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Anne Auger, Steffen Finck, Nikolaus Hansen, Raymond Ros

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Anne Auger, Steffen Finck, Nikolaus Hansen, Raymond Ros. BBOB 2010: Comparison Tables of All Algorithms on All Noisy Functions. [Technical Report] RT-389, INRIA. 2010, pp.188. inria-00516690

**HAL Id: inria-00516690**

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Submitted on 10 Sep 2010

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INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

***BBOB 2010: Comparison Tables of All Algorithms  
on All Noisy Functions***

Anne Auger — Steffen Finck — Nikolaus Hansen — Raymond Ros

**N° 0389**

July 2010

Domaine 1

 *rapport  
technique*



## BBOB 2010: Comparison Tables of All Algorithms on All Noisy Functions

Anne Auger , Steffen Finck , Nikolaus Hansen , Raymond Ros

Domaine : Mathématiques appliquées, calcul et simulation  
Équipe-Projet TAO

Rapport technique n° 0389 — July 2010 — 188 pages

**Abstract:** This document presents the results from the BBOB Black-Box Optimization Benchmarking workshop of the GECCO Genetic and Evolutionary Computation Conference 2010 in tables. Each table presents the performance of each algorithm submitted to BBOB 2010 on one function and dimension from the noisy testbed.

**Key-words:** continuous optimization, benchmarking

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## **BBOB 2010: Tables de comparaison de tous les algorithmes sur toutes les fonctions bruitées**

**Résumé :** Ce document présente les résultats sous forme de table du workshop Black-Box Optimization Benchmarking (BBOB) de la conférence Genetic and Evolutionary Computation Conference (GECCO), Portland, Oregon, États-Unis, 2010. Chaque table présente les performances des algorithmes soumis à BBOB 2010 pour un problème de la suite de fonctions tests bruitées.

**Mots-clés :** optimisation continue, banc d'essai

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2010<sup>1</sup>. Many algorithms have been tested on 30 noisy 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 ( $\text{ERT}_{\text{best}}$  is noted as infinite). If the target was never reached, the median over all trials of the best function value is shown. 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.

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<sup>1</sup>see <http://coco.gforge.inria.fr/doku.php?id=bbob-2010>

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Table 1: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{101}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	0.50	0.50	0.90	4.0	5.0	5.6	7.2	8.4	10	11	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	3.8	<b>2.5</b>	4.2	6.6	8.1	9.5	10	12	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	3.8	<b>2.4</b>	4.8	7.4	8.3	8.7	11	12	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>1.4</b>	4.3	7.0	7.3	7.9	8.9	11	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	4.6	3.2	6.5	8.5	14	13	14	15	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	5.0	<b>2.5</b>	5.0	7.0	7.0	7.7	7.9	9.1	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	3.2	<b>1.7</b>	3.3	5.4	6.3	6.6	7.2	8.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	3.2	<b>1.6</b>	<b>2.9</b>	<b>4.1</b>	<b>4.8</b>	<b>5.2</b>	<b>5.3</b>	<b>6.2</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	4.6	<b>2.5</b>	3.3	5.2	5.5	6.4	6.0	7.3	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	3.2	<b>1.7</b>	<b>2.1</b>	<b>2.3</b>	<b>2.0</b>	<b>1.9</b>	<b>1.7</b>	<b>1.6</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	10	13	14	9.3	13	19	40	49	92	2502	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	5.2	<b>2.5</b>	3.8	7.7	8.1	8.9	10	12	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	3.6	3.2	5.8	7.5	8.5	9.2	11	12	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.3</b>	3.1	10	22	30	35	38	46	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>1.8</b>	<b>2.1</b>	<b>2.3</b>	<b>2.5</b>	<b>2.3</b>	<b>2.0</b>	<b>1.9</b>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.3</b>	3.2	32	62	67	86	111	192	Basic RCGA [17]
SPSA	24	41	173	159	282	907	764	687	631	641	SPSA [9]

Table 2: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{102}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>102 Sphere moderate Uniform</b>										
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.50	0.50	0.90	3.5	5.4	8.3	10	11	12	16	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	5.6	3.2	5.2	5.7	6.6	8.6	9.3	10	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	3.3	<b>2.7</b>	<b>3.1</b>	4.7	6.7	7.1	7.6	8.7	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	3.2	<b>2.2</b>	4.1	5.1	6.2	6.9	8.0	8.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	3.1	<b>2.8</b>	4.0	5.0	7.5	7.6	10	12	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	4.0	<b>2.7</b>	3.9	<b>4.1</b>	5.1	5.4	5.5	6.6	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	4.0	<b>2.3</b>	3.2	4.2	4.8	5.6	6.0	6.6	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	3.1	<b>2.5</b>	<b>2.6</b>	<b>3.0</b>	<b>3.7</b>	<b>3.8</b>	<b>4.3</b>	<b>4.7</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	3.3	<b>2.3</b>	3.2	<b>3.0</b>	<b>3.9</b>	<b>4.1</b>	<b>4.5</b>	5.0	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.2</b>	4.0	<b>2.1</b>	<b>2.6</b>	4.4	<b>4.1</b>	<b>3.7</b>	<b>3.4</b>	<b>2.8</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	13	16	16	7.1	39	36	47	45	705	3827	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	4.1	3.5	5.9	5.8	7.0	7.9	8.2	9.1	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>2.8</b>	3.4	5.6	5.2	5.9	7.4	8.0	8.4	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.3</b>	4.3	11	17	25	26	32	34	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	7.1	11	9.3	7.0	6.6	5.8	5.2	<b>4.4</b>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.0</b>	3.3	24	47	56	75	103	146	Basic RCGA [17]
SPSA	9.1	16	27	239	265	255	254	873	870	4083	SPSA [9]

Table 3: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{103}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>103 Sphere moderate Cauchy</b>										
$\Delta ft_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 0.90	1e+00 3.9	1e-01 4.7	1e-02 4.7	1e-03 4.7	1e-04 4.9	1e-05 4.9	1e-07 6.8	$\Delta ft_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	3.4	3.3	5.3	9.3	13	17	22	23	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	3.0	<b>1.9</b>	4.0	8.0	13	16	19	21	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	<b>2.5</b>	<b>2.0</b>	4.2	8.0	12	15	19	20	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	3.0	3.2	7.3	10	13	16	21	23	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	4.0	<b>2.1</b>	4.4	6.4	9.3	12	15	16	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	<b>2.8</b>	<b>1.5</b>	3.6	6.2	9.1	11	14	14	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	<b>2.4</b>	<b>1.6</b>	<b>2.6</b>	<b>4.8</b>	<b>7.0</b>	<b>8.4</b>	<b>11</b>	<b>11</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	4.3	<b>2.3</b>	3.5	5.4	8.1	10	13	13	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	3.1	<b>1.8</b>	<b>2.1</b>	<b>3.0</b>	<b>4.1</b>	<b>4.4</b>	<b>7.1</b>	<b>6.9</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	12	19	19	6.9	12	19	35	75	82	189	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	3.2	<b>2.4</b>	4.4	8.2	12	16	21	21	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	4.0	3.3	5.7	8.5	14	17	22	23	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>2.4</b>	<b>2.6</b>	13	30	51	63	83	94	CMA+DE-MOS [13]
NEWUOA	1	1	3.2	<b>1.6</b>	<b>2.1</b>	<b>3.1</b>	<b>4.2</b>	<b>4.9</b>	<b>6.4</b>	<b>7.8</b>	NEWUOA [16]
Basic RCGA	1	1	<b>1.6</b>	3.9	22	52	110	167	268	423	Basic RCGA [17]
SPSA	22	38	369	195	256	375	1471	4060	11338	12346	SPSA [9]

Table 4: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{104}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	
$\Delta f_{target}$ $ERT_{best}/D$	0.60	2.0	2.7	7.3	97	120	124	126	128	132	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	4.3	4.2	7.5	28	9.3	16	19	20	20	29	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.5</b>	4.0	5.8	22	4.9	8.6	10	10	10	11	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.2	<b>1.9</b>	4.8	14	4.4	8.5	11	12	12	13	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	11	4.8	9.2	37	11	22	29	57	58	74	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	4.2	3.6	6.6	13	<b>2.8</b>	<b>2.8</b>	3.0	3.2	3.3	3.4	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	4.6	3.2	5.6	18	<b>2.3</b>	<b>2.5</b>	<b>2.6</b>	<b>2.7</b>	<b>2.9</b>	<b>3.0</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.6</b>	<b>1.3</b>	<b>2.9</b>	<b>7.5</b>	<b>1.7</b>	<b>1.8</b>	<b>2.0</b>	<b>2.1</b>	<b>2.1</b>	<b>2.3</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.8</b>	<b>1.7</b>	<b>3.6</b>	12	<b>2.9</b>	3.8	3.9	4.0	4.0	4.1	(1,4s)-CMA-ES [3]
avg NEWUOA	5.2	<b>2.8</b>	4.3	<b>7.8</b>	<b>1.2</b>	3.5	5.3	6.4	6.8	8.7	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	45	18	20	19	26	72	199	197	305	392	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>2.8</b>	<b>2.2</b>	<b>3.5</b>	<b>5.8</b>	<b>1.2</b>	<b>1.8</b>	<b>2.1</b>	<b>2.3</b>	<b>2.4</b>	<b>2.7</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	5.3	3.2	5.1	15	<b>2.7</b>	3.2	3.9	4.1	4.4	4.6	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.8</b>	<b>2.3</b>	6.6	11	3.1	4.3	5.1	5.8	6.5	7.5	CMA+DE-MOS [13]
NEWUOA	7.3	<b>2.9</b>	6.4	13	3.4	6.5	10	13	12	13	NEWUOA [16]
Basic RCGA	3.2	<b>2.0</b>	7.7	19	34	89	245	514	1709	<i>10e-5/5e4</i>	Basic RCGA [17]
SPSA	611	294	840	1711	4319	<i>39e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 5: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{105}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>105 Rosenbrock moderate Uniform</b>										
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	5.8	4.7	7.3	35	9.3	18	32	54	68	66	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	4.8	3.4	12	17	<b>2.3</b>	8.4	17	35	36	38	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>2.4</b>	<b>1.8</b>	<b>4.3</b>	<b>8.3</b>	3.3	13	22	32	41	40	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.7	3.3	12	36	4.4	16	42	119	121	156	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	4.4	4.0	5.6	35	<b>2.9</b>	4.9	6.4	6.4	6.3	6.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.7</b>	<b>2.4</b>	<b>4.1</b>	23	<b>1.8</b>	<b>3.6</b>	<b>4.0</b>	<b>4.3</b>	<b>4.3</b>	<b>4.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	5.4	<b>2.8</b>	5.6	17	<b>2.6</b>	4.5	5.4	5.9	6.8	6.7	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.3	5.8	<b>5.2</b>	24	3.1	6.2	7.3	7.8	7.8	7.7	(1,4s)-CMA-ES [3]
avg NEWUOA	6.4	3.7	7.0	13	<b>2.3</b>	8.6	29	55	196	388	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	50	21	18	17	41	238	959	2211	3364	6907	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	8.3	3.1	6.6	<b>8.3</b>	<b>1.0</b>	<b>1.5</b>	<b>1.9</b>	<b>2.0</b>	<b>2.0</b>	<b>2.2</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	6.5	3.7	5.5	16	<b>2.3</b>	5.4	5.7	5.8	5.9	6.1	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.6</b>	<b>2.3</b>	6.2	<b>7.4</b>	<b>1.6</b>	<b>2.9</b>	<b>3.4</b>	<b>3.7</b>	<b>4.0</b>	<b>4.7</b>	CMA+DE-MOS [13]
NEWUOA	6.3	<b>2.7</b>	7.9	16	3.1	6.3	22	42	41	115	NEWUOA [16]
Basic RCGA	3.3	3.9	8.1	11	13	50	165	465	1153	<i>18e-5/5e4</i>	Basic RCGA [17]
SPSA	519	302	320	1513	1483	8005	<i>34e-2/1e5</i>	.	.	.	SPSA [9]

Table 6: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{106}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>106 Rosenbrock moderate Cauchy</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.60	2.0	2.7	7.6	70	140	176	206	245	325	$ERT_{best}/D$
(1,2)-CMA-ES	8.0	7.2	28	53	13	9.3	8.4	7.5	6.5	5.1	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	5.1	4.8	6.8	12	4.8	3.8	3.8	3.6	3.3	<b>2.7</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.8	3.2	5.4	<b>3.9</b>	4.8	3.1	3.2	<b>3.0</b>	<b>2.6</b>	<b>2.1</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.8	3.3	3.9	84	30	21	18	20	18	16	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	5.4	3.2	6.1	11	<b>2.7</b>	<b>1.7</b>	<b>1.6</b>	<b>1.4</b>	<b>1.3</b>	<b>1.1</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.8</b>	<b>1.7</b>	4.2	6.3	<b>2.0</b>	<b>1.4</b>	<b>1.3</b>	<b>1.3</b>	<b>1.1</b>	<b>0.97</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	4.7	3.0	<b>3.0</b>	<b>2.8</b>	<b>1.3</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	<b>0.91</b>	<b>0.76</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.8</b>	<b>1.7</b>	<b>2.6</b>	10	<b>2.9</b>	<b>1.8</b>	<b>1.7</b>	<b>1.5</b>	<b>1.3</b>	<b>1.1</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	4.6	<b>2.2</b>	3.7	<b>4.5</b>	<b>2.1</b>	<b>2.1</b>	3.2	3.3	4.3	5.9	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	54	36	96	91	15	10	8.7	7.7	35	30	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.4	3.5	8.3	7.7	<b>2.1</b>	<b>1.7</b>	<b>1.5</b>	<b>1.5</b>	<b>1.4</b>	<b>1.2</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	3.1	<b>2.2</b>	3.9	9.2	3.4	<b>2.6</b>	<b>2.6</b>	<b>2.5</b>	<b>2.3</b>	<b>2.0</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.6</b>	<b>2.2</b>	6.1	13	3.9	3.6	3.7	3.5	3.6	3.3	CMA+DE-MOS [13]
NEWUOA	3.1	<b>2.1</b>	<b>2.6</b>	6.1	<b>2.0</b>	<b>2.3</b>	3.2	3.2	4.8	5.7	NEWUOA [16]
Basic RCGA	<b>2.4</b>	3.2	6.8	12	18	103	308	384	658	2206	Basic RCGA [17]
SPSA	1018	895	2614	6207	3396	10059	<i>40e-2/1e5</i>	.	.	.	SPSA [9]

Table 7: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{107}$  in **02-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>107 Sphere Gauss</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.50	0.50	0.90	6.6	14	57	79	101	128	211	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	30	14	10	3.9	5.1	7.8	11	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	4.4	5.2	4.0	<b>1.8</b>	<b>1.6</b>	<b>1.5</b>	<b>1.5</b>	<b>1.6</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.3</b>	<b>2.2</b>	<b>1.9</b>	<b>1.4</b>	<b>1.6</b>	<b>1.9</b>	<b>1.6</b>	<b>2.0</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	5.4	<b>2.4</b>	5.2	6.0	7.2	8.7	7.6	9.1	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	11	3.6	7.7	<b>2.6</b>	<b>2.2</b>	<b>2.1</b>	<b>2.1</b>	<b>1.8</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	7.3	<b>2.2</b>	4.4	<b>1.5</b>	<b>1.3</b>	<b>1.3</b>	<b>1.7</b>	<b>1.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.1</b>	<b>1.8</b>	<b>1.6</b>	<b>0.66</b>	<b>0.75</b>	<b>0.75</b>	<b>1.4</b>	<b>1.2</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	6.1	11	7.7	<b>2.4</b>	<b>2.5</b>	<b>2.1</b>	<b>2.0</b>	<b>2.0</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	14	32	24	13	15	31	45	80	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	9.2	14	20	6.9	11	3.6	25	84	153	303	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	5.2	<b>2.7</b>	<b>2.7</b>	<b>1.3</b>	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	<b>0.98</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	5.6	<b>1.9</b>	<b>2.7</b>	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.1</b>	<b>1.00</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.5</b>	<b>2.0</b>	6.1	4.5	6.0	5.9	5.7	4.5	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	26	20	31	17	20	37	82	83	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.8</b>	<b>2.0</b>	9.1	8.6	10	8.8	13	20	Basic RCGA [17]
SPSA	16	21	483	1439	3795	4061	3907	14051	<i>27e-3/1e5</i>	.	SPSA [9]



Table 8: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{108}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>108 Sphere Uniform</b>										
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.50	0.50	0.90	15	101	713	1711	2608	3684	7989	
(1,2)-CMA-ES	<b>1</b>	<b>1.2</b>	17	13	5.6	3.7	14	<i>26e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	30	17	8.8	6.5	41	<i>29e-4/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	30	7.8	5.5	10	38	<i>60e-4/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	17	12	10	8.9	<i>56e-4/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	49	12	4.1	<b>2.1</b>	7.5	54	38	<i>61e-5/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	86	14	5.8	<b>2.4</b>	4.7	17	<i>50e-5/1e4</i>	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	14	14	6.1	5.7	5.7	17	<i>48e-5/1e4</i>	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	145	26	8.7	3.8	4.8	18	40	<i>51e-5/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	87	42	20	18	16	<i>14e-3/6e3</i>	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1612	6028	4047	310	143	67	53	61	188	184	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.2</b>	5.7	6.0	<b>3.5</b>	<b>0.82</b>	<b>0.68</b>	<b>0.99</b>	<b>1.0</b>	<b>0.79</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>3.7</b>	<b>3.8</b>	<b>1.6</b>	<b>0.97</b>	<b>0.93</b>	<b>1.0</b>	<b>1.1</b>	<b>0.76</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>1.0</b>	<b>2.3</b>	<b>1.8</b>	<b>1.6</b>	<b>4.1</b>	<b>4.5</b>	<b>3.7</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	121	56	24	22	25	<i>13e-3/6e3</i>	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.3</b>	<b>1.3</b>	12	20	21	28	46	<i>21e-5/5e4</i>	Basic RCGA [17]
SPSA	27	126	204	101	101	88	<i>28e-4/1e5</i>	.	.	.	SPSA [9]

Table 9: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **02-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>109 Sphere Cauchy</b>											
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.50	0.50	0.90	4.8	6.3	34	34	48	48	48	
(1,2)-CMA-ES	<b>1</b>	<b>1.5</b>	<b>2.5</b>	3.4	4.5	<b>1.5</b>	4.3	3.8	5.1	9.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.6</b>	<b>2.0</b>	<b>2.8</b>	<b>1.4</b>	<b>2.3</b>	<b>2.3</b>	3.3	5.3	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	<b>1.4</b>	<b>2.8</b>	<b>1.1</b>	<b>1.9</b>	<b>1.7</b>	<b>2.3</b>	3.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	6.6	3.7	5.0	6.4	9.4	7.4	8.2	15	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	4.3	<b>2.1</b>	3.0	<b>0.97</b>	<b>1.8</b>	<b>1.7</b>	<b>2.5</b>	3.7	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	5.1	<b>2.6</b>	4.0	<b>1.1</b>	<b>1.9</b>	<b>1.8</b>	<b>2.3</b>	<b>3.5</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.5</b>	<b>1.9</b>	<b>3.0</b>	<b>0.96</b>	<b>1.4</b>	<b>1.3</b>	<b>1.8</b>	<b>2.4</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.2</b>	<b>1.4</b>	<b>2.9</b>	<b>0.96</b>	<b>1.7</b>	<b>1.5</b>	<b>1.9</b>	<b>2.6</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	3.3	<b>2.6</b>	15	7.0	9.0	11	15	31	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	21	21	6.9	11	7.0	116	95	889	29122	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	3.2	<b>2.0</b>	3.4	<b>1.2</b>	<b>2.0</b>	<b>2.4</b>	3.1	4.8	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>2.0</b>	<b>1.4</b>	3.8	<b>1.2</b>	<b>2.1</b>	<b>2.2</b>	3.4	5.4	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.3</b>	<b>2.3</b>	8.6	5.9	8.8	11	14	24	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	3.3	3.6	12	5.6	10	13	22	36	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.8</b>	<b>2.5</b>	15	10	19	24	36	67	Basic RCGA [17]
SPSA	19	32	282	131	273	349	1660	2432	9217	<i>72e-6/1e5</i>	SPSA [9]

Table 10: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{110}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>110 Rosenbrock Gauss</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.60	2.2	3.6	17	312	651	1159	2181	4204	4577	$ERT_{best}/D$
(1,2)-CMA-ES	3.4	<b>1.7</b>	23	11	3.4	6.1	6.9	15	34	<i>22e-5/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	15	7.2	7.7	5.7	<b>2.1</b>	3.3	4.4	5.5	4.6	15	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>3.1</b>	3.3	5.2	5.6	<b>1.5</b>	<b>3.2</b>	8.2	8.0	17	32	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	5.3	15	17	18	4.2	4.7	6.3	8.9	7.6	31	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	3.2	<b>2.2</b>	<b>3.7</b>	6.0	4.1	5.9	5.4	4.6	3.5	5.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	4.8	<b>3.0</b>	<b>3.2</b>	<b>1.8</b>	<b>1.7</b>	<b>1.7</b>	<b>1.9</b>	<b>1.6</b>	<b>1.1</b>	<b>1.3</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	4.9	<b>2.3</b>	7.3	5.3	<b>2.1</b>	4.4	3.9	4.0	<b>2.6</b>	3.3	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	4.2	<b>2.6</b>	3.9	8.2	<b>2.8</b>	3.3	<b>2.9</b>	<b>2.8</b>	<b>2.8</b>	<b>2.7</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	3.8	10	11	5.1	<b>2.5</b>	<b>3.0</b>	6.8	11	5.9	<i>12e-4/5e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	211	120	89	24	13	201	1238	<i>99e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.3	<b>2.3</b>	<b>3.7</b>	<b>3.7</b>	6.1	5.3	3.2	<b>1.7</b>	<b>0.94</b>	<b>0.90</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	7.3	3.6	4.6	8.0	4.2	5.1	<b>3.2</b>	<b>1.9</b>	<b>0.99</b>	<b>0.96</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.6</b>	<b>2.2</b>	6.6	285	16	15	9.1	5.1	<b>2.7</b>	<b>2.6</b>	CMA+DE-MOS [13]
NEWUOA	22	15	16	15	<b>2.9</b>	4.4	9.1	36	<i>19e-4/5e3</i>	.	NEWUOA [16]
Basic RCGA	<b>2.4</b>	<b>2.0</b>	<b>3.1</b>	<b>4.1</b>	5.1	22	33	39	55	157	Basic RCGA [17]
SPSA	531	198	339	832	1381	<i>38e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 11: Running time excess  $ERT/ERT_{\text{best 2009}}$  on  $f_{111}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>111 Rosenbrock Uniform</b>										
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	18	7.2	5.9	8.5	12	6.2	<i>21e-3/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	3.4	8.2	9.0	3.6	11	26	<i>30e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	20	16	11	8.9	7.3	12	<i>17e-3/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	36	7.8	8.9	10	6.8	12	<i>15e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	62	21	12	4.7	<b>5.5</b>	3.5	<b>5.1</b>	<b>4.9</b>	4.8	<i>61e-4/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	58	15	11	6.7	5.8	<b>2.9</b>	11	<i>47e-4/1e4</i>	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	20	5.4	<b>3.6</b>	4.5	6.3	6.9	11	<i>12e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	8.7	16	11	7.6	9.2	3.4	7.3	<i>17e-4/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	72	48	45	29	53	33	<i>26e-2/6e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	570	605	196	64	22	15	33	101	48	<i>22e-4/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	4.6	<b>2.7</b>	7.5	3.3	<b>3.9</b>	<b>3.2</b>	<b>3.9</b>	<b>2.4</b>	<b>1.3</b>	<b>0.51</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>3.3</b>	4.3	5.0	<b>3.3</b>	<b>4.8</b>	<b>2.0</b>	<b>4.3</b>	<b>2.6</b>	<b>1.3</b>	<b>0.55</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.7</b>	<b>1.4</b>	<b>2.0</b>	<b>2.2</b>	44	23	12	6.1	<b>3.3</b>	<b>1.3</b>	CMA+DE-MOS [13]
NEWUOA	137	33	21	25	19	11	<i>68e-3/6e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	<b>2.5</b>	<b>1.1</b>	<b>1.1</b>	<b>1.5</b>	9.1	4.0	5.7	16	24	<i>32e-5/5e4</i>	Basic RCGA [17]
SPSA	73	23	52	152	173	544	<i>51e-3/1e5</i>	.	.	.	SPSA [9]

