

Comparison tables: BBOB 2009 noisy testbed in 40-D

The BBOBies

November 20, 2009

Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2009, see <http://coco.gforge.inria.fr/doku.php?id=bbob-2009>. More than 30 algorithms have been tested on 24 benchmark functions in dimensions between 2 and 40. A description of the used objective functions can be found in [9, 5]. The experimental set-up is described in [8].

The performance measure provided in the following tables is the expected number of objective function evaluations to reach a given target function value (ERT, expected running time), divided by the respective value for the best algorithm. Consequently, the best (smallest) value is 1 and the value 1 appears in each column at least once. See [8] for details on how ERT is obtained. All numbers are computed with no more than two digits of precision.

Table 1: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{101} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

101 Sphere moderate Gauss											
Δf_{target} $\text{ERT}_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} $\text{ERT}_{\text{best}}/D$
ALPS	1	13	29	37	41	45	48	52	55	68	ALPS [11]
AMaLGaM IDEA	1	25	37	40	39	38	36	37	37	35	AMaLGaM IDEA [4]
BayEDAcG	1	37	40	39	38	38	41	<i>25e-5/2e3</i>	.	.	BayEDAcG [6]
BFGS	1	<i>30e+1/2e3</i>	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1	1	1	1	1	1	1	1	1	(1+1)-CMA-ES [2]
DASA	1	4.4	5	5.7	6.4	7.2	7.7	7.9	8.2	8.5	DASA [12]
DEPSO	1	4.7	9.8	31	<i>17e-2/2e3</i>	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	1	8.9	11	12	13	13	13	13	13	13	iAMaLGaM IDEA [4]
(1+1)-ES	1	2	2.6	2.3	2.3	2.8	3.4	4.4	4.7	13	(1+1)-ES [1]
Monte Carlo	1	<i>14e+1/1e6</i>	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEPP-CMA-ES	1	1.2	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	IPOP-SEPP-CMA-ES [13]

Table 2: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{102} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

102 Sphere moderate unif												
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	0.025	8.36	20.5	32.1	43.6	55.3	65.7	77.5	88.9	113	$\text{ERT}_{\text{best}}/D$	
ALPS	1	11	23	28	32	35	38	40	43	59	ALPS [11]	
AMaLGaM IDEA	1	22	30	27	27	26	27	26	26	26	AMaLGaM IDEA [4]	
BayEDAcG	1	30	29	28	28	28	28	<i>29e-5/2e3</i>	.	.	BayEDAcG [6]	
BFGS	1	<i>29e+1/2e3</i>	.	.	.	.	.	.	.	.	BFGS [14]	
BiPOP-CMA-ES	1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	BiPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	1.5	1.3	1.1	1	1.5	3.7	11	31	<i>19e-7/1e4</i>	(1+1)-CMA-ES [2]	
DASA	1	5.3	14	16	100	1200	6.6e4	<i>42e-4/3e5</i>	.	.	DASA [12]	
DEPSO	1	4	7.1	23	230	<i>16e-2/2e3</i>	.	.	.	.	DEPSO [7]	
iAMaLGaM IDEA	1	6.4	8	8.7	9.1	9.2	9.6	9.6	9.7	9.7	iAMaLGaM IDEA [4]	
(1+1)-ES	1	57	3900	4.4e5	<i>27e-1/1e6</i>	.	.	.	.	.	(1+1)-ES [1]	
Monte Carlo	1	<i>13e+1/1e6</i>	.	.	.	.	.	.	.	.	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]	

Table 3: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{103} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

