.	Basic RCGA [17]
SPSA	1.00e6	2.00e6	3.25e6	3.25e6	7.17e6	*16e+2/1e5*	.	.	.	.	SPSA [9]

Table 27: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{127}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

127 Griewank-Rosenbrock Cauchy

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	0.20	0.20	0.20	25716	68336	77023	77898	79070	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	**1**	85	13853	5.8	*55e-3/1e4*	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	**1**	31	5212	**2.7**	*44e-3/1e4*	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	**1**	27	4508	5.8	*29e-3/1e4*	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	**1.3**	60	37537	*64e-3/1e4*	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	**1**	18	7947	*32e-3/1e4*	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**1**	17	3986	5.6	*24e-3/1e4*	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	**1**	24	7806	*42e-3/1e4*	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	**1**	**17**	9717	5.7	*29e-3/1e4*	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	**2.0**	18	5233	*53e-3/6e3*	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	44	62	77	181	1992	3.6	*92e-4/1e5*	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**1.1**	30	3085	**0.65**	**0.50**	**0.45**	**0.46**	**0.46**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1**	**15**	**1542**	**0.69**	**0.58**	**0.63**	**0.64**	**0.65**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**1.2**	35	**656**	**0.96**	**4.6**	**20**	**20**	**19**	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	**2.5**	**14**	7248	*62e-3/4e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**1.1**	41	**991**	**1.8**	*95e-4/5e4*	.	.	.	Basic RCGA [17]
SPSA	45	56	122	21588	3.40e6	*15e-2/1e5*	.	.	.	.	SPSA [9]

Table 28: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{128}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

128 Gallagher Gauss

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	22	850	1562	2100	2489	2984	3443	4232	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	4.8	5.9	10	16	29	24	*80e-3/1e4*	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	**2.1**	**1.7**	**2.1**	**1.9**	**1.8**	3.1	3.1	**2.9**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	**2.2**	**1.8**	**2.0**	**2.3**	**2.2**	**1.8**	**2.1**	3.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	10	4.8	21	71	60	*31e-2/1e4*	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	3.1	**2.8**	**2.9**	**2.5**	3.6	3.9	4.6	7.4	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**1.9**	**2.7**	**1.6**	**1.9**	**1.8**	**1.6**	**1.5**	**1.6**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	3.4	**1.9**	**2.1**	**2.2**	**2.2**	**1.9**	**1.9**	**2.0**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	4.3	3.1	4.1	5.8	6.0	5.2	13	16	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	11	9.3	7.5	42	*31e-2/6e3*	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	37	52	**2.5**	84	134	193	163	136	118	155	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**2.6**	**1.8**	47	35	30	25	22	18	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1.0**	14	166	216	183	152	132	108	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**1.7**	58	108	81	68	57	50	41	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	12	17	43	*19e-1/5e3*	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**0.69**	13	16	16	21	19	16	17	Basic RCGA [17]
SPSA	27	55	3631	*89e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 29: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{129}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

129 Gallagher unif

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	13	2142	11889	46274	56948	72928	1.02e5	1.16e5	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	168	*33e-1/1e4*	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	111	*34e-1/1e4*	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	120	22	*23e-1/1e4*	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	192	70	*56e-1/1e4*	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	32	**12**	**12**	*20e-1/1e4*	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	28	21	*17e-1/1e4*	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	32	16	*19e-1/1e4*	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	37	15	**12**	**3.1**	*20e-1/1e4*	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	68	20	*30e-1/6e3*	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	2252	4483	2336	116	120	31	25	20	14	12	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	11	**10**	16	8.7	**7.0**	**5.5**	**3.9**	**3.5**	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**8.5**	13	18	**8.2**	**6.7**	**5.2**	**3.8**	**3.3**	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**3.9**	68	42	16	13	10	7.5	6.6	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	124	16	*61e-1/5e3*	.	.	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**2.7**	**8.5**	**13**	**7.4**	**6.1**	**10**	**7.2**	**6.4**	Basic RCGA [17]
SPSA	626	2123	1131	*58e-1/1e5*	.	.	.	.	.	.	SPSA [9]

Table 30: 05-D, running time excess ERT/ERT$_{\text{best 2009}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.20	0.20	11	162	607	1640	6565	6746	6778	6906	ERT$_{\text{best}}$/D
(1,2)-CMA-ES	**1**	**1**	14	48	23	10	**2.9**	**2.8**	**2.8**	3.6	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	**1**	**1**	7.2	17	8.7	**3.3**	**0.82**	**0.80**	**0.80**	**0.79**	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	**1**	**1**	5.3	14	**5.1**	**1.9**	**0.47**	**0.46**	**0.46**	**0.46**	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	**1**	**1**	37	58	41	15	3.8	3.7	3.8	3.8	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	**1**	**1**	5.4	25	12	4.5	**1.1**	**1.1**	**1.2**	**1.2**	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	**1**	**1**	**1.0**	15	10	3.8	**0.95**	**0.93**	**0.93**	**0.92**	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	**1**	**1**	6.8	**4.2**	**3.5**	**1.3**	**0.33**	**0.32**	**0.32**	**0.32**	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	**1**	**1**	3.3	14	15	5.5	**1.4**	**1.3**	**1.3**	**1.3**	(1,4s)-CMA-ES [3]
avg NEWUOA	**1**	**1**	**1.3**	**6.4**	**5.9**	6.0	**3.0**	13	*14e-3/6e3*	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	35	57	5.2	203	146	124	104	102	*31e-3/1e5*	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	**1**	**1**	**1.4**	143	391	145	36	35	35	35	IPOP-aCMA-ES [12]
IPOP-CMA-ES	**1**	**1**	**1.2**	59	321	147	37	36	36	35	IPOP-CMA-ES [15]
CMA+DE-MOS	**1**	**1**	**2.4**	295	221	121	30	29	29	29	CMA+DE-MOS [13]
NEWUOA	**1**	**1**	**2.3**	**11**	10	19	*62e-3/4e3*	.	.	.	NEWUOA [16]
Basic RCGA	**1**	**1**	**2.5**	250	74	29	7.5	9.2	9.3	10	Basic RCGA [17]
SPSA	40	62	142	1955	*19e-1/1e5*	.	.	.	.	.	SPSA [9]

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