Table 12: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{112}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>112 Rosenbrock Cauchy</b>											
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.60	2.0	2.7	7.3	312	522	577	618	686	766	$ERT_{best}/D$
(1,2)-CMA-ES	6.1	4.1	9.2	25	6.2	4.8	5.2	5.7	6.6	6.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.9</b>	<b>2.5</b>	34	81	3.8	3.4	4.2	4.1	3.9	3.6	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	4.6	3.7	7.8	46	<b>2.1</b>	<b>2.0</b>	<b>2.2</b>	<b>2.2</b>	<b>2.1</b>	<b>2.0</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	12	6.8	8.2	104	8.9	15	24	36	33	56	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	6.4	3.7	5.0	11	<b>0.83</b>	<b>0.93</b>	<b>1.00</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	7.1	3.9	<b>4.5</b>	<b>4.3</b>	<b>0.62</b>	<b>0.72</b>	<b>0.82</b>	<b>0.86</b>	<b>0.83</b>	<b>0.86</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	4.1	<b>2.4</b>	6.3	15	<b>0.88</b>	<b>0.70</b>	<b>0.72</b>	<b>0.72</b>	<b>0.69</b>	<b>0.69</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.2	<b>2.3</b>	<b>4.5</b>	12	<b>1.1</b>	<b>0.95</b>	<b>0.97</b>	<b>0.99</b>	<b>0.94</b>	<b>0.91</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	4.7	<b>2.5</b>	5.1	11	<b>1.1</b>	4.6	22	118	<i>19e-4/5e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	36	28	27	44	5.0	79	309	<i>12e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.1	<b>1.7</b>	4.9	16	<b>1.0</b>	<b>0.88</b>	<b>0.91</b>	<b>0.94</b>	<b>0.90</b>	<b>0.91</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>2.7</b>	<b>2.2</b>	<b>4.0</b>	<b>5.1</b>	<b>0.64</b>	<b>0.92</b>	<b>1.1</b>	<b>1.2</b>	<b>1.1</b>	<b>1.3</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.6</b>	<b>2.3</b>	6.7	11	<b>1.1</b>	<b>1.8</b>	<b>2.1</b>	<b>2.2</b>	<b>2.3</b>	<b>2.7</b>	CMA+DE-MOS [13]
NEWUOA	5.1	<b>2.7</b>	5.0	13	<b>1.2</b>	<b>1.7</b>	10	112	101	<i>70e-5/5e3</i>	NEWUOA [16]
Basic RCGA	4.6	3.0	8.9	<b>9.0</b>	4.2	43	85	114	240	447	Basic RCGA [17]
SPSA	12128	3760	2996	3330	671	2693	2435	<i>21e-2/1e5</i>	.	.	SPSA [9]

Table 13: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{113}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>113 Step-ellipsoid Gauss</b>										
$\Delta ft_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta ft_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1.9</b>	8.4	8.0	7.3	13	23	34	34	34	12	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.3</b>	4.6	4.4	<b>3.9</b>	<b>7.6</b>	<b>7.8</b>	10	10	10	4.0	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>2.8</b>	4.9	4.5	6.6	12	19	22	22	22	5.0	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	14	8.4	10	9.3	14	18	39	39	39	11	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>2.0</b>	<b>2.0</b>	<b>2.9</b>	15	14	13	16	16	16	4.2	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.8</b>	16	8.8	6.5	12	12	16	16	16	3.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	3.4	3.8	3.6	7.0	15	12	<b>10</b>	<b>10</b>	<b>10</b>	<b>2.1</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.9</b>	5.6	13	8.4	16	17	14	14	14	4.0	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>2.1</b>	13	10	6.1	<b>10</b>	19	33	33	33	13	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	35	29	17	41	350	978	1184	1184	1184	556	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>2.4</b>	3.0	<b>2.2</b>	10	17	12	14	14	14	<b>2.8</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.3</b>	<b>2.6</b>	3.8	19	15	<b>11</b>	<b>9.4</b>	<b>9.4</b>	<b>9.4</b>	<b>2.4</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.4</b>	<b>2.1</b>	<b>3.1</b>	<b>3.9</b>	<b>6.3</b>	<b>6.9</b>	<b>7.4</b>	<b>7.4</b>	<b>7.4</b>	<b>1.9</b>	CMA+DE-MOS [13]
NEWUOA	<b>2.4</b>	8.7	12	5.8	16	29	42	42	42	14	NEWUOA [16]
Basic RCGA	<b>1.5</b>	<b>1.6</b>	4.7	<b>3.7</b>	85	177	212	212	212	52	Basic RCGA [17]
SPSA	17	18	19	1040	901	3536	2899	2899	2899	761	SPSA [9]

Table 14: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{114}$  in **02-D**, 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 Uniform										
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	<b>1.5</b>	28	7.0	15	6.3	9.2	25	25	25	33	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	17	43	14	12	4.6	6.2	6.9	6.9	6.9	<i>32e-4/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	8.8	41	26	19	5.7	6.6	17	17	17	<i>63e-4/1e4</i>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	17	33	12	13	8.3	7.4	7.8	7.8	7.8	16	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.9</b>	43	17	12	<b>3.8</b>	4.1	4.8	4.8	4.8	17	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.5</b>	19	7.6	15	5.7	6.4	5.1	5.1	5.1	8.0	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	4.5	71	31	20	4.5	<b>3.4</b>	7.0	7.0	7.0	10	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.4</b>	44	14	19	7.1	13	7.6	7.6	7.6	<b>4.7</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.5</b>	66	29	16	26	21	33	33	33	20	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	618	605	211	197	60	33	21	21	21	45	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.8</b>	14	8.6	10	<b>2.8</b>	<b>1.7</b>	<b>1.7</b>	<b>1.7</b>	<b>1.7</b>	<b>1.3</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.9</b>	<b>4.2</b>	<b>2.6</b>	<b>5.6</b>	<b>1.6</b>	<b>0.73</b>	<b>0.84</b>	<b>0.84</b>	<b>0.84</b>	<b>0.83</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.4</b>	<b>2.8</b>	<b>1.3</b>	<b>3.8</b>	8.9	4.3	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>	5.0	CMA+DE-MOS [13]
NEWUOA	<b>1.9</b>	41	69	53	38	71	33	33	33	<i>21e-2/6e3</i>	NEWUOA [16]
Basic RCGA	<b>1.8</b>	<b>1.8</b>	<b>1.1</b>	<b>6.3</b>	18	22	20	20	20	17	Basic RCGA [17]
SPSA	99	270	107	184	81	88	118	118	118	<i>63e-4/1e5</i>	SPSA [9]

Table 15: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{115}$  in **02-D**, 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										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.50	1.0	1.6	6.4	112	180	197	197	197	271	$ERT_{best}/D$
(1,2)-CMA-ES	<b>2.0</b>	3.8	5.0	7.0	<b>1.8</b>	4.3	6.9	6.9	6.9	19	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.2</b>	<b>2.4</b>	6.2	5.1	<b>1.6</b>	<b>2.3</b>	5.5	5.5	5.5	16	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.9</b>	<b>2.1</b>	5.3	4.9	<b>1.5</b>	<b>2.9</b>	6.0	6.0	6.0	13	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1.7</b>	<b>1.9</b>	5.2	7.3	<b>1.6</b>	7.4	9.1	9.1	9.1	18	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.4</b>	<b>2.2</b>	4.7	<b>4.9</b>	<b>1.1</b>	<b>2.2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	3.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.3</b>	<b>2.5</b>	<b>3.1</b>	<b>4.9</b>	<b>1.3</b>	<b>2.3</b>	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>	<b>2.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1.9</b>	<b>2.2</b>	<b>3.4</b>	5.9	<b>0.91</b>	<b>1.2</b>	<b>2.0</b>	<b>2.0</b>	<b>2.0</b>	<b>1.8</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.5</b>	4.3	6.1	<b>3.9</b>	<b>0.89</b>	<b>1.9</b>	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>	<b>2.6</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.5</b>	<b>2.8</b>	6.5	7.3	<b>2.9</b>	6.1	7.1	7.1	7.1	12	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	12	14	18	99	325	551	551	551	1224	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.3</b>	3.3	<b>3.8</b>	5.4	<b>1.4</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>2.7</b>	4.5	5.2	14	<b>2.2</b>	<b>2.4</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.2</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.4</b>	<b>2.1</b>	4.1	5.6	<b>1.9</b>	<b>2.0</b>	6.3	6.3	6.3	5.3	CMA+DE-MOS [13]
NEWUOA	<b>2.0</b>	<b>2.5</b>	4.5	12	<b>2.9</b>	4.4	11	11	11	11	NEWUOA [16]
Basic RCGA	<b>1.6</b>	<b>1.9</b>	5.2	59	24	101	113	113	113	136	Basic RCGA [17]
SPSA	47	48	110	435	151	268	778	778	778	2416	SPSA [9]



Table 16: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{116}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>116 Ellipsoid Gauss</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	3.3	6.8	25	50	78	103	138	165	521	894	$ERT_{best}/D$
(1,2)-CMA-ES	12	12	13	23	31	70	102	194	131	160	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.0</b>	9.4	22	28	48	128	116	159	64	50	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.4</b>	4.4	11	<b>10</b>	35	69	88	189	135	166	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	13	40	16	26	39	165	<i>12e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.9</b>	<b>2.2</b>	15	20	35	44	42	<b>36</b>	16	9.4	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.9</b>	<b>2.5</b>	10	25	34	49	48	46	18	12	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.8</b>	8.0	15	20	<b>21</b>	<b>34</b>	<b>35</b>	37	14	9.4	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.5</b>	<b>2.3</b>	<b>6.4</b>	24	<b>30</b>	49	51	50	19	14	(1,4s)-CMA-ES [3]
avg NEWUOA	7.9	6.2	12	<b>15</b>	32	98	125	479	<i>14e-3/5e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	67	132	512	1079	3593	6360	10202	<i>34e-2/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.2	<b>2.9</b>	25	22	<b>19</b>	<b>15</b>	<b>14</b>	<b>12</b>	<b>3.9</b>	<b>2.4</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.7</b>	3.8	28	42	36	<b>36</b>	<b>30</b>	<b>26</b>	<b>8.4</b>	<b>5.1</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.2</b>	3.7	33	83	70	56	44	38	<b>13</b>	<b>7.9</b>	CMA+DE-MOS [13]
NEWUOA	5.4	4.6	<b>6.3</b>	<b>18</b>	38	107	571	<i>50e-3/5e3</i>	.	.	NEWUOA [16]
Basic RCGA	<b>1.9</b>	4.5	<b>4.6</b>	102	476	859	1611	2102	670	817	Basic RCGA [17]
SPSA	20	19	61	307	1150	4537	10864	<i>43e-3/1e5</i>	.	.	SPSA [9]

Table 17: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{117}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>117 Ellipsoid Uniform</b>											
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	4.8	17	84	673	3227	6957	14112	14949	18210	21616	$ERT_{best}/D$
(1,2)-CMA-ES	9.2	8.6	8.9	6.0	5.6	<i>12e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	6.6	7.5	8.0	5.4	5.7	21	11	<i>11e-2/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	8.8	7.7	10	<b>3.7</b>	6.9	<i>14e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	10	8.4	9.4	8.6	13	<i>31e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	11	9.3	10	3.8	<b>2.0</b>	10	<i>36e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	14	6.2	7.3	<b>3.3</b>	6.0	10	<i>12e-2/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	15	13	10	4.6	3.3	6.0	10	<i>59e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	7.9	8.7	<b>4.8</b>	4.5	<b>2.7</b>	<b>3.9</b>	11	<i>33e-3/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	15	32	24	10	8.4	<i>78e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	50	112	115	32	62	103	103	<i>17e-2/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	5.5	5.5	<b>5.0</b>	<b>3.6</b>	<b>1.8</b>	<b>0.99</b>	<b>0.67</b>	<b>0.67</b>	<b>0.61</b>	<b>0.63</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>3.2</b>	<b>4.8</b>	10	4.5	<b>2.0</b>	<b>1.5</b>	<b>0.95</b>	<b>0.96</b>	<b>0.95</b>	<b>0.93</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.1</b>	<b>1.2</b>	<b>1.6</b>	3.7	4.2	4.3	<b>2.4</b>	<b>2.6</b>	<b>2.4</b>	<b>2.9</b>	CMA+DE-MOS [13]
NEWUOA	43	25	29	12	26	<i>97e-2/6e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1.7</b>	<b>1.6</b>	5.9	22	15	13	11	<i>73e-3/5e4</i>	.	.	Basic RCGA [17]
SPSA	58	41	80	129	131	214	105	<i>35e-2/1e5</i>	.	.	SPSA [9]

Table 18: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{118}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>118 Ellipsoid Cauchy</b>											
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	2.1	2.5	10	52	66	252	292	326	388	486	$ERT_{best}/D$
(1,2)-CMA-ES	7.5	12	55	19	18	5.4	5.1	5.5	5.1	4.6	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.6</b>	5.5	45	18	17	4.7	4.3	4.0	3.6	3.2	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	4.4	11	20	8.4	7.7	<b>2.8</b>	<b>2.7</b>	<b>2.7</b>	<b>2.4</b>	<b>2.1</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	3.2	14	131	52	64	24	25	23	20	16	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	3.6	6.6	12	4.7	4.1	<b>1.4</b>	<b>1.3</b>	<b>1.2</b>	<b>1.1</b>	<b>1.0</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	3.7	6.6	9.1	3.5	3.9	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.0</b>	<b>1.0</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	3.6	7.3	5.9	<b>2.0</b>	<b>2.2</b>	<b>0.68</b>	<b>0.65</b>	<b>0.65</b>	<b>0.60</b>	<b>0.56</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>2.4</b>	<b>3.9</b>	<b>4.8</b>	<b>2.8</b>	<b>3.2</b>	<b>0.93</b>	<b>0.93</b>	<b>0.91</b>	<b>0.82</b>	<b>0.72</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>2.4</b>	<b>2.3</b>	<b>2.8</b>	3.8	12	9.0	21	221	<i>90e-5/5e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	42	142	61	44	533	615	1377	1231	3617	2888	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.0	8.1	7.9	<b>3.4</b>	<b>3.7</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	3.8	6.5	12	4.8	5.7	<b>2.4</b>	<b>2.5</b>	<b>2.4</b>	<b>2.2</b>	<b>1.9</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.5</b>	10	8.6	4.8	6.0	<b>2.0</b>	<b>2.2</b>	<b>2.5</b>	<b>2.5</b>	<b>2.9</b>	CMA+DE-MOS [13]
NEWUOA	<b>2.1</b>	<b>2.6</b>	<b>5.6</b>	4.2	11	10	35	71	187	<i>11e-4/5e3</i>	NEWUOA [16]
Basic RCGA	4.0	5.4	76	100	462	253	280	1078	907	<i>16e-3/5e4</i>	Basic RCGA [17]
SPSA	61	400	1210	755	4425	5579	<i>20e-2/1e5</i>	.	.	.	SPSA [9]

Table 19: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{119}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>119 Sum of diff powers Gauss</b>										
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03 0.50	1e+02 0.50	1e+01 0.70	1e+00 5.4	1e-01 36	1e-02 88	1e-03 520	1e-04 950	1e-05 2384	1e-07 5041	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>2.5</b>	4.0	6.4	6.7	3.9	7.4	7.7	29	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>2.0</b>	3.1	8.4	4.0	<b>2.8</b>	<b>1.2</b>	<b>2.2</b>	3.3	14	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>2.0</b>	5.4	<b>2.8</b>	<b>2.4</b>	<b>2.1</b>	3.1	<b>2.9</b>	8.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.2</b>	4.9	4.4	7.0	4.8	15	61	<i>90e-6/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>2.1</b>	3.3	4.0	3.9	<b>1.9</b>	<b>1.1</b>	<b>1.5</b>	<b>1.9</b>	8.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>2.1</b>	6.8	<b>2.3</b>	<b>1.5</b>	<b>1.5</b>	<b>2.0</b>	<b>1.6</b>	6.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.9</b>	<b>3.0</b>	5.6	<b>1.4</b>	<b>1.6</b>	<b>0.70</b>	<b>1.3</b>	<b>1.3</b>	14	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.4</b>	<b>3.0</b>	13	3.6	3.1	<b>1.0</b>	<b>2.2</b>	<b>2.1</b>	9.0	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.4</b>	<b>2.9</b>	18	8.0	14	5.9	6.6	6.8	<i>67e-6/5e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	12	20	17	<b>3.7</b>	<b>1.8</b>	13	81	83	183	<i>34e-6/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.1</b>	<b>1.7</b>	6.6	<b>1.7</b>	<b>1.3</b>	<b>0.78</b>	<b>1.6</b>	<b>1.0</b>	<b>0.76</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.7</b>	3.8	7.9	<b>2.2</b>	<b>1.5</b>	<b>1.1</b>	<b>2.5</b>	<b>1.6</b>	<b>1.9</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.2</b>	<b>1.9</b>	<b>2.8</b>	5.1	5.7	<b>1.5</b>	<b>1.2</b>	<b>0.67</b>	<b>0.55</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>2.6</b>	3.1	15	8.6	23	7.1	19	33	15	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.2</b>	<b>1.4</b>	<b>2.2</b>	3.2	8.8	4.5	11	10	19	Basic RCGA [17]
SPSA	15	32	35	933	1158	2645	838	<i>21e-3/1e5</i>	.	.	SPSA [9]

Table 20: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{120}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>120 Sum of diff powers Uniform</b>										
$\Delta ftarget$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta ftarget$ $ERT_{best}/D$
	0.50	0.50	0.70	5.7	187	1257	2862	12965	37703	94320	
(1,2)-CMA-ES	<b>1</b>	<b>1.7</b>	19	34	6.0	7.5	<i>76e-4/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.1</b>	19	19	4.7	14	<i>12e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>2.9</b>	22	19	4.9	8.2	<i>52e-4/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.1</b>	12	33	9.3	13	52	<i>15e-3/1e4</i>	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.6</b>	41	4.4	7.4	<b>15</b>	<i>56e-4/1e4</i>	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.5</b>	36	26	5.0	<b>4.3</b>	49	<i>25e-4/1e4</i>	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.5</b>	17	26	4.9	4.3	<i>54e-4/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.6</b>	9.5	3.9	7.9	<i>79e-4/1e4</i>	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	9.5	37	74	42	15	<i>94e-3/6e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	423	709	620	222	37	66	247	<i>53e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.2</b>	<b>2.0</b>	<b>8.7</b>	<b>2.4</b>	<b>0.94</b>	<b>1.1</b>	<b>0.68</b>	<b>0.53</b>	<b>0.56</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.5</b>	3.5	23	<b>3.5</b>	<b>1.5</b>	<b>1.5</b>	<b>0.78</b>	<b>0.45</b>	<b>0.64</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.3</b>	<b>1.9</b>	<b>4.5</b>	<b>3.0</b>	4.4	16	<b>11</b>	<b>4.1</b>	<b>5.7</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	3.1	48	61	41	34	<i>98e-3/6e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	<b>2.0</b>	<b>1.6</b>	6.8	13	19	16	19	<i>31e-5/5e4</i>	Basic RCGA [17]
SPSA	57	173	152	151	107	254	<i>13e-3/1e5</i>	.	.	.	SPSA [9]

Table 21: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{121}$  in **02-D**, 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										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 0.70	1e+00 3.5	1e-01 21	1e-02 72	1e-03 164	1e-04 376	1e-05 560	1e-07 851	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.3</b>	3.8	<b>2.5</b>	4.1	6.6	5.9	7.5	10	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.2</b>	<b>2.5</b>	<b>2.0</b>	<b>1.1</b>	<b>1.5</b>	<b>2.9</b>	3.5	4.9	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.5</b>	3.4	<b>1.0</b>	<b>1.1</b>	<b>1.3</b>	<b>1.7</b>	<b>2.2</b>	<b>2.7</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.3</b>	4.1	5.0	<b>1.8</b>	3.4	16	18	30	84	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.2</b>	3.1	3.2	<b>1.5</b>	<b>0.99</b>	<b>0.92</b>	<b>0.85</b>	<b>1.1</b>	<b>1.4</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.5</b>	<b>2.9</b>	3.2	<b>1.6</b>	<b>1.3</b>	<b>1.3</b>	<b>1.4</b>	<b>1.3</b>	<b>1.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>2.2</b>	<b>2.0</b>	<b>0.97</b>	<b>0.68</b>	<b>0.70</b>	<b>0.72</b>	<b>0.71</b>	<b>0.71</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.7</b>	<b>2.7</b>	<b>2.8</b>	<b>1.1</b>	<b>0.78</b>	<b>0.69</b>	<b>0.72</b>	<b>0.73</b>	<b>0.79</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.6</b>	<b>2.6</b>	5.7	4.4	6.3	22	35	<i>31e-5/5e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	15	25	22	31	10	10	61	339	2516	<i>13e-5/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.3</b>	<b>2.7</b>	3.1	<b>1.4</b>	<b>1.2</b>	<b>1.3</b>	<b>1.1</b>	<b>1.2</b>	<b>1.4</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>2.0</b>	4.1	3.7	<b>1.6</b>	<b>1.0</b>	<b>1.6</b>	<b>2.0</b>	<b>2.2</b>	<b>2.6</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.2</b>	<b>2.1</b>	4.1	5.7	3.8	3.9	<b>2.9</b>	<b>2.9</b>	3.3	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.6</b>	<b>2.7</b>	4.4	3.0	7.6	14	57	121	<i>40e-5/5e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	<b>1.7</b>	<b>2.0</b>	8.0	6.2	14	15	37	104	Basic RCGA [17]
SPSA	33	60	126	806	2749	1758	1936	<i>13e-3/1e5</i>	.	.	SPSA [9]