103 Sphere moderate Cauchy												
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	0.025	5.92	13.2	30.6	42.3	54	68	81.6	95.4	124	$\text{ERT}_{\text{best}}/D$	
ALPS	1	15	34	28	120	<i>41e-3/1e5</i>	.	.	.	.	ALPS [11]	
AMaLGaM IDEA	1	24	47	30	26	24	22	36	68	130	AMaLGaM IDEA [4]	
BayEDAcG	1	41	44	29	28	31	29	<i>33e-5/2e3</i>	.	.	BayEDAcG [6]	
BFGS	1	73	48	29	21	17	13	12	10	8	BFGS [14]	
BIPOP-CMA-ES	1	1.5	1.7	1.1	1.1	1.1	1.1	1.1	1.1	1.1	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	1.3	1.1	1.1	5.3	1300	<i>13e-3/1e4</i>	.	.	.	(1+1)-CMA-ES [2]	
DASA	1	4.2	6.1	5.1	260	<i>36e-3/3e5</i>	.	.	.	.	DASA [12]	
DEPSO	1	5.2	12	62	<i>79e-2/2e3</i>	.	.	.	.	.	DEPSO [7]	
iAMaLGaM IDEA	1	9.8	13	9.1	12	21	49	85	350	560	iAMaLGaM IDEA [4]	
(1+1)-ES	1	1	1	1	6.5	2.3e4	<i>84e-4/1e6</i>	.	.	.	(1+1)-ES [1]	
Monte Carlo	1	<i>14e+1/1e6</i>	.	.	.	.	.	.	.	.	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1.3	1.5	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]	

Table 4: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{104} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

104 Rosenbrock moderate Gauss											
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
$\text{ERT}_{\text{best}}/D$	18.6	243	77200	89900	91400	92200	92600	93000	93400	94100	$\text{ERT}_{\text{best}}/D$
ALPS [11]	34	21	1	3.4	9.5	20	<i>14e-1/1e5</i>	.	.	.	ALPS [11]
AMaLGaM IDEA	23	3.3	4.1	3.7	3.7	3.7	3.7	3.7	3.7	3.7	AMaLGaM IDEA [4]
BayEDAcG	31	7.9	<i>63e+0/2e3</i>	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	<i>50e+4/1e3</i>	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1.4	1	1.1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1	<i>39e+0/1e4</i>	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	5.5	45	4.9	31	<i>74e-1/4e5</i>	.	.	.	.	.	DASA [12]
DEPSO	13	13	<i>96e+0/2e3</i>	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	9.4	1.3	18	20	23	28	28	27	27	27	iAMaLGaM IDEA [4]
(1+1)-ES	1.5	24	<i>45e+0/1e6</i>	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	<i>93e+3/1e6</i>	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1.3	5.3	<i>37e+0/1e4</i>	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 5: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{105} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
$\text{ERT}_{\text{best}}/D$	23.9	166	1.4e5	1.48e5	1.51e5	1.52e5	1.53e5	1.54e5	1.55e5	1.57e5	$\text{ERT}_{\text{best}}/D$	
ALPS [11]	25	36	<i>1.4</i>	3.6	<i>10e+0/1e5</i>	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	21	5.3	<i>35e+0/1e6</i>	.	.	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	25	14	<i>81e+0/2e3</i>	.	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	<i>46e+4/900</i>	.	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1.1	1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1.4	23	<i>72e+0/1e4</i>	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	6.9	2100	<i>96e+0/3e5</i>	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	10	32	<i>10e+1/2e3</i>	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	7.5	1.9	<i>35e+0/1e6</i>	.	.	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	20	4.4e4	<i>15e+1/1e6</i>	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	<i>99e+3/1e6</i>	.	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1	9.2	<i>38e+0/1e4</i>	.	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 6: 40-D, running time excess ERT/ERT_{best} on f_{106} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
ERT_{best}/D	16.9	47.9	1730	2270	2390	2450	2490	2520	2540	2600	ERT_{best}/D

106 Rosenbrock moderate Cauchy

Table 7: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{107} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