Table 22: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{122}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>122 Schaffer F7 Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 1.5	1e+00 48	1e-01 261	1e-02 705	1e-03 1122	1e-04 1676	1e-05 2176	1e-07 4781	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	<b>2.9</b>	14	5.0	4.8	12	61	<i>53e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	<b>1.3</b>	<b>2.3</b>	<b>3.3</b>	<b>1.6</b>	4.9	10	19	32	<i>98e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	<b>1.7</b>	12	3.7	3.1	4.1	38	<i>32e-4/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	<b>1.6</b>	23	4.2	7.0	22	<i>16e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	<b>1.3</b>	5.7	5.9	3.3	3.1	4.7	14	32	<i>23e-5/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	<b>1.1</b>	4.7	3.8	<b>2.5</b>	<b>2.8</b>	<b>3.3</b>	6.0	7.6	31	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	<b>1.4</b>	31	<b>2.2</b>	<b>2.1</b>	<b>2.4</b>	5.9	14	20	<i>38e-5/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	<b>1.9</b>	36	4.4	5.7	7.3	20	27	67	<i>32e-4/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	<b>1.3</b>	14	10	33	55	<i>11e-2/5e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	12	16	16	21	37	91	195	<i>53e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	<b>1.3</b>	3.5	<b>1.2</b>	<b>0.81</b>	<b>0.78</b>	<b>0.75</b>	<b>0.69</b>	<b>0.90</b>	<b>0.60</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>1.3</b>	29	3.9	<b>2.5</b>	<b>1.2</b>	<b>1.1</b>	<b>1.00</b>	<b>0.98</b>	<b>0.74</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>1.4</b>	<b>2.1</b>	30	21	10	7.5	<b>5.8</b>	<b>5.1</b>	<b>2.9</b>	CMA+DE-MOS [13]
NEWUOA	1	<b>1.7</b>	10	16	30	54	<i>99e-3/5e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	1	1	<b>2.2</b>	10	22	14	21	25	45	<i>25e-6/5e4</i>	Basic RCGA [17]
SPSA	21	38	60	803	<i>44e-2/1e5</i>	.	.	.	.	.	SPSA [9]

Table 23: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{123}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>123 Schaffer F7 Uniform</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.50	0.50	1.6	106	3186	12428	19367	28294	50007	1.09e5	$ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.8</b>	26	7.1	47	<i>24e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.2</b>	<b>2.8</b>	18	<b>4.8</b>	7.2	<i>13e-2/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.1</b>	6.1	30	7.5	45	<i>23e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.2</b>	48	10	22	<i>18e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.8</b>	21	8.6	<b>3.5</b>	<i>83e-3/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>7.3</b>	<b>4.7</b>	11	<i>13e-2/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>2.0</b>	29	6.3	4.4	<b>12</b>	<i>98e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>2.8</b>	78	6.8	11	<i>11e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	10	66	24	28	<i>46e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	261	1354	557	126	20	25	<i>48e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>2.0</b>	19	5.7	<b>0.88</b>	<b>0.54</b>	<b>0.71</b>	<b>0.81</b>	<b>0.67</b>	<b>0.82</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.6</b>	18	<b>3.7</b>	<b>0.74</b>	<b>0.69</b>	<b>1.0</b>	<b>0.90</b>	<b>0.75</b>	<b>0.72</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.5</b>	<b>1.9</b>	40	39	18	<b>15</b>	<b>11</b>	<b>7.9</b>	<b>5.2</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	56	32	28	<i>44e-2/6e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.5</b>	<b>2.9</b>	21	23	<i>11e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	32	64	137	76	221	<i>22e-2/1e5</i>	.	.	.	.	SPSA [9]



Table 24: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{124}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>124 Schaffer F7 Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 1.8	1e+00 32	1e-01 158	1e-02 340	1e-03 996	1e-04 1737	1e-05 2798	1e-07 4510	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	<b>2.1</b>	3.9	13	14	26	69	<i>60e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	<b>1.8</b>	<b>3.0</b>	3.4	<b>1.9</b>	4.5	12	<i>98e-5/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	<b>1.9</b>	3.1	<b>2.8</b>	4.5	5.5	8.4	82	<i>89e-5/1e4</i>	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	<b>1.7</b>	15	12	13	44	<i>16e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	3.9	3.3	7.8	4.5	6.4	8.0	25	<i>23e-5/1e4</i>	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	<b>1.4</b>	3.2	4.5	<b>1.4</b>	<b>2.7</b>	3.2	10	50	<i>23e-5/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	<b>1.8</b>	26	5.1	<b>1.8</b>	<b>1.6</b>	<b>1.7</b>	11	51	<i>23e-5/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.1</b>	<b>1.5</b>	<b>1.8</b>	10	4.6	5.0	8.0	85	<i>42e-5/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	<b>1.7</b>	12	9.3	22	61	<i>98e-3/5e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	20	36	11	38	142	226	814	<i>19e-4/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	<b>1.8</b>	<b>2.2</b>	<b>1.0</b>	<b>0.89</b>	<b>1.5</b>	<b>1.1</b>	<b>1.1</b>	<b>1.5</b>	<b>2.0</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>1.4</b>	3.5	<b>1.2</b>	<b>0.69</b>	<b>0.81</b>	<b>1.3</b>	<b>1.4</b>	<b>2.0</b>	<b>2.5</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>1.5</b>	<b>1.9</b>	3.1	15	20	10	<b>6.2</b>	<b>7.8</b>	<b>7.4</b>	CMA+DE-MOS [13]
NEWUOA	1	<b>2.2</b>	5.6	6.5	14	46	<i>33e-3/5e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	1	<b>1.1</b>	<b>1.2</b>	3.0	23	25	33	56	130	<i>19e-5/5e4</i>	Basic RCGA [17]
SPSA	48	90	4547	844	468	2050	<i>37e-3/1e5</i>	.	.	.	SPSA [9]

Table 25: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{125}$  in **02-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>125 Griewank-Rosenbrock Gauss</b>											
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.50	0.50	0.50	0.50	0.50	74	575	1228	1927	3778	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	5.6	14	105	4.4	4.1	4.0	6.1	<i>63e-7/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	5.8	54	<b>1.6</b>	<b>2.8</b>	3.1	5.5	12	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>3.9</b>	<b>34</b>	<b>2.6</b>	3.4	4.4	7.0	18	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	11	137	3.2	5.5	4.4	7.6	38	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>4.5</b>	<b>25</b>	<b>1.9</b>	5.7	5.2	7.9	12	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	5.9	49	<b>2.5</b>	4.0	3.5	3.8	4.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	5.5	61	3.1	3.4	<b>2.1</b>	3.1	6.5	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	5.2	<b>31</b>	<b>1.8</b>	6.1	6.0	6.2	18	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>2.3</b>	6.9	46	<b>1.8</b>	<b>2.7</b>	<b>2.4</b>	<b>2.3</b>	6.2	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	20	25	34	87	5.0	5.4	6.8	14	40	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>4.7</b>	53	<b>1.4</b>	<b>1.5</b>	<b>1.0</b>	<b>1.4</b>	<b>0.94</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	5.9	34	<b>2.1</b>	<b>2.0</b>	<b>1.3</b>	<b>1.9</b>	<b>1.4</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	5.8	44	<b>1.2</b>	<b>0.47</b>	3.3	<b>2.2</b>	<b>1.2</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.0</b>	6.1	77	<b>1.4</b>	<b>2.6</b>	<b>2.1</b>	<b>2.6</b>	10	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.2</b>	6.4	58	<b>1.9</b>	<b>2.7</b>	4.7	5.0	13	Basic RCGA [17]
SPSA	22	32	37	61	169	<b>2.2</b>	98	230	344	<i>45e-5/1e5</i>	SPSA [9]

Table 26: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{126}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>126 Griewank-Rosenbrock Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 0.50	1e+00 0.50	1e-01 0.50	1e-02 151	1e-03 1709	1e-04 3408	1e-05 5528	1e-07 18193	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.3</b>	53	300	7.2	6.8	20	26	<i>75e-5/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>4.2</b>	141	6.3	4.8	6.0	8.0	<i>23e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>3.5</b>	236	4.0	8.9	7.9	27	<i>81e-5/1e4</i>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	39	246	9.1	8.5	12	25	<i>12e-4/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	6.3	336	4.4	3.6	9.0	12	7.7	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	7.4	111	3.3	3.9	3.8	5.6	<i>64e-6/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	41	113	<b>2.3</b>	3.1	3.6	5.5	8.0	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	12	256	3.4	4.8	4.7	<i>18e-5/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	26	95	667	15	11	7.8	<i>18e-4/6e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	284	472	608	704	1604	57	22	40	37	<i>32e-6/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	4.5	230	<b>1.9</b>	<b>1.4</b>	<b>1.0</b>	<b>0.97</b>	<b>1.5</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>4.2</b>	<b>73</b>	<b>1.9</b>	<b>1.1</b>	<b>2.0</b>	<b>2.2</b>	<b>1.6</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>3.9</b>	<b>49</b>	<b>0.58</b>	12	18	20	19	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.1</b>	200	595	15	52	<i>32e-4/6e3</i>	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	4.6	<b>47</b>	<b>0.72</b>	<b>0.98</b>	<b>1.3</b>	<b>1.4</b>	<b>2.0</b>	Basic RCGA [17]
SPSA	16	50	86	193	1851	88	111	95	80	<i>18e-4/1e5</i>	SPSA [9]

Table 27: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{127}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>127 Griewank-Rosenbrock Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.50	1e+02 0.50	1e+01 0.50	1e+00 0.50	1e-01 0.50	1e-02 93	1e-03 593	1e-04 2014	1e-05 3386	1e-07 3638	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	10	53	<b>2.5</b>	5.1	<b>2.8</b>	<b>2.7</b>	4.9	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	6.4	39	<b>1.2</b>	<b>2.0</b>	<b>0.95</b>	<b>0.86</b>	<b>1.6</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	4.9	33	<b>1.1</b>	<b>2.7</b>	<b>1.6</b>	<b>1.4</b>	<b>1.6</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	11	86	<b>2.5</b>	8.2	3.6	3.7	19	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>3.5</b>	<b>17</b>	<b>2.7</b>	3.5	<b>2.1</b>	<b>1.3</b>	<b>1.6</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	4.3	<b>21</b>	<b>2.6</b>	3.0	<b>1.7</b>	<b>1.4</b>	<b>1.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	4.3	<b>21</b>	<b>2.7</b>	<b>2.7</b>	<b>1.2</b>	<b>0.81</b>	<b>0.97</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>3.3</b>	82	<b>2.1</b>	<b>2.4</b>	<b>0.94</b>	<b>0.72</b>	<b>0.69</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>1.3</b>	7.2	72	<b>1.6</b>	3.5	<b>1.8</b>	<b>2.5</b>	<i>16e-6/5e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	12	17	19	28	70	<b>1.6</b>	<b>2.2</b>	4.6	12	66	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1.4</b>	6.1	39	<b>2.5</b>	<b>2.7</b>	<b>1.1</b>	<b>0.77</b>	<b>0.85</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	4.2	78	<b>1.2</b>	<b>1.7</b>	<b>1.0</b>	<b>0.72</b>	<b>1.6</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	3.9	31	<b>0.89</b>	<b>0.88</b>	<b>1.5</b>	<b>2.6</b>	3.5	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.1</b>	6.2	95	<b>1.8</b>	4.9	3.8	<b>2.8</b>	9.0	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.2</b>	<b>3.7</b>	41	<b>1.4</b>	4.0	<b>2.6</b>	<b>2.5</b>	29	Basic RCGA [17]
SPSA	26	39	94	636	4930	125	181	165	<i>40e-5/1e5</i>	.	SPSA [9]

Table 28: Running time excess  $ERT/ERT_{\text{best 2009}}$  on  $f_{128}$  in **02-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>128 Gallagher Gauss</b>											
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
	0.50	0.50	0.90	21	67	157	194	205	297	310	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	4.1	10	9.4	6.2	6.9	7.2	5.6	6.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>0.93</b>	<b>5.6</b>	<b>6.1</b>	5.3	6.2	5.9	4.6	5.7	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	<b>2.7</b>	<b>3.7</b>	<b>3.9</b>	<b>4.8</b>	<b>5.7</b>	<b>4.5</b>	4.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	7.3	8.8	<b>5.5</b>	<b>3.9</b>	7.1	10	10	11	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	21	14	6.4	6.9	6.6	4.6	<b>4.5</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.1</b>	12	12	7.1	6.1	<b>5.8</b>	<b>4.0</b>	<b>4.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.8</b>	14	10	<b>4.2</b>	<b>3.6</b>	<b>3.7</b>	<b>2.6</b>	<b>2.5</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	6.7	10	5.9	<b>5.2</b>	7.2	5.6	5.4	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>2.9</b>	21	9.3	7.9	7.4	8.7	10	32	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	13	19	15	16	44	20	48	76	244	563	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>2.0</b>	26	16	7.8	11	19	13	14	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>0.78</b>	9.4	11	8.9	7.3	7.3	5.2	5.2	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.4</b>	35	84	50	41	40	28	29	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>1.9</b>	17	10	10	10	16	14	20	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>1.8</b>	18	16	30	66	57	149	Basic RCGA [17]
SPSA	10	22	35	309	656	812	2220	2096	<i>83e-4/1e5</i>	.	SPSA [9]

Table 29: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{129}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>129 Gallagher Uniform</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.50	0.50	0.90	33	110	261	951	1622	2972	5330	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	9.3	8.2	13	13	10	17	16	27	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.8</b>	11	10	7.6	4.7	15	48	<i>12e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.3</b>	11	11	11	3.9	12	8.3	27	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	18	8.5	<b>6.5</b>	11	8.6	6.3	10	<i>60e-6/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.3</b>	8.1	8.9	8.3	3.8	<b>4.6</b>	<b>3.3</b>	<b>6.4</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	<b>7.0</b>	<b>5.7</b>	<b>4.3</b>	<b>3.0</b>	<b>4.9</b>	<b>3.7</b>	8.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.6</b>	11	9.2	<b>5.0</b>	4.3	5.2	5.6	13	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>0.81</b>	7.6	<b>5.6</b>	7.3	<b>3.6</b>	5.0	11	<i>31e-6/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	52	25	31	27	9.4	25	29	16	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	288	439	273	92	53	95	39	69	56	274	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1.6</b>	13	13	<b>6.5</b>	<b>2.2</b>	<b>2.4</b>	<b>3.2</b>	<b>5.4</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	7.4	12	9.3	5.6	8.2	4.7	<b>3.2</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.4</b>	<b>1.4</b>	13	49	28	20	11	6.9	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	24	23	21	26	19	25	31	<i>37e-4/6e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>0.85</b>	<b>0.64</b>	13	15	13	11	24	135	Basic RCGA [17]
SPSA	5.1	48	96	100	66	108	55	81	150	<i>86e-6/1e5</i>	SPSA [9]

Table 30: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{130}$  in **02-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	
$\Delta f_{target}$ $ERT_{best}/D$	0.50	0.50	0.77	23	99	248	399	824	886	2221	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.0</b>	40	33	18	13	6.2	7.8	3.2	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.4</b>	30	16	8.8	5.7	<b>2.8</b>	<b>2.7</b>	<b>1.1</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.5</b>	14	15	11	7.2	4.5	4.2	<b>1.8</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.6</b>	41	54	32	20	10	10	4.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.0</b>	22	13	6.2	4.5	<b>2.2</b>	<b>2.0</b>	<b>0.84</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.4</b>	15	10	7.0	4.6	<b>2.3</b>	<b>2.2</b>	<b>0.89</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.4</b>	<b>6.5</b>	8.8	<b>5.2</b>	<b>3.3</b>	<b>1.6</b>	<b>1.9</b>	<b>0.76</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.3</b>	9.0	13	5.3	<b>3.4</b>	<b>1.6</b>	<b>1.5</b>	<b>0.63</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	3.2	8.2	<b>3.7</b>	<b>2.6</b>	<b>3.6</b>	3.9	7.5	6.9	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	8.8	12	11	7.8	22	18	30	71	130	127	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1.5</b>	6.6	6.5	39	26	13	12	33	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	8.3	18	8.7	5.8	3.1	<b>3.0</b>	<b>1.2</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.7</b>	<b>1.1</b>	<b>0.97</b>	10	24	20	18	15	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.8</b>	10	<b>5.4</b>	<b>3.7</b>	3.8	3.6	4.7	6.6	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.0</b>	<b>1.1</b>	8.5	21	37	45	63	76	Basic RCGA [17]
SPSA	22	34	84	662	510	298	243	285	486	311	SPSA [9]

Table 31: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{101}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>101 Sphere moderate Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.2	1e+00 4.4	1e-01 6.3	1e-02 6.7	1e-03 9.3	1e-04 11	1e-05 11	1e-07 13	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	5.6	4.9	7.3	12	10	10	12	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.6</b>	<b>2.8</b>	6.0	7.7	7.6	8.3	9.3	11	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.2</b>	4.7	3.1	5.7	7.0	6.4	7.3	8.5	10	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	6.9	5.3	7.4	10	10	11	12	14	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	3.6	<b>3.0</b>	4.2	5.9	5.5	6.2	7.4	8.2	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.6</b>	<b>2.9</b>	3.6	5.2	5.1	5.7	6.4	7.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	3.3	<b>2.6</b>	<b>3.1</b>	<b>4.1</b>	<b>3.9</b>	<b>4.2</b>	<b>4.9</b>	<b>5.5</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	3.6	3.2	3.6	5.0	4.5	4.8	5.5	6.5	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.1</b>	3.4	<b>1.6</b>	<b>1.7</b>	<b>1.9</b>	<b>1.5</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	21	16	12	112	384	484	694	1414	1256	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	4.0	3.8	5.0	7.6	7.2	7.9	9.2	11	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	3.8	3.0	5.1	7.5	7.2	8.1	9.3	11	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>2.5</b>	10	21	28	28	30	36	42	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.5</b>	<b>2.8</b>	<b>2.0</b>	<b>2.5</b>	<b>2.9</b>	<b>2.4</b>	<b>2.2</b>	<b>2.3</b>	<b>2.2</b>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	<b>2.4</b>	10	36	73	88	132	182	315	Basic RCGA [17]
SPSA	30	46	198	295	846	1989	1524	1398	1375	3664	SPSA [9]



Table 32: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{102}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>102 Sphere moderate Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.2	1e+00 4.0	1e-01 7.6	1e-02 9.3	1e-03 11	1e-04 12	1e-05 13	1e-07 16	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	5.6	5.6	5.9	7.2	8.1	9.5	11	11	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	3.3	3.9	4.6	5.4	6.2	7.1	7.6	8.6	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	3.1	3.1	4.1	4.9	5.4	6.5	7.1	7.6	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	4.3	5.8	5.3	7.4	8.1	8.9	8.6	14	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	3.2	<b>2.7</b>	<b>2.9</b>	3.6	4.3	5.1	5.6	6.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	4.2	3.3	3.3	4.0	4.7	5.2	5.7	6.0	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.6</b>	<b>2.2</b>	<b>2.2</b>	<b>3.1</b>	<b>3.4</b>	<b>3.9</b>	<b>4.1</b>	<b>4.5</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	3.0	<b>2.6</b>	<b>2.5</b>	<b>3.4</b>	<b>3.9</b>	<b>4.3</b>	<b>4.6</b>	<b>5.1</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.9</b>	3.6	<b>2.8</b>	<b>2.9</b>	<b>2.6</b>	<b>2.8</b>	<b>2.7</b>	<b>2.5</b>	<b>2.2</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	28	45	21	14	15	19	21	149	1947	4298	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	4.2	3.9	4.1	5.3	6.4	7.2	7.7	8.5	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	4.4	4.2	4.4	5.6	6.7	7.8	8.4	8.8	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>2.5</b>	11	17	21	25	29	30	34	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.5</b>	5.9	5.7	5.4	7.2	6.8	8.1	9.1	10	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	<b>1.7</b>	17	29	43	77	115	167	242	Basic RCGA [17]
SPSA	24	38	470	396	697	2079	2142	2293	5383	87971	SPSA [9]

Table 33: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{103}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>103 Sphere moderate Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.2	1e+00 4.3	1e-01 6.4	1e-02 6.4	1e-03 6.4	1e-04 6.6	1e-05 7.7	1e-07 14	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	6.2	5.1	6.7	10	14	18	19	14	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.5</b>	<b>2.8</b>	4.5	7.5	10	12	13	10	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.7</b>	3.0	4.4	7.2	8.7	11	12	9.1	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	3.9	4.3	5.2	7.7	12	15	17	13	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	4.0	3.5	4.0	6.1	7.8	10	11	8.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.5</b>	<b>2.1</b>	3.9	5.8	7.8	9.4	10	<b>7.3</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.9</b>	<b>2.0</b>	<b>2.6</b>	<b>4.1</b>	<b>5.1</b>	<b>6.8</b>	<b>6.9</b>	<b>5.3</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	3.8	<b>2.3</b>	3.3	5.0	6.7	<b>8.5</b>	<b>8.0</b>	<b>6.1</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.9</b>	3.3	<b>1.7</b>	<b>1.6</b>	<b>2.0</b>	<b>5.6</b>	9.2	10	9.0	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	17	30	19	16	22	27	34	1298	2202	2619	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>2.9</b>	4.6	7.8	10	13	13	10	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	4.0	3.5	4.8	7.9	11	14	14	11	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>2.5</b>	11	20	31	42	53	62	51	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	3.4	<b>2.1</b>	<b>2.6</b>	<b>3.4</b>	<b>4.8</b>	<b>5.9</b>	<b>5.8</b>	10	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	<b>2.3</b>	13	39	69	140	225	281	291	Basic RCGA [17]
SPSA	40	142	360	216	228	400	565	1216	4576	11577	SPSA [9]



Table 35: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{105}$  in **03-D**, 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 Uniform										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	4.1	7.1	8.6	4.9	14	13	27	40	40	131	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>2.6</b>	7.5	6.2	<b>1.7</b>	6.9	8.4	18	22	30	29	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>2.7</b>	<b>2.5</b>	<b>2.9</b>	<b>1.1</b>	4.6	5.5	13	40	40	40	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	5.9	7.2	7.0	3.8	12	13	25	42	133	<i>91e-4/1e4</i>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	3.5	<b>2.3</b>	3.8	3.3	5.6	4.0	7.0	7.3	7.4	7.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	3.7	3.1	3.2	<b>1.9</b>	<b>2.8</b>	<b>2.2</b>	<b>2.2</b>	<b>2.7</b>	<b>2.7</b>	<b>2.7</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.0</b>	<b>1.5</b>	<b>1.6</b>	<b>1.9</b>	5.3	<b>2.4</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	<b>2.5</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	4.0	<b>2.6</b>	<b>2.3</b>	<b>2.2</b>	9.1	4.6	8.1	13	16	16	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>2.7</b>	<b>1.8</b>	<b>1.8</b>	<b>0.75</b>	<b>1.6</b>	3.2	8.2	35	75	<i>20e-4/6e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	20	9.1	14	126	410	392	603	601	1289	1279	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.0	<b>2.6</b>	3.5	<b>1.7</b>	<b>1.9</b>	<b>0.77</b>	<b>0.81</b>	<b>0.84</b>	<b>0.85</b>	<b>0.89</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>2.9</b>	<b>2.8</b>	4.2	<b>2.4</b>	4.4	<b>1.6</b>	<b>1.7</b>	<b>1.7</b>	<b>1.8</b>	<b>1.8</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	3.5	4.2	10	<b>1.4</b>	<b>1.7</b>	<b>0.71</b>	<b>0.78</b>	<b>0.86</b>	<b>0.93</b>	<b>1.1</b>	CMA+DE-MOS [13]
NEWUOA	5.0	<b>2.2</b>	<b>1.5</b>	<b>0.67</b>	<b>1.9</b>	<b>2.0</b>	7.5	21	69	70	NEWUOA [16]
Basic RCGA	<b>1.4</b>	5.0	14	11	104	109	220	675	<i>26e-3/5e4</i>	.	Basic RCGA [17]
SPSA	514	176	1.51e5	<i>18e+0/1e5</i>	.	.	.	.	.	.	SPSA [9]

Table 36: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{106}$  in **03-D**, 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										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	5.2	3.6	4.0	11	12	5.8	4.1	4.1	<b>2.7</b>	<b>2.6</b>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	3.1	<b>2.0</b>	3.8	13	10	4.3	<b>2.8</b>	<b>2.8</b>	<b>1.9</b>	<b>1.8</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	3.0	<b>2.3</b>	4.1	8.3	6.5	<b>2.9</b>	<b>2.0</b>	<b>2.0</b>	<b>1.3</b>	<b>1.3</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	12	9.2	10	40	29	13	8.8	8.8	5.7	5.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	5.3	<b>2.6</b>	3.1	9.5	6.6	<b>2.8</b>	<b>1.9</b>	<b>1.8</b>	<b>1.2</b>	<b>1.1</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.8</b>	<b>1.6</b>	3.3	9.0	6.1	<b>2.6</b>	<b>1.7</b>	<b>1.6</b>	<b>1.1</b>	<b>1.0</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.7</b>	<b>1.2</b>	<b>2.1</b>	5.0	<b>3.8</b>	<b>1.6</b>	<b>1.1</b>	<b>1.0</b>	<b>0.69</b>	<b>0.67</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.3	<b>1.4</b>	<b>2.3</b>	7.3	5.4	<b>2.3</b>	<b>1.5</b>	<b>1.5</b>	<b>0.98</b>	<b>0.92</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	3.1	<b>1.1</b>	<b>1.1</b>	<b>2.4</b>	<b>1.9</b>	<b>1.0</b>	<b>2.1</b>	3.3	5.0	7.5	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	40	17	17	40	24	10	7.1	7.0	4.8	5.4	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>2.8</b>	<b>1.5</b>	<b>2.7</b>	<b>3.7</b>	<b>4.3</b>	<b>2.0</b>	<b>1.3</b>	<b>1.3</b>	<b>0.90</b>	<b>0.90</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	3.2	<b>2.3</b>	3.3	5.1	6.5	3.1	<b>2.1</b>	<b>2.1</b>	<b>1.4</b>	<b>1.4</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	3.4	3.9	10	8.6	10	4.8	3.0	3.2	<b>2.2</b>	<b>2.4</b>	CMA+DE-MOS [13]
NEWUOA	3.0	<b>0.95</b>	<b>1.0</b>	<b>3.3</b>	5.6	4.4	7.4	14	13	33	NEWUOA [16]
Basic RCGA	3.2	4.6	14	145	911	1110	2842	<i>43e-3/5e4</i>	.	.	Basic RCGA [17]
SPSA	1188	595	815	9052	<i>19e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 37: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{107}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>107 Sphere Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 2.0	1e+00 16	1e-01 51	1e-02 77	1e-03 108	1e-04 138	1e-05 168	1e-07 228	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	22	12	10	22	27	45	203	<i>28e-6/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	7.4	<b>1.9</b>	<b>1.9</b>	<b>2.1</b>	<b>2.1</b>	<b>2.7</b>	3.2	4.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	7.0	<b>2.2</b>	<b>2.2</b>	3.5	4.7	4.6	7.3	8.2	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	5.9	8.4	13	17	48	115	95	642	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	8.9	3.4	<b>2.9</b>	3.3	3.5	4.4	6.2	5.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	3.7	<b>1.2</b>	<b>0.71</b>	<b>0.82</b>	<b>0.96</b>	<b>1.2</b>	<b>1.1</b>	<b>1.5</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.1</b>	14	<b>2.5</b>	<b>1.2</b>	<b>1.6</b>	<b>1.6</b>	<b>1.9</b>	3.1	4.2	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>2.2</b>	<b>1.5</b>	3.7	3.3	3.9	4.4	10	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	17	20	45	115	360	592	<i>16e-3/6e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	24	37	13	5.0	6.1	14	49	226	555	6150	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>2.0</b>	5.4	<b>1.4</b>	<b>0.99</b>	<b>0.97</b>	<b>0.96</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1.7</b>	<b>1.2</b>	<b>0.80</b>	<b>0.96</b>	<b>1.0</b>	<b>0.95</b>	<b>0.98</b>	<b>1.0</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.6</b>	3.3	5.3	7.2	7.2	7.2	7.2	7.0	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.1</b>	12	29	61	65	150	532	<i>57e-4/5e3</i>	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.6</b>	7.8	9.2	11	13	20	26	31	Basic RCGA [17]
SPSA	36	53	199	8554	13692	18097	13131	<i>11e-1/1e5</i>	.	.	SPSA [9]

Table 38: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{108}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>108 Sphere Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.9	1e+00 33	1e-01 655	1e-02 1842	1e-03 3608	1e-04 5060	1e-05 5729	1e-07 10727	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	34	29	53	<i>15e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	23	24	25	13	37	<i>84e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	54	25	23	81	<i>10e-2/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	30	41	19	79	<i>88e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.1</b>	30	<b>10</b>	6.0	38	<i>42e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	30	19	<b>5.9</b>	<b>14</b>	<i>18e-3/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>10</b>	14	9.3	38	<i>38e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	35	20	8.6	77	<i>39e-3/1e4</i>	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.5</b>	121	82	126	<i>39e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1294	1758	2673	269	44	25	<b>17</b>	<b>25</b>	<b>44</b>	68	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	14	<b>8.4</b>	<b>1.8</b>	<b>1.1</b>	<b>0.96</b>	<b>0.80</b>	<b>1.1</b>	<b>0.81</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.1</b>	97	11	<b>1.3</b>	<b>1.0</b>	<b>0.89</b>	<b>0.92</b>	<b>1.1</b>	<b>1.0</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.6</b>	66	138	91	61	49	45	<b>29</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	108	56	36	<i>41e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.1</b>	<b>10</b>	24	20	22	33	129	<i>18e-4/5e4</i>	Basic RCGA [17]
SPSA	111	264	275	166	58	390	<i>28e-3/1e5</i>	.	.	.	SPSA [9]

Table 39: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **03-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>109 Sphere Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.33	0.33	1.2	6.8	31	48	64	65	84	84	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	5.4	3.5	<b>2.0</b>	<b>1.9</b>	<b>2.8</b>	3.6	3.9	6.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	3.9	<b>2.9</b>	<b>1.3</b>	<b>1.6</b>	<b>1.7</b>	<b>2.3</b>	<b>2.4</b>	3.7	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	3.5	<b>1.8</b>	<b>0.83</b>	<b>0.96</b>	<b>1.1</b>	<b>1.4</b>	<b>1.5</b>	<b>2.4</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	8.9	7.6	<b>2.5</b>	3.1	3.5	4.5	6.1	8.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>1.9</b>	<b>0.92</b>	<b>1.1</b>	<b>1.2</b>	<b>1.8</b>	<b>1.7</b>	3.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	4.1	<b>2.0</b>	<b>1.1</b>	<b>1.2</b>	<b>1.3</b>	<b>1.8</b>	<b>1.7</b>	<b>2.6</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.1</b>	<b>1.3</b>	<b>0.66</b>	<b>0.72</b>	<b>0.72</b>	<b>0.99</b>	<b>0.94</b>	<b>1.3</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.2</b>	<b>1.6</b>	<b>0.75</b>	<b>0.84</b>	<b>0.90</b>	<b>1.2</b>	<b>1.2</b>	<b>1.8</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.5</b>	3.4	7.6	5.9	8.9	17	58	112	262	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	15	30	21	9.5	4.4	33	403	3363	<i>20e-5/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>2.6</b>	<b>2.6</b>	<b>1.3</b>	<b>1.4</b>	<b>1.6</b>	<b>2.0</b>	<b>2.1</b>	3.1	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	4.5	<b>2.3</b>	<b>1.2</b>	<b>1.3</b>	<b>1.7</b>	<b>2.3</b>	<b>2.4</b>	3.6	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>2.5</b>	6.1	4.2	5.6	6.4	10	12	16	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.3</b>	5.3	6.2	6.4	12	34	146	181	<i>17e-5/5e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	3.4	11	11	14	20	27	33	51	Basic RCGA [17]
SPSA	37	157	448	231	1467	1620	3769	6888	<i>43e-4/1e5</i>	.	SPSA [9]







Table 42: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{112}$  in **03-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>112 Rosenbrock Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	7.7	7.6	17	28	10	8.7	8.0	7.8	8.5	7.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>3.0</b>	<b>2.6</b>	3.3	5.8	<b>2.5</b>	<b>2.0</b>	<b>1.9</b>	<b>2.0</b>	<b>2.0</b>	<b>1.9</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	5.1	<b>2.2</b>	3.5	5.1	<b>1.7</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.3</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	4.5	4.4	8.7	27	12	16	17	21	31	28	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>2.9</b>	<b>1.4</b>	<b>2.2</b>	<b>1.3</b>	<b>0.95</b>	<b>0.88</b>	<b>0.88</b>	<b>0.93</b>	<b>0.93</b>	<b>0.89</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>3.0</b>	<b>1.3</b>	<b>2.3</b>	3.1	<b>1.1</b>	<b>0.90</b>	<b>0.87</b>	<b>0.87</b>	<b>0.86</b>	<b>0.83</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.9</b>	<b>1.2</b>	<b>1.9</b>	<b>2.1</b>	<b>0.76</b>	<b>0.58</b>	<b>0.56</b>	<b>0.56</b>	<b>0.56</b>	<b>0.52</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.1	<b>1.6</b>	<b>2.7</b>	4.6	<b>1.5</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>2.8</b>	<b>0.93</b>	<b>2.1</b>	<b>2.2</b>	<b>1.8</b>	10	85	<i>20e-3/6e3</i>	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	57	24	23	306	571	1699	<i>26e-2/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.0	<b>1.8</b>	3.8	<b>1.6</b>	<b>0.79</b>	<b>0.70</b>	<b>0.72</b>	<b>0.74</b>	<b>0.76</b>	<b>0.76</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	4.2	<b>2.3</b>	3.7	4.6	<b>1.8</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	3.4	4.0	10	<b>2.4</b>	<b>1.9</b>	<b>1.6</b>	<b>1.6</b>	<b>1.8</b>	<b>1.9</b>	<b>2.0</b>	CMA+DE-MOS [13]
NEWUOA	<b>2.0</b>	<b>0.89</b>	<b>1.3</b>	<b>1.7</b>	<b>1.4</b>	8.7	37	73	<i>44e-4/5e3</i>	.	NEWUOA [16]
Basic RCGA	<b>2.7</b>	3.6	11	18	72	93	365	713	<i>23e-3/5e4</i>	.	Basic RCGA [17]
SPSA	1314	1782	2830	12462	<i>29e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 43: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{113}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>113 Step-ellipsoid Gauss</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.33	1.1	8.8	42	649	1031	1079	1079	1079	1143	
(1,2)-CMA-ES	<b>2.5</b>	11	6.6	11	<b>2.6</b>	6.0	11	11	11	15	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.4</b>	<b>1.3</b>	<b>2.6</b>	<b>4.1</b>	<b>0.84</b>	<b>2.9</b>	4.1	4.1	4.1	6.4	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.2</b>	<b>2.4</b>	8.6	7.4	<b>1.3</b>	<b>1.8</b>	7.3	7.3	7.3	13	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>2.7</b>	24	12	8.7	3.6	18	41	41	41	125	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.6</b>	<b>3.0</b>	4.2	4.9	<b>2.0</b>	<b>2.3</b>	3.5	3.5	3.5	3.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.1</b>	<b>2.5</b>	<b>1.1</b>	5.7	<b>1.9</b>	<b>2.6</b>	3.4	3.4	3.4	3.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1.3</b>	4.4	6.3	4.9	<b>1.6</b>	<b>2.7</b>	<b>2.8</b>	<b>2.8</b>	<b>2.8</b>	<b>3.2</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.3</b>	<b>2.8</b>	<b>2.4</b>	<b>4.6</b>	<b>1.7</b>	<b>2.2</b>	3.3	3.3	3.3	5.8	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.6</b>	5.6	8.2	15	8.0	25	75	75	75	<i>57e-3/6e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	28	14	22	19	82	292	392	392	392	1280	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	20	8.4	<b>2.0</b>	7.7	<b>0.88</b>	<b>0.60</b>	<b>0.77</b>	<b>0.77</b>	<b>0.77</b>	<b>0.75</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.7</b>	<b>2.7</b>	<b>1.8</b>	6.6	<b>1.9</b>	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.1</b>	<b>1.7</b>	<b>1.3</b>	<b>4.1</b>	3.4	3.4	3.5	3.5	3.5	3.5	CMA+DE-MOS [13]
NEWUOA	<b>1.5</b>	14	7.7	14	5.1	12	70	70	70	<i>74e-3/5e3</i>	NEWUOA [16]
Basic RCGA	<b>1.1</b>	<b>1.6</b>	<b>2.1</b>	11	19	39	38	38	38	38	Basic RCGA [17]
SPSA	40	24	18	1660	1007	1374	<i>71e-2/1e5</i>	.	.	.	SPSA [9]

Table 44: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{114}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>114 Step-ellipsoid Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.33	0.98	8.5	338	2093	6295	9441	9441	9441	10860	
(1,2)-CMA-ES	<b>1.1</b>	5.1	34	11	21	<i>31e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.1</b>	8.2	17	6.9	21	<i>30e-2/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.1</b>	63	32	22	23	<i>22e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1.1</b>	35	30	12	<i>52e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.3</b>	67	21	3.6	7.6	23	<i>11e-2/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.8</b>	<b>2.2</b>	<b>6.7</b>	<b>2.5</b>	<b>5.7</b>	<b>10</b>	15	15	15	<i>83e-3/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1.8</b>	27	25	4.0	12	<i>16e-2/1e4</i>	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	17	14	19	6.4	10	<i>22e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	143	104	26	<i>11e-1/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	877	2294	553	127	148	<i>14e-2/1e5</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.4</b>	34	25	<b>1.4</b>	<b>0.88</b>	<b>0.61</b>	<b>0.42</b>	<b>0.42</b>	<b>0.42</b>	<b>0.39</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.1</b>	12	7.1	<b>2.4</b>	<b>1.6</b>	<b>0.81</b>	<b>0.60</b>	<b>0.60</b>	<b>0.60</b>	<b>0.59</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.1</b>	<b>1.9</b>	<b>1.9</b>	9.3	31	20	13	13	13	<b>14</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	50	71	31	<i>11e-1/5e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1.5</b>	<b>1.8</b>	<b>1.6</b>	8.0	12	14	<b>12</b>	<b>12</b>	<b>12</b>	20	Basic RCGA [17]
SPSA	271	204	223	63	685	<i>29e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 45: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{115}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>115 Step-ellipsoid Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.33	0.93	4.0	39	198	280	297	297	297	415	
(1,2)-CMA-ES	<b>1.7</b>	3.2	4.9	<b>2.7</b>	7.9	41	63	63	63	<i>54e-4/1e4</i>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.5</b>	<b>2.1</b>	<b>1.7</b>	<b>2.1</b>	<b>2.8</b>	5.8	12	12	12	21	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.1</b>	<b>1.5</b>	<b>2.9</b>	<b>1.4</b>	<b>1.6</b>	5.0	13	13	13	39	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1.5</b>	3.8	4.3	3.4	3.4	23	50	50	50	169	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.5</b>	3.6	<b>2.9</b>	<b>1.4</b>	<b>1.6</b>	<b>2.8</b>	4.3	4.3	4.3	6.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.4</b>	<b>2.9</b>	<b>2.7</b>	<b>0.88</b>	<b>1.3</b>	<b>1.4</b>	3.4	3.4	3.4	4.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1.1</b>	<b>1.4</b>	<b>2.1</b>	<b>1.2</b>	<b>0.87</b>	<b>1.4</b>	<b>1.6</b>	<b>1.6</b>	<b>1.6</b>	<b>2.1</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.1</b>	<b>1.9</b>	4.5	<b>1.9</b>	<b>1.6</b>	<b>2.5</b>	3.1	3.1	3.1	5.3	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.5</b>	3.1	<b>1.1</b>	<b>2.6</b>	4.9	19	45	45	45	59	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	24	17	20	122	392	1637	4763	4763	4763	3402	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.2</b>	<b>2.7</b>	<b>2.0</b>	<b>0.88</b>	<b>0.91</b>	<b>0.80</b>	<b>0.90</b>	<b>0.90</b>	<b>0.90</b>	<b>0.78</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.7</b>	3.2	6.4	<b>2.4</b>	<b>1.8</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>2.4</b>	<b>1.9</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.1</b>	<b>2.0</b>	<b>2.3</b>	<b>2.1</b>	5.0	7.4	7.6	7.6	7.6	5.6	CMA+DE-MOS [13]
NEWUOA	<b>2.4</b>	<b>2.8</b>	<b>0.96</b>	4.0	8.3	66	215	215	215	154	NEWUOA [16]
Basic RCGA	<b>1.1</b>	<b>0.95</b>	6.1	56	96	145	138	138	138	129	Basic RCGA [17]
SPSA	52	44	49	576	560	1532	<i>43e-3/1e5</i>	.	.	.	SPSA [9]

Table 46: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{116}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>116 Ellipsoid Gauss</b>											
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	6.2	25	56	881	1473	2051	2381	3153	3205	3790	$ERT_{best}/D$
(1,2)-CMA-ES	14	14	17	9.4	96	<i>68e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	6.3	11	14	4.0	8.4	10	14	10	46	<i>54e-3/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	11	12	27	5.6	6.8	34	<i>45e-3/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	14	36	40	13	46	34	63	<i>61e-2/1e4</i>	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>2.4</b>	<b>2.3</b>	12	3.8	11	15	18	15	15	19	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	4.6	<b>5.9</b>	10	3.1	4.3	4.9	5.4	7.6	14	12	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	11	8.9	11	<b>1.8</b>	4.0	4.5	5.5	7.9	10	<i>96e-5/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	17	7.0	<b>8.2</b>	<b>2.2</b>	3.9	7.1	13	14	<i>18e-3/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	19	24	65	28	<i>30e-1/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1443	1318	1980	1701	<i>97e-1/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	6.8	6.2	<b>5.9</b>	<b>1.3</b>	<b>1.2</b>	<b>1.0</b>	<b>0.90</b>	<b>0.71</b>	<b>0.71</b>	<b>0.63</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	4.5	7.4	11	<b>2.8</b>	<b>2.5</b>	<b>2.1</b>	<b>1.9</b>	<b>1.5</b>	<b>1.5</b>	<b>1.3</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>2.2</b>	<b>2.8</b>	<b>7.3</b>	4.4	<b>3.0</b>	<b>2.4</b>	<b>2.2</b>	<b>1.9</b>	<b>2.0</b>	<b>1.9</b>	CMA+DE-MOS [13]
NEWUOA	12	18	45	41	50	<i>49e-1/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>2.6</b>	18	61	26	52	65	<i>67e-3/5e4</i>	.	.	.	Basic RCGA [17]
SPSA	98	863	4071	1622	<i>20e+0/1e5</i>	.	.	.	.	.	SPSA [9]





Table 48: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{118}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>118 Ellipsoid Cauchy</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	4.7	6.8	36	68	237	284	336	392	428	531	$ERT_{best}/D$
(1,2)-CMA-ES	11	18	9.4	15	7.2	6.5	6.1	5.8	5.6	6.5	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	4.1	8.8	4.2	7.5	3.4	3.4	3.3	<b>3.0</b>	3.0	<b>2.7</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	4.0	7.4	5.5	5.5	<b>2.0</b>	<b>1.8</b>	<b>2.0</b>	<b>1.9</b>	<b>1.8</b>	<b>1.6</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	6.9	13	30	46	23	24	27	23	21	20	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	4.1	6.5	<b>2.6</b>	3.2	<b>1.3</b>	<b>1.3</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.5</b>	6.8	3.2	3.5	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>0.99</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.4</b>	<b>3.4</b>	<b>2.0</b>	<b>2.3</b>	<b>0.92</b>	<b>0.83</b>	<b>0.78</b>	<b>0.71</b>	<b>0.71</b>	<b>0.66</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.6</b>	6.0	3.3	<b>3.0</b>	<b>1.1</b>	<b>1.0</b>	<b>0.93</b>	<b>0.85</b>	<b>0.82</b>	<b>0.75</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>0.98</b>	<b>1.4</b>	<b>1.0</b>	5.0	5.4	26	77	<i>43e-4/6e3</i>	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	38	81	715	2979	2747	4936	<i>21e-1/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	3.3	4.9	3.4	<b>3.0</b>	<b>1.0</b>	<b>0.98</b>	<b>0.95</b>	<b>0.89</b>	<b>0.94</b>	<b>0.94</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	4.3	7.9	6.2	6.7	<b>2.6</b>	<b>2.4</b>	<b>2.2</b>	<b>2.0</b>	<b>2.0</b>	<b>1.9</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	3.3	10	6.0	5.2	<b>1.9</b>	<b>2.0</b>	<b>2.3</b>	<b>2.5</b>	<b>2.8</b>	3.1	CMA+DE-MOS [13]
NEWUOA	<b>1.3</b>	<b>1.4</b>	<b>1.7</b>	3.7	6.5	43	109	<i>19e-3/5e3</i>	.	.	NEWUOA [16]
Basic RCGA	<b>2.3</b>	78	142	542	672	1269	2227	<i>75e-2/5e4</i>	.	.	Basic RCGA [17]
SPSA	126	254	1406	6641	<i>41e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 49: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{119}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>119 Sum of diff powers Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 0.73	1e+00 22	1e-01 140	1e-02 203	1e-03 668	1e-04 1894	1e-05 4013	1e-07 5240	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.3</b>	6.6	4.3	5.3	17	48	<i>24e-4/1e4</i>	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	4.8	3.2	<b>1.7</b>	4.2	3.2	8.2	17	<i>14e-5/1e4</i>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>2.2</b>	<b>1.5</b>	<b>1.4</b>	<b>2.9</b>	4.5	35	<i>18e-5/1e4</i>	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.1</b>	28	6.9	3.7	39	110	<i>50e-4/1e4</i>	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>2.1</b>	9.2	4.3	<b>1.5</b>	<b>3.0</b>	<b>2.4</b>	4.1	18	<i>63e-6/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.3</b>	4.7	3.2	<b>0.92</b>	<b>1.5</b>	<b>2.3</b>	3.0	3.9	28	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.8</b>	12	<b>1.7</b>	<b>0.96</b>	<b>1.8</b>	<b>2.6</b>	<b>2.9</b>	6.1	<i>48e-6/1e4</i>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	3.7	43	3.7	<b>2.0</b>	3.2	4.9	9.3	35	<i>18e-5/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	23	8.2	16	51	<i>13e-3/6e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	24	36	25	24	25	136	193	367	<i>11e-4/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>2.1</b>	5.5	<b>1.1</b>	<b>0.55</b>	<b>0.92</b>	<b>0.77</b>	<b>0.87</b>	<b>0.72</b>	<b>0.79</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.9</b>	8.4	<b>0.93</b>	<b>0.38</b>	<b>0.69</b>	<b>0.91</b>	<b>1.2</b>	<b>1.0</b>	<b>1.7</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>2.6</b>	4.6	<b>2.1</b>	<b>1.0</b>	<b>0.68</b>	<b>1.0</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>2.2</b>	13	18	27	116	114	<i>31e-3/5e3</i>	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	<b>2.4</b>	6.6	6.2	7.6	9.3	8.9	24	<i>17e-6/5e4</i>	Basic RCGA [17]
SPSA	35	55	187	5891	10571	7294	<i>10e-1/1e5</i>	.	.	.	SPSA [9]