107 Sphere Gauss												
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	0.025	225	960	1440	1870	2170	2440	2720	3010	3620	$\text{ERT}_{\text{best}}/D$	
ALPS	1	<i>10</i>	<i>$35e+0/1e5$</i>	48	50	45	41	39	36	32	ALPS [11]	
AMaLGaM IDEA	1	1.5	15	48	50	45	41	39	36	32	AMaLGaM IDEA [4]	
BayEDA _{cG}	1	2.7	<i>$22e+0/2e3$</i>	48	50	45	41	39	36	32	BayEDA _{cG} [6]	
BFGS	1	<i>$22e+1/1e3$</i>	1	1	1	1	1	1	1	1	BFGS [14]	
BIPOP-CMA-ES	1	1.7	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	<i>$22e+1/1e4$</i>	1	1	1	1	1	1	1	1	(1+1)-CMA-ES [2]	
DASA	1	<i>$20e+1/2e5$</i>	1	1	1	1	1	1	1	1	DASA [12]	
DEPSO	1	<i>$19e+1/2e3$</i>	1	1	1	1	1	1	1	1	DEPSO [7]	
iAMaLGaM IDEA	1	1	130	110	140	170	150	140	130	110	iAMaLGaM IDEA [4]	
(1+1)-ES	1	<i>$17e+1/1e6$</i>	1	1	1	1	1	1	1	1	(1+1)-ES [1]	
Monte Carlo	1	<i>$13e+1/1e6$</i>	1	1	1	1	1	1	1	1	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	660	<i>$17e+1/1e4$</i>	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]	

Table 8: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{108} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	$\text{ERT}_{\text{best}}/D$	0.025	2340	5370	14000	23400	37400	45900	52500	70400	1.06e5	$\text{ERT}_{\text{best}}/D$
ALPS		1	120	<i>11e+1/1e5</i>								ALPS [11]
AMaLGaM IDEA		1	4.1	130	520	630	<i>46e-1/1e6</i>					AMaLGaM IDEA [4]
BayEDA _{CG}		1	<i>22e+1/2e3</i>									BayEDA _{CG} [6]
BFGS		1	<i>32e+1/800</i>									BFGS [14]
BIPOP-CMA-ES		1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES		1	<i>22e+1/1e4</i>									(1+1)-CMA-ES [2]
DASA		1	<i>23e+1/2e5</i>									DASA [12]
DEPSO		1	<i>31e+1/2e3</i>									DEPSO [7]
iAMaLGaM IDEA		1	20	270	520	<i>82e-1/1e6</i>						iAMaLGaM IDEA [4]
(1+1)-ES		1	<i>18e+1/1e6</i>									(1+1)-ES [1]
Monte Carlo		1	<i>14e+1/1e6</i>									Monte Carlo [3]
IPOP-SEP-CMA-ES		1	<i>29e+1/1e4</i>									IPOP-SEP-CMA-ES [13]

Table 9: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{109} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$\Delta \text{ftarget}$	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	$\Delta \text{ftarget}$
$\text{ERT}_{\text{best}}/D$	0.025	7.73	12	21	36.4	62.6	91.8	124	156	188	251	$\text{ERT}_{\text{best}}/D$
ALPS [11]	1	12	$1.4e4$	16	$11e+0/1e5$	15	46	.	.	.	.	ALPS [11]
AMaLGaM IDEA [4]	1	16	16	16	16	15	46	130	140	150	150	AMaLGaM IDEA [4]
BayEDA _c G [6]	1	31	28	28	26	23	46	$10e-3/2e3$	.	.	.	BayEDA _c G [6]
BFGS [14]	1	$33e+1/2e3$	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES [10]	1	1	1	1	1.1	1.1	1.1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES [2]	1	5.6	390	$37e+0/2e5$	$87e-1/1e4$	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA [12]	1	240	60	60	$62e-1/2e3$	.	.	.	.	.	.	DASA [12]
DEPSO [7]	1	4.8	60	60	$62e-1/2e3$	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA [4]	1	7.4	9.7	1600	27	87	230	490	430	410	350	iAMaLGaM IDEA [4]
(1+1)-ES [1]	1	1.9	1600	1600	$52e-1/1e6$	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo [3]	1	$13e+1/1e6$	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES [13]	1	1	1	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]

Table 10: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{110} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