Table 50: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{120}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>120 Sum of diff powers Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 0.73	1e+00 27	1e-01 601	1e-02 2312	1e-03 10645	1e-04 25282	1e-05 40067	1e-07 88603	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	41	43	31	31	<i>11e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	4.0	58	<b>7.8</b>	15	<i>54e-3/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.1</b>	65	31	29	63	<i>14e-2/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.3</b>	22	37	28	29	<i>13e-2/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	3.1	9.0	11	13	62	<i>71e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.4</b>	27	12	<b>7.1</b>	<i>44e-3/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.7</b>	<b>5.3</b>	17	10	61	<i>31e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	54	18	14	<i>51e-3/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	24	120	66	40	<i>36e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	779	1826	2111	847	151	74	43	58	<i>11e-3/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>2.2</b>	14	8.3	<b>1.9</b>	<b>1.6</b>	<b>0.66</b>	<b>0.49</b>	<b>0.57</b>	<b>0.50</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.3</b>	8.6	11	<b>1.9</b>	<b>0.97</b>	<b>0.60</b>	<b>0.54</b>	<b>0.53</b>	<b>0.77</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.2</b>	<b>3.5</b>	78	38	<b>15</b>	<b>10</b>	<b>10</b>	<b>4.4</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.7</b>	120	62	62	<i>42e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.5</b>	<b>3.0</b>	<b>5.5</b>	19	<b>26</b>	32	<i>85e-4/5e4</i>	.	.	Basic RCGA [17]
SPSA	99	281	549	247	338	<i>12e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 51: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{121}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>121 Sum of diff powers Cauchy</b>											
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07		$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.33	0.33	0.73	14	39	83	233	500	766	1107		
(1,2)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.7</b>	<b>1.6</b>	<b>1.6</b>	<b>2.4</b>	3.1	<b>2.9</b>	3.9	5.3		(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	3.0	<b>1.1</b>	<b>1.1</b>	<b>1.4</b>	<b>1.7</b>	<b>2.0</b>	<b>2.2</b>	<b>3.0</b>		(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.9</b>	<b>1.1</b>	<b>1.1</b>	<b>0.88</b>	<b>1.1</b>	<b>1.4</b>	<b>1.4</b>	<b>1.8</b>		(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.6</b>	<b>2.7</b>	<b>2.8</b>	7.4	7.3	7.1	12	23		(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>1.5</b>	<b>0.78</b>	<b>0.78</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>0.95</b>	<b>1.1</b>		(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.3</b>	3.9	<b>1.2</b>	<b>0.87</b>	<b>1.0</b>	<b>1.0</b>	<b>0.96</b>	<b>0.82</b>	<b>1.0</b>		(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.4</b>	<b>2.3</b>	<b>0.99</b>	<b>0.64</b>	<b>0.66</b>	<b>0.66</b>	<b>0.54</b>	<b>0.52</b>	<b>0.56</b>		(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.5</b>	4.6	<b>1.2</b>	<b>0.82</b>	<b>0.89</b>	<b>0.93</b>	<b>0.80</b>	<b>0.77</b>	<b>0.80</b>		(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.3</b>	<b>2.9</b>	3.5	5.3	27	319	<i>47e-4/5e3</i>	.	.		avg NEWUOA [16]
CMA-EGS (IPOP,r1)	18	34	29	7.9	4.6	266	886	2818	<i>11e-4/1e5</i>	.		CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>2.8</b>	<b>1.1</b>	<b>0.92</b>	<b>1.0</b>	<b>0.90</b>	<b>0.80</b>	<b>0.87</b>	<b>0.90</b>		IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.1</b>	4.3	<b>1.3</b>	<b>1.2</b>	<b>1.5</b>	<b>1.6</b>	<b>1.7</b>	<b>1.9</b>	<b>2.6</b>		IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.4</b>	4.5	4.7	3.2	<b>2.4</b>	<b>2.3</b>	<b>2.6</b>		CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.2</b>	3.2	3.6	7.7	43	<i>62e-4/5e3</i>	.	.	.		NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.4</b>	<b>1.5</b>	<b>2.6</b>	13	11	37	43	161	<i>19e-6/5e4</i>		Basic RCGA [17]
SPSA	36	101	278	2723	3628	2262	6233	<i>24e-2/1e5</i>	.	.		SPSA [9]

Table 52: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{122}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>122 Schaffer F7 Gauss</b>											
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	<b>1</b>	5.3	7.0	6.8	53	<i>15e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.8</b>	5.1	<b>1.6</b>	5.0	24	<i>21e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.3</b>	6.4	3.1	10	47	<i>35e-3/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.7</b>	10	5.2	56	<i>16e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.3</b>	6.1	3.5	6.1	47	<i>20e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	4.5	<b>1.9</b>	<b>3.6</b>	9.3	<i>85e-4/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.3</b>	3.0	<b>0.74</b>	5.3	11	58	<i>18e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>2.3</b>	11	5.1	11	103	<i>61e-3/1e4</i>	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.1</b>	13	22	<i>37e-2/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	29	35	11	4.1	49	147	165	406	<i>52e-3/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.3</b>	<b>2.9</b>	<b>1.4</b>	<b>0.80</b>	<b>0.70</b>	<b>0.67</b>	<b>0.61</b>	<b>0.81</b>	<b>0.90</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.1</b>	<b>1.9</b>	<b>1.1</b>	<b>1.1</b>	<b>0.69</b>	<b>0.76</b>	<b>0.84</b>	<b>0.96</b>	<b>1.1</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.3</b>	<b>1.5</b>	<b>2.7</b>	9.2	15	15	17	<b>22</b>	<b>17</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.1</b>	8.5	21	122	<i>65e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1.1</b>	<b>1.1</b>	<b>1.4</b>	7.9	13	<b>8.6</b>	<b>13</b>	<b>16</b>	87	<i>67e-6/5e4</i>	Basic RCGA [17]
SPSA	69	158	103	2636	<i>20e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 53: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{123}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>123 Schaffer F7 Uniform</b>										
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.33	0.33	1.6	515	7277	16727	31053	43067	63620	1.47e5	
(1,2)-CMA-ES	1	5.9	29	11	<i>73e-2/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	<b>2.3</b>	34	7.4	<i>62e-2/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	20	48	5.0	<i>65e-2/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	<b>1.2</b>	49	15	<i>90e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	<b>1.5</b>	27	7.2	19	<i>34e-2/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	<b>1.4</b>	<b>4.6</b>	<b>3.1</b>	<i>32e-2/1e4</i>	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	<b>1.4</b>	30	5.2	<i>45e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	37	82	10	<i>59e-2/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	12	118	33	<i>16e-1/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	374	549	697	46	<b>17</b>	89	<i>75e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	<b>1.1</b>	25	<b>2.9</b>	<b>0.56</b>	<b>0.71</b>	<b>0.75</b>	<b>0.75</b>	<b>0.84</b>	<b>0.92</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>1.4</b>	8.5	<b>1.7</b>	<b>0.90</b>	<b>0.98</b>	<b>0.89</b>	<b>0.82</b>	<b>0.85</b>	<b>1.2</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>1.3</b>	<b>1.8</b>	171	51	<b>22</b>	<b>16</b>	<b>16</b>	<b>11</b>	<b>4.8</b>	CMA+DE-MOS [13]
NEWUOA	1	12	132	20	<i>12e-1/5e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	<b>1.2</b>	<b>2.2</b>	13	47	<i>36e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	64	46353	22910	1289	<i>14e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 54: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{124}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>124 Schaffer F7 Cauchy</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.33	0.33	1.2	65	309	1139	2364	3098	4301	4961	$ERT_{best}/D$
(1,2)-CMA-ES	1	1.4	43	7.4	34	<i>82e-3/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1.5	<b>2.3</b>	<b>0.46</b>	<b>2.7</b>	4.1	60	<i>70e-4/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1.6	3.9	<b>2.2</b>	3.7	7.6	<i>73e-4/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1.3	6.4	10	78	<i>13e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1.9	34	17	8.5	11	60	<i>79e-4/1e4</i>	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1.1	<b>2.8</b>	<b>0.89</b>	<b>2.1</b>	<b>2.9</b>	6.5	46	<i>10e-4/1e4</i>	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1.4	3.7	<b>2.4</b>	<b>1.2</b>	<b>1.5</b>	<b>5.7</b>	<i>91e-5/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	2.1	22	<b>2.6</b>	4.2	5.5	63	<i>45e-4/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1.5	11	7.7	59	<i>18e-2/5e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	15	24	16	6.2	30	103	<i>11e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	2.0	4.2	<b>0.54</b>	<b>0.82</b>	<b>0.50</b>	<b>0.55</b>	<b>0.87</b>	<b>1.2</b>	<b>1.4</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1.5	3.2	<b>0.59</b>	<b>2.0</b>	<b>1.1</b>	<b>0.79</b>	<b>0.96</b>	<b>1.5</b>	<b>2.4</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1.3	<b>2.4</b>	<b>2.5</b>	27	10	5.8	<b>5.0</b>	<b>5.0</b>	<b>5.0</b>	CMA+DE-MOS [13]
NEWUOA	1	1.5	5.6	13	36	<i>14e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	1	1.2	<b>1.8</b>	4.5	22	11	18	50	170	<i>80e-5/5e4</i>	Basic RCGA [17]
SPSA	27	51	6155	2182	4845	<i>11e-1/1e5</i>	.	.	.	.	SPSA [9]

Table 55: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{125}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>125 Griewank-Rosenbrock Gauss</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 0.33	1e+00 0.33	1e-01 0.33	1e-02 1473	1e-03 8226	1e-04 11656	1e-05 12117	1e-07 12667	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	1	19	572	6.4	<i>69e-4/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	<b>8.7</b>	<b>207</b>	3.9	18	13	<i>38e-4/1e4</i>	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	10	289	<b>2.8</b>	18	13	<i>53e-4/1e4</i>	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	<b>1.3</b>	11	791	5.8	<i>68e-4/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	<b>8.1</b>	677	4.8	8.6	<i>55e-4/1e4</i>	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	10	508	3.1	8.6	13	12	<i>31e-4/1e4</i>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	<b>8.9</b>	298	<b>2.5</b>	4.0	13	<i>31e-4/1e4</i>	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	14	556	5.3	18	<i>69e-4/1e4</i>	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	<b>1.4</b>	9.3	326	<b>1.6</b>	3.0	6.9	6.7	<i>40e-4/6e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	30	38	49	79	569	<b>1.8</b>	21	38	57	115	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	<b>1.3</b>	9.5	289	<b>0.69</b>	<b>0.67</b>	<b>0.70</b>	<b>0.76</b>	<b>0.75</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	<b>1.2</b>	11	<b>243</b>	<b>1.4</b>	<b>1.1</b>	<b>0.98</b>	<b>0.97</b>	<b>0.99</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>1.1</b>	13	<b>222</b>	<b>1.8</b>	4.0	6.3	6.1	<b>5.9</b>	CMA+DE-MOS [13]
NEWUOA	1	1	<b>2.8</b>	10	332	<b>0.88</b>	<b>2.8</b>	<b>2.0</b>	<b>1.9</b>	<i>19e-4/5e3</i>	NEWUOA [16]
Basic RCGA	1	1	<b>1.3</b>	9.3	291	<b>1.0</b>	5.2	8.1	59	<i>54e-5/5e4</i>	Basic RCGA [17]
SPSA	25	38	41	66	21710	14	<i>36e-4/1e5</i>	.	.	.	SPSA [9]



Table 56: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{126}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>126 Griewank-Rosenbrock Uniform</b>												
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$	
$ERT_{best}/D$	0.33	0.33	0.33	0.33	0.33	4499	37712	1.11e5	2.08e5	3.20e5	$ERT_{best}/D$	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	135	3640	15	<i>26e-3/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]	
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	87	3050	16	<i>22e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]	
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	148	1434	7.1	<i>20e-3/1e4</i>	.	.	.	(1,2ms)-CMA-ES [4]	
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	209	5363	<i>38e-3/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]	
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	15	1230	10	<i>18e-3/1e4</i>	.	.	.	(1,4)-CMA-ES [5, 3]	
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>11</b>	1618	3.4	<i>10e-3/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]	
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>6.5</b>	1116	7.3	<i>12e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]	
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	32	97	1584	5.4	<i>12e-3/1e4</i>	.	.	.	(1,4s)-CMA-ES [3]	
avg NEWUOA	<b>1</b>	<b>1</b>	<b>1.7</b>	258	6248	<i>49e-3/6e3</i>	.	.	.	.	avg NEWUOA [16]	
CMA-EGS (IPOP,r1)	630	728	1797	2592	7997	8.5	4.1	6.1	<i>22e-4/1e5</i>	.	CMA-EGS (IPOP,r1) [8]	
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	74	933	<b>0.68</b>	<b>0.89</b>	<b>0.66</b>	<b>0.49</b>	<b>0.49</b>	IPOP-aCMA-ES [12]	
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	15	<b>645</b>	<b>0.85</b>	<b>0.88</b>	<b>0.81</b>	<b>0.95</b>	<b>0.91</b>	IPOP-CMA-ES [15]	
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	16	<b>237</b>	<b>0.11</b>	15	<i>27e-4/1e5</i>	.	.	CMA+DE-MOS [13]	
NEWUOA	<b>1</b>	<b>1</b>	13	266	8605	17	<i>48e-3/5e3</i>	.	.	.	NEWUOA [16]	
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>7.1</b>	<b>350</b>	<b>0.31</b>	<b>0.65</b>	<b>1.1</b>	<b>3.5</b>	<i>15e-5/5e4</i>	Basic RCGA [17]	
SPSA	18	46208	75111	2.01e5	3.07e5	159	<i>54e-3/1e5</i>	.	.	.	SPSA [9]	

Table 57: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{127}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>127 Griewank-Rosenbrock Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 0.33	1e+00 0.33	1e-01 0.33	1e-02 1168	1e-03 13028	1e-04 15016	1e-05 15116	1e-07 15332	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.3</b>	11	367	6.1	<i>76e-4/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	6.9	<b>184</b>	<b>2.1</b>	<b>1.8</b>	4.7	4.6	4.6	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	10	644	3.5	5.5	<i>54e-4/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	12	644	7.3	11	<i>73e-4/1e4</i>	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>4.8</b>	423	6.0	5.4	10	9.5	9.4	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	9.3	417	3.7	5.4	10	10	10	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>4.7</b>	217	<b>1.5</b>	<b>2.2</b>	<b>2.0</b>	<b>2.0</b>	<b>1.9</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	13	204	4.5	<b>2.3</b>	4.5	4.5	4.4	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>2.1</b>	11	295	4.5	<i>61e-4/5e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	14	24	30	55	224	10	24	94	<i>17e-4/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>6.4</b>	<b>179</b>	3.7	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	14	<b>189</b>	4.3	<b>0.83</b>	<b>1.4</b>	<b>1.5</b>	<b>1.5</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	12	190	<b>0.19</b>	<b>1.9</b>	<b>2.7</b>	<b>2.7</b>	<b>2.8</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.1</b>	18	278	<b>1.6</b>	<b>2.3</b>	4.3	4.2	<i>61e-4/4e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	12	293	<b>1.1</b>	<b>2.3</b>	8.3	15	46	Basic RCGA [17]
SPSA	31	47	82	1530	45810	582	<i>22e-3/1e5</i>	.	.	.	SPSA [9]

Table 58: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{128}$  in **03-D**, 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										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.8	1e+00 142	1e-01 375	1e-02 449	1e-03 639	1e-04 903	1e-05 905	1e-07 1447	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	4.7	3.7	<b>2.3</b>	4.7	4.7	6.8	7.1	7.7	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	<b>1.9</b>	<b>1.6</b>	<b>2.3</b>	<b>2.5</b>	<b>1.8</b>	<b>1.4</b>	<b>1.7</b>	<b>1.1</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	<b>2.3</b>	<b>2.9</b>	4.0	3.7	3.1	<b>2.3</b>	<b>2.6</b>	<b>1.9</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	3.5	3.1	3.4	5.7	5.0	3.9	3.9	4.3	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	<b>2.6</b>	<b>2.7</b>	<b>2.4</b>	<b>2.5</b>	<b>1.8</b>	<b>1.3</b>	<b>1.3</b>	<b>0.91</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	<b>2.0</b>	3.3	4.1	4.0	<b>2.8</b>	<b>2.4</b>	<b>2.4</b>	<b>1.9</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	3.6	3.1	3.1	<b>3.6</b>	<b>2.5</b>	<b>1.9</b>	<b>1.9</b>	<b>1.2</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	<b>2.7</b>	3.1	4.8	4.8	3.7	<b>2.7</b>	<b>2.8</b>	<b>2.4</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	4.3	10	19	25	18	17	45	<i>45e-3/6e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	30	40	12	14	48	84	146	264	471	<i>90e-5/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	<b>1.2</b>	7.3	16	36	26	76	76	48	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	<b>2.2</b>	7.3	12	11	15	11	11	7.3	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>2.3</b>	33	52	46	32	24	24	16	CMA+DE-MOS [13]
NEWUOA	1	1	<b>1.7</b>	7.0	9.1	14	35	84	<i>89e-4/5e3</i>	.	NEWUOA [16]
Basic RCGA	1	1	<b>1.3</b>	18	33	58	49	35	43	41	Basic RCGA [17]
SPSA	20	31	150	1406	1931	3251	2283	<i>13e-1/1e5</i>	.	.	SPSA [9]

Table 59: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{129}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>129 Gallagher Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.33	1e+02 0.33	1e+01 1.6	1e+00 121	1e-01 1131	1e-02 2617	1e-03 3861	1e-04 8261	1e-05 9454	1e-07 12845	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	53	15	5.2	54	<i>23e-3/1e4</i>	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	21	13	4.8	17	36	<i>61e-3/1e4</i>	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	31	18	7.9	18	38	<i>27e-3/1e4</i>	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	28	25	11	28	<i>90e-3/1e4</i>	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	14	14	<b>4.0</b>	5.7	<b>11</b>	18	15	<i>11e-3/1e4</i>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	5.1	<b>7.3</b>	<b>3.2</b>	<b>5.3</b>	12	<b>8.5</b>	<i>47e-4/1e4</i>	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	10	11	<b>4.5</b>	6.2	37	<i>30e-3/1e4</i>	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	22	<b>11</b>	5.5	7.6	38	18	<i>14e-3/1e4</i>	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	51	34	12	15	21	<b>10</b>	<i>23e-2/6e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	181	2286	6231	223	74	45	88	56	157	116	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	<b>1.4</b>	<b>5.9</b>	5.0	<b>2.8</b>	<b>12</b>	<b>10</b>	<b>9.1</b>	<b>6.9</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	7.5	12	4.7	<b>3.3</b>	<b>6.1</b>	13	<b>11</b>	<b>22</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>2.4</b>	239	81	72	77	51	45	48	CMA+DE-MOS [13]
NEWUOA	1	1	56	63	21	30	21	<i>79e-2/5e3</i>	.	.	NEWUOA [16]
Basic RCGA	1	1	<b>1.6</b>	11	12	11	24	14	<b>13</b>	<b>27</b>	Basic RCGA [17]
SPSA	54	279	1008	171	308	271	<i>14e-2/1e5</i>	.	.	.	SPSA [9]

Table 60: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{130}$  in **03-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>130 Gallagher Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.33	0.33	1.8	82	172	305	501	2264	3981	4782	
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.9</b>	38	43	24	15	3.4	<b>2.3</b>	<b>2.0</b>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.7</b>	17	14	<b>7.9</b>	5.5	<b>1.2</b>	<b>0.71</b>	<b>0.60</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	8.1	<b>10</b>	10	5.9	<b>1.7</b>	<b>0.97</b>	<b>0.82</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	4.0	32	53	31	19	5.0	<b>2.8</b>	<b>2.4</b>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	21	10	13	10	6.0	<b>1.3</b>	<b>0.76</b>	<b>0.64</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.1</b>	11	15	8.6	<b>5.2</b>	<b>1.2</b>	<b>0.67</b>	<b>0.56</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	14	8.5	<b>7.6</b>	<b>5.2</b>	<b>3.2</b>	<b>0.70</b>	<b>0.40</b>	<b>0.34</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.4</b>	<b>7.7</b>	15	<b>8.4</b>	<b>5.2</b>	<b>1.1</b>	<b>0.65</b>	<b>0.55</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>2.6</b>	<b>3.9</b>	12	8.5	11	5.6	5.7	<i>90e-5/5e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	22	37	12	54	155	216	204	131	104	<i>99e-5/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>2.3</b>	19	46	51	57	35	20	17	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	3.1	53	57	33	153	34	19	16	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.8</b>	90	332	398	389	86	87	73	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.0</b>	<b>3.0</b>	<b>9.4</b>	18	21	6.6	17	<i>86e-4/5e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.3</b>	15	84	132	139	31	23	26	Basic RCGA [17]
SPSA	15	30	103	523	486	574	1367	648	369	<i>51e-3/1e5</i>	SPSA [9]

Table 61: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{101}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>101 Sphere moderate Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 2.2	1e+00 7.4	1e-01 8.8	1e-02 10	1e-03 12	1e-04 13	1e-05 14	1e-07 15	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.2</b>	8.3	4.4	6.3	8.1	8.5	10	11	13	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	3.1	4.3	<b>3.3</b>	4.9	6.0	5.8	6.6	7.4	8.9	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	3.8	<b>2.9</b>	4.1	5.0	5.1	5.8	6.7	7.7	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	7.0	4.7	6.7	8.0	7.6	8.7	10	12	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.8</b>	<b>2.8</b>	3.6	4.5	4.6	5.5	6.1	7.1	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.4</b>	<b>2.1</b>	<b>2.8</b>	4.0	4.1	4.5	5.1	6.4	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>2.4</b>	<b>1.7</b>	<b>2.3</b>	<b>2.9</b>	<b>3.0</b>	<b>3.5</b>	<b>3.9</b>	<b>4.6</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	3.3	<b>2.7</b>	<b>2.1</b>	<b>2.7</b>	3.5	3.5	4.0	4.4	5.3	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.6</b>	<b>2.9</b>	<b>1.5</b>	<b>1.6</b>	<b>1.7</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	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	<b>1</b>	<b>1.2</b>	<b>3.0</b>	<b>3.0</b>	4.2	5.8	5.8	6.7	7.6	9.3	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.2</b>	3.3	3.4	4.7	6.0	6.0	6.9	7.8	9.3	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	7.3	12	19	23	24	27	31	37	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	3.6	<b>2.5</b>	<b>1.6</b>	<b>2.1</b>	<b>2.5</b>	<b>2.6</b>	<b>2.9</b>	<b>3.0</b>	<b>3.1</b>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	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 62: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{102}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>102 Sphere moderate Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.20	0.20	2.2	7.1	10	13	14	16	17	20	
(1,2)-CMA-ES	<b>1</b>	<b>1.4</b>	9.2	5.8	6.2	6.5	7.7	9.1	10	11	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.4</b>	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	<b>1</b>	<b>2.4</b>	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	<b>1</b>	<b>2.3</b>	4.1	5.2	6.4	6.6	8.0	8.6	9.3	10	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	3.2	<b>2.5</b>	<b>2.9</b>	<b>3.0</b>	3.7	4.2	4.6	5.3	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.7</b>	<b>2.4</b>	<b>2.4</b>	<b>2.7</b>	<b>2.7</b>	3.4	3.9	4.1	4.5	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.3</b>	<b>1.7</b>	<b>2.1</b>	<b>2.3</b>	<b>2.7</b>	<b>3.0</b>	<b>3.2</b>	<b>3.7</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.8</b>	<b>2.1</b>	<b>2.4</b>	<b>2.7</b>	<b>3.2</b>	<b>3.4</b>	<b>3.6</b>	<b>4.4</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.3</b>	<b>2.7</b>	<b>1.4</b>	<b>1.5</b>	<b>1.4</b>	<b>1.5</b>	<b>1.5</b>	<b>1.6</b>	<b>1.5</b>	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	<b>1</b>	<b>1.4</b>	3.5	3.4	3.8	4.3	5.0	5.8	6.1	7.0	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.5</b>	3.4	3.1	4.1	4.2	5.1	6.0	6.5	7.3	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	5.7	12	17	18	20	22	25	27	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	3.9	6.3	6.0	7.0	15	20	27	33	41	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.2</b>	10	29	39	57	88	123	155	209	Basic RCGA [17]
SPSA	41	60	1987	4868	9895	9681	9199	11030	24495	<i>31e-3/1e5</i>	SPSA [9]

Table 63: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{103}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>103 Sphere moderate Cauchy</b>											
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.20	0.20	2.2	5.5	6.0	6.0	6.3	6.4	7.0	23	$ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.5</b>	6.2	6.7	9.0	13	18	22	25	10	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>2.5</b>	3.4	3.8	5.5	8.4	10	13	15	6.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	3.8	3.6	5.4	7.5	9.4	12	13	5.4	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>2.1</b>	8.2	7.0	10	12	16	20	22	9.2	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.1</b>	3.0	<b>4.4</b>	6.5	8.5	10	12	5.0	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>2.6</b>	<b>2.8</b>	4.6	<b>6.3</b>	<b>7.8</b>	<b>10</b>	<b>11</b>	<b>4.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>2.4</b>	<b>2.1</b>	<b>3.5</b>	<b>4.9</b>	<b>6.1</b>	<b>7.5</b>	<b>8.1</b>	<b>3.4</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.9</b>	<b>2.9</b>	4.8	6.7	<b>8.0</b>	<b>10</b>	<b>10</b>	<b>4.2</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.5</b>	<b>2.5</b>	<b>1.6</b>	<b>3.6</b>	<b>5.4</b>	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	<b>1</b>	<b>1</b>	<b>2.9</b>	4.1	6.3	8.8	11	14	16	6.5	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.4</b>	3.6	4.0	6.6	9.4	12	15	17	7.1	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	7.6	13	28	38	48	60	72	30	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	3.5	<b>2.4</b>	<b>1.9</b>	5.7	9.4	60	85	178	136	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	7.1	27	60	133	234	353	434	222	Basic RCGA [17]
SPSA	51	202	151	119	165	251	415	5261	93276	<i>42e-6/1e5</i>	SPSA [9]











Table 68: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{108}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

$\Delta f_{target}$ $ERT_{best}/D$	<b>108 Sphere Uniform</b>										$\Delta f_{target}$ $ERT_{best}/D$
	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	
(1,2)-CMA-ES	1	<b>1.7</b>	43	<i>23e-1/1e4</i>	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	<b>2.7</b>	27	22	<i>18e-1/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	<b>1.1</b>	32	44	<i>19e-1/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	<b>2.8</b>	90	69	<i>22e-1/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	<b>1.7</b>	<b>5.9</b>	15	51	<i>11e-1/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	<b>1.4</b>	25	<b>7.7</b>	<i>84e-2/1e4</i>	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	3.7	15	13	<i>94e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	<b>2.7</b>	25	69	<i>15e-1/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	3.0	155	44	<i>27e-1/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	5825	9728	290	14	<b>7.8</b>	<b>7.2</b>	<b>8.6</b>	<b>10</b>	<b>13</b>	<b>46</b>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	12	11	<b>0.68</b>	<b>0.64</b>	<b>0.64</b>	<b>0.64</b>	<b>0.75</b>	<b>0.66</b>	<b>0.94</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>1.7</b>	9.1	<b>0.80</b>	<b>0.67</b>	<b>0.64</b>	<b>0.77</b>	<b>0.70</b>	<b>0.62</b>	<b>0.69</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>1.1</b>	<b>2.5</b>	95	125	157	267	201	141	<i>89e-2/1e5</i>	CMA+DE-MOS [13]
NEWUOA	1	48	77	64	<i>41e-1/5e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	<b>1</b>	<b>0.79</b>	13	30	70	<i>16e-2/5e4</i>	.	.	.	Basic RCGA [17]
SPSA	436	1305	89	10	242	<i>15e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 69: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>109 Sphere Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 2.2	1e+00 11	1e-01 43	1e-02 75	1e-03 114	1e-04 139	1e-05 175	1e-07 189	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>2.7</b>	5.5	<b>2.8</b>	<b>1.8</b>	<b>1.9</b>	<b>1.9</b>	<b>2.5</b>	<b>2.5</b>	3.4	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	3.3	4.1	<b>2.5</b>	<b>1.2</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.0</b>	<b>1.3</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.3</b>	3.4	<b>2.1</b>	<b>1.0</b>	<b>0.86</b>	<b>0.77</b>	<b>0.89</b>	<b>0.89</b>	<b>1.1</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	5.8	3.5	<b>2.0</b>	<b>2.0</b>	<b>2.2</b>	<b>2.4</b>	<b>2.4</b>	3.4	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1.1</b>	3.4	<b>2.2</b>	<b>1.0</b>	<b>0.98</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	<b>1.4</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>2.9</b>	<b>1.4</b>	<b>0.79</b>	<b>0.82</b>	<b>0.81</b>	<b>0.88</b>	<b>0.93</b>	<b>1.2</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>1.9</b>	<b>1.1</b>	<b>0.57</b>	<b>0.52</b>	<b>0.50</b>	<b>0.53</b>	<b>0.52</b>	<b>0.67</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>3.0</b>	<b>1.3</b>	<b>0.79</b>	<b>0.76</b>	<b>0.68</b>	<b>0.68</b>	<b>0.66</b>	<b>0.88</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1.5</b>	4.3	3.6	26	47	<i>67e-4/6e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	41	62	21	8.3	3.1	110	2422	<i>17e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.1</b>	3.1	<b>1.9</b>	<b>1.1</b>	<b>1.0</b>	<b>0.92</b>	<b>1.1</b>	<b>1.2</b>	<b>1.5</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>2.9</b>	<b>2.2</b>	<b>1.2</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	<b>1.5</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	6.1	8.7	4.9	4.9	4.7	5.2	5.3	7.4	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.7</b>	4.8	13	83	885	<i>41e-3/5e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	9.0	20	12	14	16	20	25	53	Basic RCGA [17]
SPSA	50	101	138	953	3515	<i>13e-2/1e5</i>	.	.	.	.	SPSA [9]











Table 74: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{114}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>114 Step-ellipsoid Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.20	2.3	153	2944	11262	15778	16654	16654	16654	16990	
(1,2)-CMA-ES	<b>1.3</b>	144	101	<i>11e+0/1e4</i>	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.5</b>	87	25	<i>63e-1/1e4</i>	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1.3</b>	139	54	<i>79e-1/1e4</i>	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	38	56	56	<i>73e-1/1e4</i>	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>2.3</b>	55	18	<i>46e-1/1e4</i>	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.3</b>	<b>17</b>	14	<i>30e-1/1e4</i>	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	53	26	19	50	<i>21e-1/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.4</b>	23	21	<i>53e-1/1e4</i>	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.3</b>	112	74	<i>11e+0/6e3</i>	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1787	721	152	61	<i>19e-1/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.3</b>	35	<b>3.3</b>	<b>0.61</b>	<b>0.49</b>	<b>0.62</b>	<b>0.60</b>	<b>0.60</b>	<b>0.60</b>	<b>0.61</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.3</b>	41	<b>3.2</b>	<b>0.45</b>	<b>0.48</b>	<b>0.80</b>	<b>0.79</b>	<b>0.79</b>	<b>0.79</b>	<b>0.80</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.5</b>	<b>2.5</b>	60	130	34	<b>33</b>	<b>48</b>	<b>48</b>	<b>48</b>	<b>47</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	150	43	<i>89e-1/5e3</i>	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1.2</b>	<b>1.2</b>	<b>12</b>	<b>16</b>	<b>31</b>	<i>41e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	1025	531	181	245	<i>29e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 75: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{115}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>115 Step-ellipsoid Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>2.2</b>	3.8	5.3	5.7	66	<i>13e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1.7</b>	<b>2.5</b>	<b>1.9</b>	<b>2.4</b>	6.6	54	137	137	137	240	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>2.9</b>	<b>3.0</b>	<b>2.3</b>	<b>1.6</b>	7.5	44	88	88	88	247	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1.3</b>	3.1	4.7	11	50	<i>17e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1.9</b>	<b>1.7</b>	<b>1.7</b>	<b>1.7</b>	5.5	23	134	134	134	119	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1.6</b>	<b>1.4</b>	<b>1.2</b>	<b>1.3</b>	<b>2.6</b>	<b>13</b>	26	26	26	70	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1.7</b>	<b>1.4</b>	<b>2.9</b>	<b>1.7</b>	4.6	26	49	49	49	55	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1.7</b>	<b>1.6</b>	<b>1.9</b>	<b>1.8</b>	6.9	45	89	89	89	<i>11e-3/1e4</i>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1.1</b>	<b>1.6</b>	<b>1.1</b>	4.2	28	<i>10e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	63	13	8.6	422	1803	3116	2779	2779	2779	<i>31e-2/1e5</i>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1.2</b>	<b>2.0</b>	<b>1.8</b>	<b>0.81</b>	<b>1.1</b>	<b>1.1</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.5</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1.3</b>	<b>1.2</b>	<b>1.7</b>	<b>2.4</b>	<b>2.7</b>	<b>2.9</b>	<b>3.1</b>	<b>3.1</b>	<b>3.1</b>	<b>2.7</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1.5</b>	<b>2.5</b>	5.3	18	31	25	<b>23</b>	<b>23</b>	<b>23</b>	<b>20</b>	CMA+DE-MOS [13]
NEWUOA	<b>2.1</b>	<b>1.2</b>	<b>2.9</b>	14	42	<i>34e-2/4e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1.4</b>	<b>1.7</b>	74	68	108	769	703	703	703	604	Basic RCGA [17]
SPSA	58	64	222	1640	3866	<i>12e-1/1e5</i>	.	.	.	.	SPSA [9]





Table 78: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{118}$  in **05-D**, 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										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	6.6	11	86	243	311	355	400	441	486	583	$ERT_{best}/D$
(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	<b>2.4</b>	<b>2.2</b>	<b>2.2</b>	<b>2.2</b>	<b>2.0</b>	<b>2.0</b>	<b>1.8</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	5.0	7.2	<b>2.6</b>	<b>1.6</b>	<b>1.8</b>	<b>1.8</b>	<b>1.7</b>	<b>1.6</b>	<b>1.5</b>	<b>1.4</b>	(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	<b>2.3</b>	<b>1.4</b>	<b>1.3</b>	<b>1.4</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.2</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>2.6</b>	5.7	<b>2.0</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>2.0</b>	<b>4.1</b>	<b>1.1</b>	<b>0.71</b>	<b>0.77</b>	<b>0.78</b>	<b>0.75</b>	<b>0.73</b>	<b>0.70</b>	<b>0.65</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	3.6	7.2	<b>1.9</b>	<b>1.0</b>	<b>0.96</b>	<b>0.97</b>	<b>0.95</b>	<b>0.92</b>	<b>0.88</b>	<b>0.84</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>0.92</b>	<b>0.97</b>	<b>1.8</b>	8.3	64	<i>18e-2/7e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	27	689	337	622	889	3954	<i>21e-1/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>2.5</b>	6.1	<b>1.7</b>	<b>0.88</b>	<b>0.91</b>	<b>0.91</b>	<b>0.91</b>	<b>0.92</b>	<b>0.91</b>	<b>0.90</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>3.0</b>	9.0	3.2	<b>2.0</b>	<b>1.9</b>	<b>2.0</b>	<b>2.0</b>	<b>1.9</b>	<b>1.9</b>	<b>1.7</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	7.6	17	3.7	<b>1.8</b>	<b>1.7</b>	<b>1.8</b>	<b>2.1</b>	<b>2.3</b>	<b>2.5</b>	<b>2.8</b>	CMA+DE-MOS [13]
NEWUOA	<b>0.80</b>	<b>1.3</b>	4.3	10	116	<i>30e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	5.4	520	495	1424	<i>45e-1/5e4</i>	.	.	.	.	.	Basic RCGA [17]
SPSA	46	255	2588	<i>18e+0/1e5</i>	.	.	.	.	.	.	SPSA [9]





Table 80: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{120}$  in **05-D**, 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 Uniform										
$\Delta ft_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 3.2	1e+00 580	1e-01 3740	1e-02 6898	1e-03 14488	1e-04 35436	1e-05 66660	1e-07 1.10e5	$\Delta ft_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.5</b>	77	33	<i>14e-1/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	34	46	79	40	<i>11e-1/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.7</b>	34	26	<i>10e-1/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	63	51	34	<i>14e-1/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	11	36	16	<i>77e-2/1e4</i>	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>2.9</b>	13	<b>6.6</b>	<i>66e-2/1e4</i>	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	56	64	10	<i>69e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.9</b>	38	15	<i>83e-2/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	42	94	49	<i>15e-1/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1223	2182	675	85	33	24	49	<i>13e-3/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>2.3</b>	18	<b>0.76</b>	<b>0.65</b>	<b>0.82</b>	<b>0.83</b>	<b>0.53</b>	<b>0.43</b>	<b>0.66</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.1</b>	<b>6.0</b>	<b>1.6</b>	<b>0.68</b>	<b>0.73</b>	<b>0.69</b>	<b>0.46</b>	<b>0.55</b>	<b>0.83</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.2</b>	<b>2.5</b>	63	130	71	<b>34</b>	<b>22</b>	<b>24</b>	<b>15</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	34	130	55	<i>24e-1/5e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	<b>0.87</b>	17	<b>12</b>	<b>23</b>	<i>50e-3/5e4</i>	.	.	.	Basic RCGA [17]
SPSA	194	1082	276	165	<i>84e-2/1e5</i>	.	.	.	.	.	SPSA [9]

Table 81: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{121}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>121 Sum of diff powers Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
	0.20	0.20	1.7	22	55	107	317	525	774	1239	
(1,2)-CMA-ES	<b>1</b>	<b>1.3</b>	4.5	<b>2.9</b>	<b>1.9</b>	3.3	<b>2.9</b>	3.8	4.5	9.0	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.6</b>	<b>2.4</b>	<b>1.2</b>	<b>0.94</b>	<b>1.2</b>	<b>1.1</b>	<b>1.7</b>	<b>1.9</b>	<b>2.8</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>2.7</b>	<b>1.1</b>	<b>0.87</b>	<b>0.84</b>	<b>0.90</b>	<b>1.0</b>	<b>1.2</b>	<b>1.3</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	4.4	5.3	<b>2.9</b>	<b>2.2</b>	<b>2.8</b>	5.7	5.5	9.4	27	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>2.1</b>	<b>1.7</b>	<b>1.2</b>	<b>0.91</b>	<b>1.1</b>	<b>0.96</b>	<b>1.1</b>	<b>1.2</b>	<b>1.3</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.7</b>	3.4	<b>1.2</b>	<b>0.86</b>	<b>1.1</b>	<b>0.91</b>	<b>0.93</b>	<b>1.0</b>	<b>1.2</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.2</b>	<b>2.0</b>	<b>0.72</b>	<b>0.57</b>	<b>0.70</b>	<b>0.51</b>	<b>0.58</b>	<b>0.60</b>	<b>0.56</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	3.1	<b>2.6</b>	<b>0.98</b>	<b>0.75</b>	<b>0.86</b>	<b>0.62</b>	<b>0.70</b>	<b>0.77</b>	<b>0.80</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	3.3	4.3	3.3	45	788	<i>38e-3/6e3</i>	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	46	62	16	4.3	<b>2.9</b>	482	4519	<i>55e-4/1e5</i>	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	3.3	3.0	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>0.78</b>	<b>0.79</b>	<b>0.84</b>	<b>0.82</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.6</b>	<b>1.9</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	<b>1.7</b>	<b>2.1</b>	<b>2.3</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.2</b>	3.5	4.9	4.0	4.0	<b>2.3</b>	<b>2.4</b>	<b>2.3</b>	<b>2.5</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	3.9	4.8	15	76	<i>86e-3/4e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.3</b>	<b>2.1</b>	11	11	11	30	1408	<i>22e-5/5e4</i>	.	Basic RCGA [17]
SPSA	42	74	119	6850	<i>11e-1/1e5</i>	.	.	.	.	.	SPSA [9]





Table 84: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{124}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>124 Schaffer F7 Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 1.9	1e+00 40	1e-01 208	1e-02 1795	1e-03 4096	1e-04 5279	1e-05 9067	1e-07 19040	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1.1</b>	11	127	700	<i>52e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1.1</b>	3.4	<b>2.7</b>	30	83	<i>65e-3/1e4</i>	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1.3</b>	4.3	5.5	22	<i>60e-3/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1.8</b>	96	277	<i>88e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	3.1	<b>2.8</b>	21	119	<i>13e-2/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1.1</b>	<b>2.4</b>	<b>2.5</b>	15	39	<i>41e-3/1e4</i>	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1.3</b>	<b>1.8</b>	7.6	18	79	<i>46e-3/1e4</i>	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1.7</b>	17	19	72	<i>10e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>2.1</b>	6.1	89	<i>63e-2/6e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	54	76	19	5.7	80	<i>44e-3/6e4</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.3</b>	<b>2.6</b>	<b>1.2</b>	<b>2.1</b>	<b>0.85</b>	<b>0.93</b>	<b>0.93</b>	<b>0.94</b>	<b>0.59</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.8</b>	<b>2.8</b>	<b>1.3</b>	<b>4.0</b>	<b>1.0</b>	<b>1.2</b>	<b>1.1</b>	<b>0.93</b>	<b>0.65</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1.1</b>	<b>1.7</b>	5.9	<b>15</b>	<b>3.5</b>	<b>2.4</b>	<b>2.2</b>	<b>3.3</b>	<b>1.9</b>	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1.1</b>	<b>3.0</b>	158	<i>11e-1/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1.1</b>	<b>2.4</b>	63	41	10	11	66	<i>55e-5/5e4</i>	.	Basic RCGA [17]
SPSA	59	96	516	16583	<i>39e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 85: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{125}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>125 Griewank-Rosenbrock Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 0.20	1e+00 0.20	1e-01 0.20	1e-02 25031	1e-03 47750	1e-04 48260	1e-05 48600	1e-07 49199	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	1	120	59424	<i>92e-3/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	<b>1.3</b>	69	14809	<i>69e-3/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	36	32993	<i>81e-3/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1	247	1.04e5	<i>11e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	<b>21</b>	12610	<i>58e-3/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	24	12571	<i>58e-3/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	<b>20</b>	12034	<i>54e-3/1e4</i>	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	48	23166	<i>82e-3/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	<b>2.0</b>	81	9966	<i>36e-3/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	49	65	70	153	3423	5.7	<i>10e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	1	26	3142	<b>0.75</b>	<b>0.53</b>	<b>0.56</b>	<b>0.57</b>	<b>0.57</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	1	27	<b>2599</b>	<b>0.79</b>	<b>0.78</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>1.2</b>	34	<b>810</b>	5.0	<b>16</b>	<b>16</b>	<b>16</b>	<b>16</b>	CMA+DE-MOS [13]
NEWUOA	1	1	3.9	<b>15</b>	6088	<b>2.8</b>	<i>40e-3/5e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	1	1	<b>1.1</b>	26	<b>1574</b>	<b>1.3</b>	<i>82e-4/5e4</i>	.	.	.	Basic RCGA [17]
SPSA	41	60	35786	35837	52690	56	<i>51e-3/1e5</i>	.	.	.	SPSA [9]

Table 86: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{126}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>126 Griewank-Rosenbrock Uniform</b>										
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03 0.20	1e+02 0.20	1e+01 0.20	1e+00 0.20	1e-01 0.20	1e-02 1.75e5	1e-03 $\infty$	1e-04 $\infty$	1e-05 $\infty$	1e-07 $\infty$	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.1</b>	2015	7.40e5	<i>25e-2/1e4</i>	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	618	<i>22e-2/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	719	<i>20e-2/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	32	585	7.17e5	<i>26e-2/1e4</i>	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	532	<i>15e-2/1e4</i>	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	356	2.33e5	<i>12e-2/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	82	1.14e5	<i>12e-2/1e4</i>	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	282	3.57e5	<i>18e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	22	1636	4.54e5	<i>26e-2/6e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	1548	1777	5228	7914	99874	8.3	<i>23e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>62</b>	<b>7882</b>	<b>1.4</b>	<i>51e-4/4e5</i>	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	63	10254	<b>1.2</b>	<b>1.21e7</b>	<b>1.87e7</b>	<b>1.88e7</b>	<b>1.89e7</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.2</b>	<b>34</b>	<b>568</b>	<i>23e-3/1e5</i>	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>1.2</b>	1053	3.47e5	<i>26e-2/5e3</i>	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>33</b>	<b>1409</b>	<b>0.59</b>	<i>11e-3/5e4</i>	.	.	.	Basic RCGA [17]
SPSA	1.00e6	2.00e6	3.25e6	3.25e6	7.17e6	<i>16e+2/1e5</i>	.	.	.	.	SPSA [9]

Table 87: Running time excess  $ERT/ERT_{best\ 2009}$  on  $f_{127}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

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







Table 90: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{130}$  in **05-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>130 Gallagher Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.20	1e+02 0.20	1e+01 11	1e+00 162	1e-01 607	1e-02 1640	1e-03 6565	1e-04 6746	1e-05 6778	1e-07 6906	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	14	48	23	10	<b>2.9</b>	<b>2.8</b>	<b>2.8</b>	3.6	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	7.2	17	8.7	<b>3.3</b>	<b>0.82</b>	<b>0.80</b>	<b>0.80</b>	<b>0.79</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	5.3	14	<b>5.1</b>	<b>1.9</b>	<b>0.47</b>	<b>0.46</b>	<b>0.46</b>	<b>0.46</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	37	58	41	15	3.8	3.7	3.8	3.8	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	5.4	25	12	4.5	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1.0</b>	15	10	3.8	<b>0.95</b>	<b>0.93</b>	<b>0.93</b>	<b>0.92</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	6.8	<b>4.2</b>	<b>3.5</b>	<b>1.3</b>	<b>0.33</b>	<b>0.32</b>	<b>0.32</b>	<b>0.32</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	3.3	14	15	5.5	<b>1.4</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<b>1.3</b>	<b>6.4</b>	<b>5.9</b>	6.0	<b>3.0</b>	13	<i>14e-3/6e3</i>	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	35	57	5.2	203	146	124	104	102	<i>31e-3/1e5</i>	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1.4</b>	143	391	145	36	35	35	35	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1.2</b>	59	321	147	37	36	36	35	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>2.4</b>	295	221	121	30	29	29	29	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<b>2.3</b>	<b>11</b>	10	19	<i>62e-3/4e3</i>	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>2.5</b>	250	74	29	7.5	9.2	9.3	10	Basic RCGA [17]
SPSA	40	62	142	1955	<i>19e-1/1e5</i>	.	.	.	.	.	SPSA [9]