110 Rosenbrock Gauss											
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
$\text{ERT}_{\text{best}}/D$	388	4140	nan	nan	nan	nan	nan	nan	nan	nan	$\text{ERT}_{\text{best}}/D$
ALPS	160	<i>73e+1/1e5</i>	.	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	4.6	3.7	<i>38e+0/1e6</i>	.	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAeG	4.5	<i>72e+1/2e3</i>	.	.	.	.	.	.	.	.	BayEDAeG [6]
BFGS	<i>52e+4/500</i>	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1	<i>37e+0/1e6</i>	.	.	.	.	.	.	.	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	<i>24e+4/1e4</i>	.	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	<i>23e+4/2e5</i>	.	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	<i>35e+4/2e3</i>	.	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	6	33	<i>39e+0/1e6</i>	.	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	<i>14e+4/1e6</i>	.	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	<i>92e+3/1e6</i>	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	<i>40e+3/1e4</i>	.	.	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 11: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{111} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

111 Rosenbrock unif												
	$\Delta \text{ft}_{\text{target}}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta \text{ft}_{\text{target}}$
$\text{ERT}_{\text{best}}/D$	$\text{ERT}_{\text{best}}/D$	2640	15500	nan	nan	nan	nan	nan	nan	nan	nan	$\text{ERT}_{\text{best}}/D$
ALPS		<i>30e+3/1e5</i>										ALPS [11]
AMaLGaM IDEA		6.2	18	<i>71e+0/1e6</i>								AMaLGaM IDEA [4]
BayEDA cG		<i>21e+3/2e3</i>										BayEDA cG [6]
BFGS		<i>46e+4/400</i>										BFGS [14]
BIPOP-CMA-ES		1	1	<i>38e+0/1e6</i>								BIPOP-CMA-ES [10]
(1+1)-CMA-ES		<i>27e+4/1e4</i>										(1+1)-CMA-ES [2]
DASA		<i>24e+4/2e5</i>										DASA [12]
DEPSO		<i>44e+4/2e3</i>										DEPSO [7]
iAMaLGaM IDEA		44	37	<i>59e+0/1e6</i>								iAMaLGaM IDEA [4]
(1+1)-ES		<i>16e+4/1e6</i>										(1+1)-ES [1]
Monte Carlo		<i>94e+3/1e6</i>										Monte Carlo [3]
IPOP-SEP-CMA-ES		<i>49e+4/1e4</i>										IPOP-SEP-CMA-ES [13]

Table 12: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{112} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

112 Rosenbrock Cauchy											
Δf_{target} $\text{ERT}_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} $\text{ERT}_{\text{best}}/D$
ALPS	33	3900	<i>11e+1/1e5</i>	•	•	•	•	•	•	•	ALPS [11]
AMaLGaM IDEA	27	12	<i>21e+0/1e6</i>	•	•	•	•	•	•	•	AMaLGaM IDEA [4]
BayEDAeG	32	28	<i>89e+0/2e3</i>	•	•	•	•	•	•	•	BayEDAeG [6]
BFGS	<i>51e+4/2e3</i>	•	•	•	•	•	•	•	•	•	BFGS [14]
BIPOP-CMA-ES	1.4	1	1.1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1.2	35	<i>63e+0/1e4</i>	•	•	•	•	•	•	•	(1+1)-CMA-ES [2]
DASA	5	463	<i>97e+0/3e5</i>	•	•	•	•	•	•	•	DASA [12]
DEPSO	15	<i>24e+1/2e3</i>	•	•	•	•	•	•	•	•	DEPSO [7]
iAMaLGaM IDEA	9.6	5.1	<i>28e+0/1e6</i>	•	•	•	•	•	•	•	iAMaLGaM IDEA [4]
(1+1)-ES	1	94	<i>51e+0/1e6</i>	•	•	•	•	•	•	•	(1+1)-ES [1]
Monte Carlo	<i>89e+3/1e6</i>	•	•	•	•	•	•	•	•	•	Monte Carlo [3]
IPOP-SEP-CMA-ES	1.2	2.2	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]

Table 13: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{113} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