Table 91: Running time excess  $ERT/ERT_{\text{best } 2009}$  on  $f_{101}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>101 Sphere moderate Gauss</b>												
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	
	0.10	0.10	2.6	4.0	18	19	19	20	21	23		
(1,2)-CMA-ES	<b>1</b>	50	13	14	4.3	5.1	6.0	6.7	7.4	8.8	(1,2)-CMA-ES [4, 2]	
(1,2m)-CMA-ES	<b>1</b>	14	7.1	7.8	<b>2.4</b>	3.2	3.8	4.2	4.6	5.5	(1,2m)-CMA-ES [4]	
(1,2ms)-CMA-ES	<b>1</b>	29	5.6	5.8	<b>1.9</b>	<b>2.5</b>	<b>3.0</b>	3.4	3.8	4.5	(1,2ms)-CMA-ES [4]	
(1,2s)-CMA-ES	<b>1</b>	54	14	13	4.2	5.2	6.1	6.9	7.8	9.3	(1,2s)-CMA-ES [2]	
(1,4)-CMA-ES	<b>1</b>	10	5.1	6.0	<b>2.0</b>	<b>2.6</b>	<b>3.0</b>	3.5	3.8	4.7	(1,4)-CMA-ES [5, 3]	
(1,4m)-CMA-ES	<b>1</b>	10	4.0	5.0	<b>1.6</b>	<b>2.2</b>	<b>2.6</b>	3.0	3.3	4.1	(1,4m)-CMA-ES [5]	
(1,4ms)-CMA-ES	<b>1</b>	12	<b>3.0</b>	<b>3.9</b>	<b>1.3</b>	<b>1.7</b>	<b>2.0</b>	<b>2.3</b>	<b>2.6</b>	<b>3.2</b>	(1,4ms)-CMA-ES [1, 5]	
(1,4s)-CMA-ES	<b>1</b>	14	4.7	5.4	<b>1.7</b>	<b>2.2</b>	<b>2.6</b>	<b>3.0</b>	3.3	4.0	(1,4s)-CMA-ES [3]	
avg NEWUOA	<b>1</b>	20	<b>2.9</b>	<b>3.4</b>	<b>0.99</b>	<b>1.2</b>	<b>1.2</b>	<b>1.3</b>	<b>1.3</b>	<b>1.4</b>	avg NEWUOA [16]	
CMA-EGS (IPOP,r1)	153	253	33	32	8.5	10	11	12	12	14	CMA-EGS (IPOP,r1) [8]	
IPOP-aCMA-ES	<b>1</b>	<b>6.6</b>	5.1	7.2	<b>2.4</b>	3.2	3.8	4.5	5.0	6.1	IPOP-aCMA-ES [12]	
IPOP-CMA-ES	<b>1</b>	11	5.6	7.4	<b>2.5</b>	3.4	4.1	4.7	5.2	6.1	IPOP-CMA-ES [15]	
CMA+DE-MOS	<b>1</b>	<b>5.9</b>	17	33	8.8	12	15	16	18	22	CMA+DE-MOS [13]	
NEWUOA	<b>1</b>	15	<b>2.1</b>	<b>3.0</b>	<b>1.0</b>	<b>1.6</b>	<b>1.9</b>	<b>2.1</b>	<b>2.3</b>	<b>2.9</b>	NEWUOA [16]	
Basic RCGA	<b>1</b>	<b>7.1</b>	28	63	28	46	121	229	288	377	Basic RCGA [17]	
SPSA	104	177	4405	5820	2316	4151	5693	6382	7916	<i>34e-5/1e5</i>	SPSA [9]	

Table 92: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{102}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>102 Sphere moderate Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 2.6	1e+00 4.1	1e-01 20	1e-02 21	1e-03 23	1e-04 24	1e-05 27	1e-07 30	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	50	15	15	4.4	5.2	5.7	6.4	6.8	7.9	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	25	7.3	7.7	<b>2.3</b>	<b>2.8</b>	3.1	3.6	3.7	4.1	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	23	4.9	6.3	<b>1.9</b>	<b>2.3</b>	<b>2.6</b>	<b>2.9</b>	3.1	3.5	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	26	22	21	5.8	6.6	7.4	8.2	8.6	12	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	21	5.8	6.4	<b>2.0</b>	<b>2.5</b>	<b>2.9</b>	3.2	3.4	3.8	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	7.7	4.6	5.1	<b>1.6</b>	<b>1.9</b>	<b>2.2</b>	<b>2.6</b>	<b>2.7</b>	3.1	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	14	<b>3.6</b>	<b>4.4</b>	<b>1.3</b>	<b>1.6</b>	<b>1.9</b>	<b>2.1</b>	<b>2.2</b>	<b>2.5</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	17	4.7	<b>4.9</b>	<b>1.6</b>	<b>2.0</b>	<b>2.2</b>	<b>2.5</b>	<b>2.7</b>	<b>3.0</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	31	<b>2.9</b>	<b>3.2</b>	<b>0.89</b>	<b>1.1</b>	<b>1.2</b>	<b>1.3</b>	<b>1.4</b>	<b>1.7</b>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	147	242	35	32	8.9	10	10	11	11	11	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	10	5.0	6.9	<b>2.2</b>	<b>2.8</b>	3.3	3.7	4.0	4.4	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>6.0</b>	5.3	7.2	<b>2.3</b>	<b>2.9</b>	3.3	3.8	4.0	4.4	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>5.9</b>	19	32	8.3	11	13	13	15	16	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	18	<b>3.5</b>	7.9	8.0	30	48	81	146	547	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>4.1</b>	26	57	26	42	102	193	234	285	Basic RCGA [17]
SPSA	124	183	1.56e5	3.44e5	<i>21e+0/1e5</i>	.	.	.	.	.	SPSA [9]

Table 93: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{103}$  in **10-D**, 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										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 2.6	1e+00 4.7	1e-01 13	1e-02 14	1e-03 36	1e-04 36	1e-05 36	1e-07 36	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	34	14	12	6.4	7.4	3.6	4.3	5.2	6.8	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	27	6.8	6.4	3.3	4.0	<b>2.1</b>	<b>2.5</b>	<b>3.0</b>	3.8	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	16	6.1	6.0	3.0	3.5	<b>1.7</b>	<b>2.1</b>	<b>2.4</b>	3.1	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	26	12	11	5.5	6.3	3.1	3.8	4.7	6.1	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	16	5.8	5.7	<b>3.0</b>	3.6	<b>1.8</b>	<b>2.2</b>	<b>2.6</b>	3.5	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	13	4.7	4.6	<b>2.6</b>	<b>3.1</b>	<b>1.5</b>	<b>1.9</b>	<b>2.2</b>	<b>2.9</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	14	<b>3.5</b>	<b>3.4</b>	<b>1.9</b>	<b>2.2</b>	<b>1.1</b>	<b>1.4</b>	<b>1.6</b>	<b>2.1</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	17	4.8	4.4	<b>2.4</b>	<b>2.8</b>	<b>1.4</b>	<b>1.7</b>	<b>2.1</b>	<b>2.7</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	31	<b>3.0</b>	<b>2.9</b>	<b>1.8</b>	6.8	25	100	1518	<i>39e-6/8e3</i>	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	121	223	32	25	12	12	5.5	6.6	7.7	10	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>7.8</b>	4.9	6.0	3.5	4.2	<b>2.1</b>	<b>2.6</b>	3.1	4.0	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	11	5.0	6.0	3.4	4.2	<b>2.1</b>	<b>2.6</b>	3.1	4.0	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>5.9</b>	16	28	13	17	8.4	11	13	18	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	15	<b>2.3</b>	<b>3.6</b>	5.2	29	95	243	1050	<i>15e-5/6e3</i>	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>5.3</b>	33	55	43	74	83	157	201	253	Basic RCGA [17]
SPSA	105	725	112	109	57	88	1065	4244	<i>18e-5/1e5</i>	.	SPSA [9]











Table 98: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{108}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>108 Sphere Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 1002	1e+00 3143	1e-01 4759	1e-02 7751	1e-03 10929	1e-04 13571	1e-05 17900	1e-07 30809	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1016	<i>28e+0/1e4</i>	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1587	<i>26e+0/1e4</i>	.	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	926	<i>29e+0/1e4</i>	.	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	758	<i>27e+0/1e4</i>	.	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	924	67	<i>18e+0/1e4</i>	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	965	149	<i>17e+0/1e4</i>	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	707	33	<i>16e+0/1e4</i>	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	896	<i>22e+0/1e4</i>	.	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1432	<i>27e+0/7e3</i>	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	11234	22743	<b>4.5</b>	<b>3.5</b>	<b>4.3</b>	<b>4.4</b>	<b>4.6</b>	<b>4.9</b>	<b>7.5</b>	<b>12</b>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	376	<b>1.0</b>	<b>0.63</b>	<b>0.98</b>	<b>0.88</b>	<b>0.98</b>	<b>1.0</b>	<b>1.1</b>	<b>0.88</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>63</b>	<b>0.78</b>	<b>0.64</b>	<b>0.69</b>	<b>0.77</b>	<b>0.70</b>	<b>0.82</b>	<b>0.78</b>	<b>0.77</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>5.9</b>	46	479	<i>74e-1/1e5</i>	.	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	1	593	<i>28e+0/4e3</i>	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	<b>5.1</b>	4.6	225	<i>21e-1/5e4</i>	.	.	.	.	.	Basic RCGA [17]
SPSA	3022	8166	5.7	22	<i>78e-2/1e5</i>	.	.	.	.	.	SPSA [9]

Table 99: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>109 Sphere Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 2.8	1e+00 29	1e-01 50	1e-02 82	1e-03 116	1e-04 146	1e-05 179	1e-07 242	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	55	15	<b>2.5</b>	<b>2.8</b>	<b>2.3</b>	<b>2.2</b>	<b>2.2</b>	<b>2.3</b>	<b>2.5</b>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	31	6.0	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>0.98</b>	<b>1.0</b>	<b>1.0</b>	<b>1.1</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	28	5.8	<b>1.0</b>	<b>0.94</b>	<b>0.83</b>	<b>0.77</b>	<b>0.79</b>	<b>0.78</b>	<b>0.75</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	55	14	<b>2.6</b>	<b>2.4</b>	<b>1.9</b>	<b>1.8</b>	<b>1.8</b>	<b>2.0</b>	<b>2.1</b>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	16	5.4	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	13	<b>4.2</b>	<b>0.84</b>	<b>0.83</b>	<b>0.83</b>	<b>0.82</b>	<b>0.81</b>	<b>0.83</b>	<b>0.87</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	12	<b>3.4</b>	<b>0.69</b>	<b>0.66</b>	<b>0.55</b>	<b>0.52</b>	<b>0.52</b>	<b>0.52</b>	<b>0.53</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	19	4.4	<b>0.99</b>	<b>0.94</b>	<b>0.83</b>	<b>0.77</b>	<b>0.77</b>	<b>0.76</b>	<b>0.77</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	20	11	38	665	<i>31e-2/7e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	125	202	31	4.7	3.5	485	<i>49e-4/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	10	4.5	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>6.3</b>	<b>4.4</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>5.9</b>	16	4.6	4.8	4.5	4.9	5.0	5.3	5.6	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	16	12	77	<i>57e-2/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>4.4</b>	28	10	12	23	47	48	46	41	Basic RCGA [17]
SPSA	101	733	495	368	13065	<i>36e-2/1e5</i>	.	.	.	.	SPSA [9]



Table 101: Running time excess  $ERT/ERT_{\text{best}} 2009$  on  $f_{111}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>111 Rosenbrock Uniform</b>											
$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{\text{target}}$ $ERT_{\text{best}}/D$
	384	1951	8293	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	$\infty$	
(1,2)-CMA-ES	380	<i>68e+2/1e4</i>	.	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	371	<i>45e+2/1e4</i>	.	.	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<i>76e+2/1e4</i>	.	.	.	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<i>65e+2/1e4</i>	.	.	.	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<i>46e+2/1e4</i>	.	.	.	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	121	<i>21e+2/1e4</i>	.	.	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	120	<i>43e+2/1e4</i>	.	.	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	388	<i>46e+2/1e4</i>	.	.	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	263	<i>10e+3/7e3</i>	.	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	11	5.3	<b>7.9</b>	<i>93e-1/1e5</i>	.	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>0.79</b>	<b>0.47</b>	<b>0.72</b>	<i>70e-1/9e5</i>	.	.	.	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>0.63</b>	<b>0.57</b>	<b>0.85</b>	<i>70e-1/1e6</i>	.	.	.	.	.	.	IPOP-CMA-ES [15]
CMA+DE-MOS	17	17	15	<i>89e-1/1e5</i>	.	.	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	<i>74e+2/4e3</i>	.	.	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>0.93</b>	<b>0.57</b>	25	<i>10e+0/5e4</i>	.	.	.	.	.	.	Basic RCGA [17]
SPSA	9.2	35	<i>87e+0/1e5</i>	.	.	.	.	.	.	.	SPSA [9]





















Table 111: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{121}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>121 Sum of diff powers Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 7.2	1e+00 32	1e-01 63	1e-02 148	1e-03 368	1e-04 694	1e-05 999	1e-07 1821	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	20	5.8	3.3	3.0	<b>2.7</b>	<b>2.3</b>	<b>2.7</b>	4.0	80	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	10	<b>2.4</b>	<b>1.3</b>	<b>1.2</b>	<b>1.0</b>	<b>0.95</b>	<b>1.1</b>	<b>1.4</b>	<b>2.0</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	5.1	<b>1.7</b>	<b>0.92</b>	<b>0.93</b>	<b>0.71</b>	<b>0.66</b>	<b>0.70</b>	<b>0.89</b>	<b>1.3</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	17	4.5	<b>2.9</b>	<b>2.4</b>	<b>2.1</b>	<b>2.6</b>	4.1	5.8	81	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	9.1	<b>1.5</b>	<b>1.2</b>	<b>1.3</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.5</b>	<b>1.4</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	13	<b>1.3</b>	<b>0.91</b>	<b>0.93</b>	<b>0.85</b>	<b>0.77</b>	<b>0.83</b>	<b>1.0</b>	<b>1.1</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	10	<b>1.1</b>	<b>0.71</b>	<b>0.61</b>	<b>0.48</b>	<b>0.44</b>	<b>0.46</b>	<b>0.51</b>	<b>0.57</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	11	<b>1.1</b>	<b>1.00</b>	<b>0.90</b>	<b>0.75</b>	<b>0.65</b>	<b>0.61</b>	<b>0.74</b>	<b>0.81</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	15	<b>2.1</b>	153	1671	<i>76e-2/7e3</i>	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	142	200	8.6	5.0	4.1	9513	<i>20e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	7.1	<b>1.4</b>	<b>1.0</b>	<b>1.1</b>	<b>0.94</b>	<b>0.78</b>	<b>0.70</b>	<b>0.72</b>	<b>0.69</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>4.3</b>	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.0</b>	<b>1.2</b>	<b>1.5</b>	<b>1.7</b>	<b>2.0</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	<b>3.0</b>	4.2	4.0	4.2	3.7	<b>2.9</b>	<b>2.5</b>	<b>2.6</b>	<b>2.3</b>	CMA+DE-MOS [13]
NEWUOA	1	7.9	3.4	215	<i>11e-1/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	<b>1.9</b>	3.3	12	12	23	423	<i>22e-4/5e4</i>	.	.	Basic RCGA [17]
SPSA	100	206	236	20545	<i>46e-1/1e5</i>	.	.	.	.	.	SPSA [9]









Table 115: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{125}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>125 Griewank-Rosenbrock Gauss</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 0.10	1e+00 0.10	1e-01 0.10	1e-02 1.05e5	1e-03 2.97e5	1e-04 6.38e5	1e-05 6.40e5	1e-07 6.44e5	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	2738	<i>50e-2/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	1214	<i>39e-2/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	469	<i>41e-2/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	4806	<i>54e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	947	<i>38e-2/1e4</i>	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	381	<i>37e-2/1e4</i>	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	500	<i>34e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	1304	<i>40e-2/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	5.9	<b>39</b>	<i>19e-2/7e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	129	163	186	372	<b>2.30e5</b>	<b>3.2</b>	<i>14e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	115	<b>2.71e5</b>	<b>0.66</b>	<b>0.57</b>	<b>0.40</b>	<b>0.41</b>	<b>0.41</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>94</b>	<b>2.69e5</b>	<b>0.82</b>	<b>0.70</b>	<b>0.43</b>	<b>0.43</b>	<b>0.44</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	426	3.25e5	15	<i>26e-3/1e5</i>	.	.	.	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	3.8	<b>84</b>	<i>22e-2/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	178	4.66e5	<i>88e-3/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	71510	71522	71531	71588	2.87e6	<i>12e-2/1e5</i>	.	.	.	.	SPSA [9]



Table 117: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{127}$  in **10-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>127 Griewank-Rosenbrock Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.10	1e+02 0.10	1e+01 0.10	1e+00 0.10	1e-01 0.10	1e-02 79920	1e-03 1.35e5	1e-04 2.06e5	1e-05 2.08e5	1e-07 2.11e5	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	1	418	<i>30e-2/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	137	4.77e5	<i>18e-2/1e4</i>	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	131	1.43e6	<i>22e-2/1e4</i>	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1	534	<i>34e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	116	2.11e5	<i>15e-2/1e4</i>	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	78	1.59e5	<i>11e-2/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	99	1.46e5	<i>12e-2/1e4</i>	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	122	4.70e5	<i>15e-2/1e4</i>	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	1	40	<i>20e-2/7e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	115	148	159	397	4.47e5	<i>72e-3/1e5</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	1	<b>78</b>	<b>75310</b>	<b>0.40</b>	<b>0.57</b>	<b>0.49</b>	<b>0.49</b>	<b>0.50</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	1	<b>66</b>	<b>1.08e5</b>	<b>0.63</b>	<b>0.80</b>	<b>0.62</b>	<b>0.63</b>	<b>0.64</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>1.1</b>	273	<b>35137</b>	<b>1.0</b>	<i>66e-4/1e5</i>	.	.	.	CMA+DE-MOS [13]
NEWUOA	1	1	<b>2.4</b>	79	<i>25e-2/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	1	<b>1.2</b>	206	2.25e5	<i>25e-3/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	112	144	652	1.34e5	1.41e7	<i>59e-2/1e5</i>	.	.	.	.	SPSA [9]











Table 122: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{102}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>102 Sphere moderate Uniform</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.29	1e+01 12	1e+00 20	1e-01 29	1e-02 38	1e-03 46	1e-04 49	1e-05 58	1e-07 70	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	109	5.0	4.1	3.7	3.7	4.1	5.0	5.3	10	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	54	<b>2.5</b>	<b>2.0</b>	<b>1.8</b>	<b>1.7</b>	<b>1.7</b>	<b>1.8</b>	<b>1.7</b>	<b>1.8</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	44	<b>1.9</b>	<b>1.6</b>	<b>1.4</b>	<b>1.4</b>	<b>1.3</b>	<b>1.5</b>	<b>1.5</b>	<b>1.5</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	143	6.0	4.7	4.4	5.5	7.4	13	18	50	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	34	<b>2.0</b>	<b>1.8</b>	<b>1.6</b>	<b>1.6</b>	<b>1.6</b>	<b>1.7</b>	<b>1.7</b>	<b>1.8</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	28	<b>1.5</b>	<b>1.4</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	19	<b>1.2</b>	<b>1.0</b>	<b>0.99</b>	<b>0.97</b>	<b>0.97</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	28	<b>1.5</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.3</b>	<b>1.4</b>	<b>1.4</b>	<b>1.6</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	19	<b>0.92</b>	<b>1.1</b>	<b>0.93</b>	<b>0.90</b>	<b>0.88</b>	<b>0.99</b>	1.1	1.3	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	291	131	10	7.7	6.1	5.3	4.8	4.9	4.5	4.3	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	11	<b>1.5</b>	<b>1.6</b>	<b>1.6</b>	<b>1.5</b>	<b>1.6</b>	<b>1.7</b>	<b>1.7</b>	<b>1.8</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	15	<b>1.6</b>	<b>1.6</b>	<b>1.6</b>	<b>1.5</b>	<b>1.6</b>	<b>1.8</b>	<b>1.7</b>	<b>1.8</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	47	9.0	6.3	5.1	5.6	5.8	5.8	5.7	6.1	CMA+DE-MOS [13]
NEWUOA	1	10	<b>2.9</b>	6.1	6.3	22	45	505	<i>31e-5/5e3</i>	.	NEWUOA [16]
Basic RCGA	1	30	11	15	56	152	178	203	200	195	Basic RCGA [17]
SPSA	218	212	<i>43e+0/1e5</i>	.	.	.	.	.	.	.	SPSA [9]

Table 123: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{103}$  in **20-D**, 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										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.28	1e+01 3.3	1e+00 21	1e-01 31	1e-02 52	1e-03 66	1e-04 80	1e-05 95	1e-07 123	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	119	18	3.7	3.1	<b>2.3</b>	<b>2.2</b>	<b>2.1</b>	<b>2.1</b>	<b>2.0</b>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	51	7.7	<b>1.7</b>	<b>1.6</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	39	6.4	<b>1.5</b>	<b>1.3</b>	<b>1.00</b>	<b>0.95</b>	<b>0.92</b>	<b>0.89</b>	<b>0.88</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	103	15	3.1	<b>2.7</b>	<b>2.1</b>	<b>2.1</b>	<b>2.0</b>	<b>2.0</b>	<b>1.9</b>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	36	6.3	<b>1.5</b>	<b>1.4</b>	<b>1.0</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	28	5.1	<b>1.3</b>	<b>1.2</b>	<b>0.93</b>	<b>0.91</b>	<b>0.90</b>	<b>0.88</b>	<b>0.87</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	23	<b>4.3</b>	<b>0.99</b>	<b>0.92</b>	<b>0.70</b>	<b>0.67</b>	<b>0.66</b>	<b>0.65</b>	<b>0.63</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	32	5.2	<b>1.3</b>	<b>1.2</b>	<b>0.88</b>	<b>0.86</b>	<b>0.84</b>	<b>0.83</b>	<b>0.82</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	19	<b>3.0</b>	<b>0.95</b>	<b>2.0</b>	20	655	<i>14e-4/1e4</i>	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	305	146	36	7.4	5.6	3.8	3.3	3.1	3.1	<b>3.0</b>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	<b>14</b>	5.4	<b>1.5</b>	<b>1.5</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>13</b>	5.5	<b>1.5</b>	<b>1.4</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	<b>1.2</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	33	23	6.0	4.6	4.0	4.1	4.3	4.2	4.4	CMA+DE-MOS [13]
NEWUOA	1	<b>9.5</b>	<b>2.3</b>	<b>1.00</b>	5.9	44	1231	<i>48e-4/5e3</i>	.	.	NEWUOA [16]
Basic RCGA	1	26	32	13	72	230	212	195	179	151	Basic RCGA [17]
SPSA	352	615	125	31	30	34	84	17508	<i>37e-5/1e5</i>	.	SPSA [9]













Table 129: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>109 Sphere Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.28	1e+01 17	1e+00 32	1e-01 57	1e-02 84	1e-03 114	1e-04 150	1e-05 179	1e-07 248	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	107	3.6	3.5	<b>2.7</b>	<b>2.7</b>	<b>2.4</b>	<b>2.3</b>	<b>2.3</b>	<b>2.2</b>	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	56	<b>1.7</b>	<b>1.5</b>	<b>1.4</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>0.96</b>	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	35	<b>1.3</b>	<b>1.2</b>	<b>0.97</b>	<b>0.90</b>	<b>0.84</b>	<b>0.77</b>	<b>0.77</b>	<b>0.72</b>	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	107	3.4	<b>2.8</b>	<b>2.3</b>	<b>2.1</b>	<b>2.0</b>	<b>1.9</b>	<b>1.8</b>	<b>1.8</b>	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	34	<b>1.3</b>	<b>1.4</b>	<b>1.3</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	20	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>0.96</b>	<b>0.95</b>	<b>0.91</b>	<b>0.91</b>	<b>0.88</b>	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	25	<b>0.92</b>	<b>0.81</b>	<b>0.67</b>	<b>0.62</b>	<b>0.57</b>	<b>0.53</b>	<b>0.52</b>	<b>0.50</b>	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	33	<b>1.1</b>	<b>1.0</b>	<b>0.89</b>	<b>0.79</b>	<b>0.73</b>	<b>0.68</b>	<b>0.70</b>	<b>0.68</b>	(1,4s)-CMA-ES [3]
avg NEWUOA	1	19	17	<i>25e-1/9e3</i>	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	325	141	7.1	5.4	3.7	16693	<i>19e-3/1e5</i>	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	<b>12</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	<b>15</b>	<b>1.1</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	<b>1.00</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	50	6.2	4.1	4.3	4.3	4.2	4.1	4.1	4.0	CMA+DE-MOS [13]
NEWUOA	1	<b>10</b>	17	<i>33e-1/4e3</i>	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	34	7.4	10	117	127	111	97	87	70	Basic RCGA [17]
SPSA	311	551	54	2319	5124	<i>30e-2/1e5</i>	.	.	.	.	SPSA [9]

























Table 141: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{121}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>121 Sum of diff powers Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.05	1e+01 12	1e+00 38	1e-01 71	1e-02 172	1e-03 465	1e-04 1099	1e-05 1722	1e-07 2870	$\Delta f_{target}$ $ERT_{best}/D$	
(1,2)-CMA-ES	1	217	4.8	3.4	<b>3.0</b>	<b>2.3</b>	<b>1.9</b>	<b>1.8</b>	3.8	<i>35e-7/1e4</i>	(1,2)-CMA-ES [4, 2]	
(1,2m)-CMA-ES	1	163	<b>2.2</b>	<b>1.4</b>	<b>1.2</b>	<b>0.93</b>	<b>0.81</b>	<b>0.69</b>	<b>0.80</b>	6.2	(1,2m)-CMA-ES [4]	
(1,2ms)-CMA-ES	1	133	<b>1.9</b>	<b>1.2</b>	<b>1.0</b>	<b>0.74</b>	<b>0.58</b>	<b>0.51</b>	<b>0.59</b>	5.3	(1,2ms)-CMA-ES [4]	
(1,2s)-CMA-ES	1	215	4.5	<b>2.8</b>	<b>2.7</b>	<b>1.9</b>	<b>1.5</b>	<b>1.5</b>	3.8	<i>44e-7/1e4</i>	(1,2s)-CMA-ES [2]	
(1,4)-CMA-ES	1	62	<b>1.8</b>	<b>1.5</b>	<b>1.4</b>	<b>1.1</b>	<b>0.87</b>	<b>0.79</b>	<b>1.0</b>	<b>2.1</b>	(1,4)-CMA-ES [5, 3]	
(1,4m)-CMA-ES	1	26	<b>1.4</b>	<b>1.1</b>	<b>1.0</b>	<b>0.87</b>	<b>0.73</b>	<b>0.62</b>	<b>0.75</b>	<b>1.2</b>	(1,4m)-CMA-ES [5]	
(1,4ms)-CMA-ES	1	43	<b>1.1</b>	<b>0.80</b>	<b>0.71</b>	<b>0.52</b>	<b>0.41</b>	<b>0.35</b>	<b>0.39</b>	<b>0.53</b>	(1,4ms)-CMA-ES [1, 5]	
(1,4s)-CMA-ES	1	24	<b>1.5</b>	<b>1.1</b>	<b>0.90</b>	<b>0.69</b>	<b>0.55</b>	<b>0.46</b>	<b>0.58</b>	<b>0.98</b>	(1,4s)-CMA-ES [3]	
avg NEWUOA	1	82	49	<i>40e-1/9e3</i>	.	.	.	.	.	.	avg NEWUOA [16]	
CMA-EGS (IPOP,r1)	301	475	8.1	5.5	5.5	<i>46e-3/1e5</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]	
IPOP-aCMA-ES	1	20	<b>1.2</b>	<b>1.0</b>	<b>1.1</b>	<b>0.98</b>	<b>0.77</b>	<b>0.58</b>	<b>0.56</b>	<b>0.64</b>	IPOP-aCMA-ES [12]	
IPOP-CMA-ES	1	<b>1.8</b>	<b>1.3</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.2</b>	<b>1.4</b>	<b>1.9</b>	IPOP-CMA-ES [15]	
CMA+DE-MOS	1	<b>5.1</b>	6.6	3.4	3.7	3.4	<b>2.5</b>	<b>2.3</b>	<b>2.2</b>	<b>2.2</b>	CMA+DE-MOS [13]	
NEWUOA	1	29	31	<i>52e-1/4e3</i>	.	.	.	.	.	.	NEWUOA [16]	
Basic RCGA	1	<b>5.3</b>	5.0	10	36	76	<i>41e-4/5e4</i>	.	.	.	Basic RCGA [17]	
SPSA	210	876	12355	<i>10e+0/1e5</i>	.	.	.	.	.	.	SPSA [9]	









Table 145: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{125}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>125 Griewank-Rosenbrock Gauss</b>											
$\frac{\Delta f_{target}}{ERT_{best}/D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\frac{\Delta f_{target}}{ERT_{best}/D}$
	0.05	0.05	0.05	0.05	0.05	6.24e5	1.25e6	3.12e6	4.01e6	4.03e6	
(1,2)-CMA-ES	1	1	1	9.05e5	<i>12e-1/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	1.46e5	<i>94e-2/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	1.22e5	<i>96e-2/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1	<i>13e-1/1e4</i>	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	1.61e5	<i>95e-2/1e4</i>	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	81397	<i>88e-2/1e4</i>	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	81829	<i>95e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	2.36e5	<i>10e-1/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	1	<b>493</b>	<i>45e-2/9e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	283	321	364	738	<i>9.45e6</i>	<i>23e-2/1e5</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	1	827	<b>3.85e6</b>	<b>0.47</b>	<b>1.1</b>	<b>0.81</b>	<b>1.7</b>	<b>1.7</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	1	957	7.10e6	<b>0.70</b>	<b>0.79</b>	<b>0.56</b>	<b>1.8</b>	<b>1.8</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	1.1	1527	6.76e6	<i>18e-2/1e5</i>	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	1	1	1	<b>414</b>	<i>49e-2/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	1	1.1	<b>322</b>	<b>2.34e6</b>	<i>33e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	1.00e6	1.00e6	1.00e6	1.00e6	<b>3.44e6</b>	<i>12e-2/1e5</i>	.	.	.	.	SPSA [9]

Table 146: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{126}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>126 Griewank-Rosenbrock Uniform</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.05	1e+01 0.05	1e+00 0.05	1e-01 0.05	1e-02 $\infty$	1e-03 $\infty$	1e-04 $\infty$	1e-05 $\infty$	1e-07 $\infty$	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	1	<i>15e-1/1e4</i>	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	<i>15e-1/1e4</i>	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	<i>15e-1/1e4</i>	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1	<i>14e-1/1e4</i>	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	<i>14e-1/1e4</i>	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	<i>13e-1/1e4</i>	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	2.92e6	<i>13e-1/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	2.86e6	<i>13e-1/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	122	2.60e6	<i>16e-1/9e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	2514	3109	3338	13054	<i>33e-2/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	1	6417	<i>30e-2/2e5</i>	.	.	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	1	<b>5759</b>	<i>28e-2/2e5</i>	.	.	.	.	.	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>1.1</b>	<b>1527</b>	<i>39e-2/1e5</i>	.	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	1	1	4.2	1.32e5	<i>12e-1/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	1	<b>1.1</b>	<b>335</b>	<b>4.18e6</b>	<i>32e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	2.80e7	2.80e7	2.80e7	2.80e7	<i>45e+3/1e5</i>	.	.	.	.	.	SPSA [9]

Table 147: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{127}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>127 Griewank-Rosenbrock Cauchy</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.05	1e+01 0.05	1e+00 0.05	1e-01 0.05	1e-02 79507	1e-03 2.22e5	1e-04 3.40e5	1e-05 3.63e5	1e-07 3.71e5	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	1	1	1	7537	<i>70e-2/1e4</i>	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	1	1	1	595	<i>52e-2/1e4</i>	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	1	1	1	843	<i>48e-2/1e4</i>	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	1	1	1	7404	<i>67e-2/1e4</i>	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	1	1	1	1139	<i>44e-2/1e4</i>	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	1	1	1	756	2.91e6	<i>39e-2/1e4</i>	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	1	1	1	654	<i>23e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	1	1	1	1149	<i>53e-2/1e4</i>	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	1	1	7.7	<b>219</b>	<i>43e-2/9e3</i>	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	292	335	353	754	<i>28e-2/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	1	1	1	<b>193</b>	<b>2.82e5</b>	<b>0.75</b>	<b>1.0</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	1	1	1	267	<b>9.58e5</b>	<b>1.0</b>	<b>0.81</b>	<b>0.89</b>	<b>0.84</b>	<b>0.85</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	1	1	<b>1.1</b>	1526	<b>2.24e5</b>	<i>44e-3/1e5</i>	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	1	1	3.7	<b>253</b>	<i>45e-2/4e3</i>	.	.	.	.	.	NEWUOA [16]
Basic RCGA	1	1	1	314	1.07e6	<i>59e-3/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	226	276	960	2.30e6	8.02e6	<i>10e-1/1e5</i>	.	.	.	.	SPSA [9]

Table 148: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{128}$  in **20-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>128 Gallagher Gauss</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.05	1e+02 0.05	1e+01 7017	1e+00 6.69e5	1e-01 8.61e5	1e-02 8.61e5	1e-03 8.61e5	1e-04 8.62e5	1e-05 8.62e5	1e-07 8.62e5	$\Delta f_{target}$ $ERT_{best}/D$
(1,2)-CMA-ES	<b>1</b>	<b>1</b>	<i>71e+0/1e4</i>	.	.	.	.	.	.	.	(1,2)-CMA-ES [4, 2]
(1,2m)-CMA-ES	<b>1</b>	<b>1</b>	<i>65e+0/1e4</i>	.	.	.	.	.	.	.	(1,2m)-CMA-ES [4]
(1,2ms)-CMA-ES	<b>1</b>	<b>1</b>	<i>66e+0/1e4</i>	.	.	.	.	.	.	.	(1,2ms)-CMA-ES [4]
(1,2s)-CMA-ES	<b>1</b>	<b>1</b>	<i>70e+0/1e4</i>	.	.	.	.	.	.	.	(1,2s)-CMA-ES [2]
(1,4)-CMA-ES	<b>1</b>	<b>1</b>	<i>66e+0/1e4</i>	.	.	.	.	.	.	.	(1,4)-CMA-ES [5, 3]
(1,4m)-CMA-ES	<b>1</b>	<b>1</b>	<i>64e+0/1e4</i>	.	.	.	.	.	.	.	(1,4m)-CMA-ES [5]
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<i>65e+0/1e4</i>	.	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
(1,4s)-CMA-ES	<b>1</b>	<b>1</b>	<i>68e+0/1e4</i>	.	.	.	.	.	.	.	(1,4s)-CMA-ES [3]
avg NEWUOA	<b>1</b>	<b>1</b>	<i>69e+0/9e3</i>	.	.	.	.	.	.	.	avg NEWUOA [16]
CMA-EGS (IPOP,r1)	284	367	<b>1.8</b>	<b>0.12</b>	<b>0.12</b>	<b>0.12</b>	<b>0.12</b>	<b>0.16</b>	<b>0.16</b>	<b>0.17</b>	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>0.51</b>	<b>0.72</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	12	<b>1.0</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	96	<i>50e+0/1e5</i>	.	.	.	.	.	.	CMA+DE-MOS [13]
NEWUOA	<b>1</b>	<b>1</b>	<i>70e+0/4e3</i>	.	.	.	.	.	.	.	NEWUOA [16]
Basic RCGA	<b>1</b>	<b>1</b>	<b>4.7</b>	<b>0.10</b>	<b>0.10</b>	<b>0.10</b>	<b>0.10</b>	<b>0.13</b>	<b>0.13</b>	<b>0.14</b>	Basic RCGA [17]
SPSA	309	350	<i>73e+0/1e5</i>	.	.	.	.	.	.	.	SPSA [9]











Table 153: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{103}$  in **40-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>103 Sphere moderate Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,4ms)-CMA-ES	<b>1</b>	<b>2.1</b>	<b>1.5</b>	<b>0.86</b>	<b>0.79</b>	<b>0.76</b>	<b>0.72</b>	<b>0.69</b>	<b>0.68</b>	<b>0.64</b>	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	739	16	14	7.7	6.1	5.1	4.4	4.0	3.9	3.8	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.5</b>	<b>1.7</b>	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.1</b>	<b>1.2</b>	<b>1.2</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.5</b>	<b>1.7</b>	<b>1.2</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	6.4	7.9	3.9	3.3	3.4	3.7	3.4	3.5	3.4	CMA+DE-MOS [13]
Basic RCGA	<b>1</b>	4.2	11	83	424	381	334	299	269	221	Basic RCGA [17]
SPSA	864	36	34	24	25	63	231	<i>52e-5/1e5</i>	.	.	SPSA [9]











Table 159: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{109}$  in **40-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

<b>109 Sphere Cauchy</b>											
$\Delta f_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$ $ERT_{best}/D$
(1,4ms)-CMA-ES	<b>1</b>	<b>1.5</b>	<b>0.94</b>	<b>0.85</b>	<b>0.68</b>	<b>0.61</b>	<b>0.56</b>	<b>0.52</b>	<b>0.50</b>	<b>0.48</b>	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	689	12	8.4	6.3	4.3	<i>38e-3/1e5</i>	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.1</b>	<b>1.0</b>	<b>1.0</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	5.1	4.9	3.5	3.9	3.2	3.3	3.2	3.1	3.1	CMA+DE-MOS [13]
Basic RCGA	<b>1</b>	3.4	8.2	251	234	194	161	139	122	98	Basic RCGA [17]
SPSA	683	30	371	1563	22528	<i>82e-2/1e5</i>	.	.	.	.	SPSA [9]











Table 164: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{114}$  in **40-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>114 Step-ellipsoid Uniform</b>										
$\Delta_{target}$ $ERT_{best}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta_{target}$ $ERT_{best}/D$
(1,4ms)-CMA-ES	<i>16e+2/1e4</i>	.	.	.	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	27	<b>3.1</b>	<b>34</b>	<i>25e+0/1e5</i>	.	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>4.0</b>	<b>0.72</b>	<b>0.52</b>	<b>0.41</b>	<b>0.35</b>	<b>0.45</b>	<b>0.45</b>	<b>0.45</b>	<b>0.45</b>	<b>0.45</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>4.3</b>	<b>0.72</b>	<b>0.60</b>	<b>0.75</b>	<b>0.66</b>	<b>0.65</b>	<b>0.65</b>	<b>0.65</b>	<b>0.65</b>	<b>0.65</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	167	<i>74e+1/1e5</i>	.	.	.	.	.	.	.	.	CMA+DE-MOS [13]
Basic RCGA	<b>1.2</b>	<i>32e+1/5e4</i>	.	.	.	.	.	.	.	.	Basic RCGA [17]
SPSA	26	<i>28e+1/1e5</i>	.	.	.	.	.	.	.	.	SPSA [9]























Table 175: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{125}$  in **40-D**, in *italics* is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>125 Griewank-Rosenbrock Gauss</b>										
$\Delta f_{target}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta f_{target}$
$ERT_{best}/D$	0.03	0.03	0.03	115	2.64e6	2.74e6	1.36e7	$\infty$	$\infty$	$\infty$	$ERT_{best}/D$
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<i>16e-1/1e4</i>	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	717	916	1032	<b>0.36</b>	<i>45e-2/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>2.9</b>	<b>0.21</b>	<b>0.40</b>	<b>0.40</b>	<i>95e-4/1e6</i>	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	3.2	<b>0.55</b>	<b>0.75</b>	<i>48e-2/3e5</i>	.	.	.	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>0.66</b>	<i>51e-2/1e5</i>	.	.	.	.	.	CMA+DE-MOS [13]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>0.10</b>	<b>0.08</b>	<i>52e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	<i>11e+4/1e5</i>	.	.	.	.	.	.	.	.	.	SPSA [9]



Table 176: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{126}$  in **40-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>126 Griewank-Rosenbrock Uniform</b>										
$\Delta f_{target}$ $ERT_{best}/D$	1e+03 0.03	1e+02 0.03	1e+01 0.03	1e+00 218	1e-01 $\infty$	1e-02 $\infty$	1e-03 $\infty$	1e-04 $\infty$	1e-05 $\infty$	1e-07 $\infty$	$\Delta f_{target}$ $ERT_{best}/D$
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<i>17e-1/1e4</i>	.	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	3014	3562	3755	<b>1.3</b>	<i>52e-2/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	3.8	<i>51e-2/2e5</i>	.	.	.	.	.	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	3.3	<i>50e-2/2e5</i>	.	.	.	.	.	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>0.35</b>	<i>54e-2/1e5</i>	.	.	.	.	.	CMA+DE-MOS [13]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1.1</b>	<b>0.06</b>	<b>1.36e7</b>	<i>55e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	2.60e7	2.60e7	2.60e7	2979	<i>93e+3/1e5</i>	.	.	.	.	.	SPSA [9]

Table 177: Running time excess  $ERT/ERT_{best}$  2009 on  $f_{127}$  in **40-D**, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	<b>127 Griewank-Rosenbrock Cauchy</b>										
$\Delta ftarget$ $ERT_{best}/D$	1e+03 0.03	1e+02 0.03	1e+01 0.03	1e+00 18	1e-01 44721	1e-02 2.63e5	1e-03 3.78e5	1e-04 6.24e5	1e-05 6.49e5	1e-07 6.66e5	$\Delta ftarget$ $ERT_{best}/D$
(1,4ms)-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	10	<i>78e-2/1e4</i>	.	.	.	.	.	(1,4ms)-CMA-ES [1, 5]
CMA-EGS (IPOP,r1)	711	818	968	<b>2.3</b>	<i>47e-2/1e5</i>	.	.	.	.	.	CMA-EGS (IPOP,r1) [8]
IPOP-aCMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>1.0</b>	<b>1.1</b>	<b>0.39</b>	<b>0.89</b>	<b>0.93</b>	<b>0.95</b>	<b>0.94</b>	IPOP-aCMA-ES [12]
IPOP-CMA-ES	<b>1</b>	<b>1</b>	<b>1</b>	<b>1.1</b>	3.6	<b>0.92</b>	<b>0.73</b>	<b>0.59</b>	<b>0.75</b>	<b>0.81</b>	IPOP-CMA-ES [15]
CMA+DE-MOS	<b>1</b>	<b>1</b>	<b>1.1</b>	4.3	<b>2.6</b>	<i>10e-2/1e5</i>	.	.	.	.	CMA+DE-MOS [13]
Basic RCGA	<b>1</b>	<b>1</b>	<b>1</b>	<b>0.57</b>	<b>3.1</b>	<i>16e-2/5e4</i>	.	.	.	.	Basic RCGA [17]
SPSA	431	527	4104	6726	31	<i>19e-1/1e5</i>	.	.	.	.	SPSA [9]







## References

- [1] Anne Auger, Dimo Brockhoff, and Nikolaus Hansen. Benchmarking the (1, 4)-CMA-ES with mirrored sampling and sequential selection on the noisy BBOB-2010 testbed. In Pelikan and Branke [14], pages 1625–1632.
- [2] Anne Auger, Dimo Brockhoff, and Nikolaus Hansen. Investigating the impact of sequential selection in the (1, 2)-CMA-ES on the noisy BBOB-2010 testbed. In Pelikan and Branke [14], pages 1605–1610.
- [3] Anne Auger, Dimo Brockhoff, and Nikolaus Hansen. Investigating the impact of sequential selection in the (1, 4)-CMA-ES on the noisy BBOB-2010 testbed. In Pelikan and Branke [14], pages 1611–1616.
- [4] Anne Auger, Dimo Brockhoff, and Nikolaus Hansen. Mirrored variants of the (1, 2)-CMA-ES compared on the noisy BBOB-2010 testbed. In Pelikan and Branke [14], pages 1575–1582.
- [5] Anne Auger, Dimo Brockhoff, and Nikolaus Hansen. Mirrored variants of the (1, 4)-CMA-ES compared on the noisy BBOB-2010 testbed. In Pelikan and Branke [14], pages 1583–1590.
- [6] Anne Auger, Steffen Finck, Nikolaus Hansen, and Raymond Ros. BBOB 2009: Comparison tables of all algorithms on all noisy functions. Technical Report RT-0384, INRIA, 04 2010.
- [7] S. Finck, N. Hansen, R. Ros, and A. Auger. Real-parameter black-box optimization benchmarking 2010: Presentation of the noisy functions. Technical Report 2009/21, Research Center PPE, 2010.
- [8] Steffen Finck and Hans-Georg Beyer. Benchmarking CMA-EGS on the BBOB 2010 noisy function testbed. In Pelikan and Branke [14], pages 1641–1648.
- [9] Steffen Finck and Hans-Georg Beyer. Benchmarking SPSA on BBOB-2010 noisy function testbed. In Pelikan and Branke [14], pages 1665–1672.
- [10] N. Hansen, A. Auger, S. Finck, and R. Ros. Real-parameter black-box optimization benchmarking 2010: Experimental setup. Technical Report RR-7215, INRIA, 2010.
- [11] N. Hansen, S. Finck, R. Ros, and A. Auger. Real-parameter black-box optimization benchmarking 2009: Noisy functions definitions. Technical Report RR-6869, INRIA, 2009. Updated February 2010.
- [12] Nikolaus Hansen and Raymond Ros. Benchmarking a weighted negative covariance matrix update on the BBOB-2010 noisy testbed. In Pelikan and Branke [14], pages 1681–1688.
- [13] Antonio LaTorre, Santiago Muelas, and José María Peña. Benchmarking a MOS-based algorithm on the BBOB-2010 noisy function testbed. In Pelikan and Branke [14], pages 1725–1730.

- [14] Martin Pelikan and Jürgen Branke, editors. *Genetic and Evolutionary Computation Conference, GECCO 2010, Proceedings, Portland, Oregon, USA, July 7-11, 2010, Companion Material*. ACM, 2010.
- [15] Raymond Ros. Black-box optimization benchmarking the IPOP-CMA-ES on the noisy testbed: comparison to the BIPOP-CMA-ES. In Pelikan and Branke [14], pages 1511–1518.
- [16] Raymond Ros. Comparison of NEWUOA with different numbers of interpolation points on the BBOB noisy testbed. In Pelikan and Branke [14], pages 1495–1502.
- [17] Thanh-Do Tran and Gang-Gyoo Jin. Benchmarking real-coded genetic algorithm on noisy black-box optimization testbed. In Pelikan and Branke [14], pages 1739–1744.



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Éditeur  
INRIA - Domaine de Voluceau - Rocquencourt, BP 105 - 78153 Le Chesnay Cedex (France)  
<http://www.inria.fr>  
ISSN 0249-0803