113 Step-ellipsoid Gauss												
Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	51.8	1430	11000	63500	67400	75000	75000	75000	75000	75100	$\text{ERT}_{\text{best}}/D$	
ALPS	2.1	140	<i>10e+1/1e5</i>	2.1	2.1	2.1	2.1	2.1	2.1	2.1	ALPS [11]	
AMaLGaM IDEA	1.9	1.9	3.2	2.1	2.1	2.1	2.1	2.1	2.1	2.1	AMaLGaM IDEA [4]	
BayEDAeG	4	<i>18e+1/2e3</i>									BayEDAeG [6]	
BFGS	<i>19e+2/1e3</i>										BFGS [14]	
BIPOP-CMA-ES	2	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	870	<i>11e+2/1e4</i>									(1+1)-CMA-ES [2]	
DASA	3200	<i>89e+1/2e5</i>									DASA [12]	
DEPSO	120	<i>19e+2/2e3</i>									DEPSO [7]	
iAMaLGaM IDEA	1	3.6	15	5.1	5.3	5.1	5.1	5.1	5.1	5.1	iAMaLGaM IDEA [4]	
(1+1)-ES	1900	<i>72e+1/1e6</i>									(1+1)-ES [1]	
Monte Carlo	24	<i>52e+1/1e6</i>									Monte Carlo [3]	
IPOP-SEP-CMA-ES	59	<i>51e+1/1e4</i>									IPOP-SEP-CMA-ES [13]	

Table 14: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{114} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
$\text{ERT}_{\text{best}}/D$	165	7220	42000	1.64e5	2.51e5	2.88e5	2.88e5	2.88e5	2.88e5	2.92e5	$\text{ERT}_{\text{best}}/D$
ALPS	2.1	<i>50e+1/1e5</i>	.	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	1	9	62	<i>12e+0/1e6</i>	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	12	<i>94e+1/2e3</i>	.	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	<i>19e+2/700</i>	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	2.6	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	430	<i>13e+2/1e4</i>	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	990	<i>99e+1/2e5</i>	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	<i>20e+2/2e3</i>	.	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	10	29	360	<i>19e+0/1e6</i>	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	1200	<i>74e+1/1e6</i>	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	11	<i>54e+1/1e6</i>	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	<i>19e+2/1e4</i>	.	.	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 15: 40-D, running time excess ERT/ERT_{best} on f_{115} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
ERT_{best}/D	4.15	26.7	51.4	4860	9320	10500	10500	10500	10500	10500	ERT_{best}/D
ALPS	8.9	16	<i>41e+0/1e5</i>	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	11	12	1.1	1	1	1	1	1	1	1	AMaLGaM IDEA [4]
BayEDAcG	14	25	<i>25e+0/2e3</i>	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	<i>17e+2/2e3</i>	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1.1	1.8	6.6	4.1	4	4	4	4	4	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1.2	470	<i>10e+1/1e4</i>	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	7.1	<i>17e+1/2e5</i>	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	3.8	24	<i>59e+0/2e3</i>	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	4.9	4.8	1	3.4	4.5	6	6	6	6	5.9	iAMaLGaM IDEA [4]
(1+1)-ES	2.2	2.6e5	<i>12e+1/1e6</i>	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	420	<i>53e+1/1e6</i>	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1.1	1	1.1	29	15	<i>31e-1/1e4</i>	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 16: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{116} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

116 Ellipsoid Gauss												
	$\Delta\text{ftarget}$	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	$\Delta\text{ftarget}$
	$\text{ERT}_{\text{best}}/\text{D}$	13100	60200	1.04e5	1.08e5	1.13e5	1.17e5	1.21e5	1.25e5	1.28e5	1.36e5	$\text{ERT}_{\text{best}}/\text{D}$
ALPS		<i>65e+2/1e5</i>	.	.	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	1	1	1.2	1	1	1	1	1	1	1	1	AMaLGaM IDEA [4]
BayEDAcG		<i>20e+3/2e3</i>	.	.	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS		<i>19e+4/500</i>	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1.1	1	1	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	BIPOP-CMA-ES [10]
(1+1)-CMA-ES		<i>93e+3/1e4</i>	.	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA		<i>71e+3/2e5</i>	.	.	.	.	.	.	.	.	.	DASA [12]
DEPSO		<i>14e+4/2e3</i>	.	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	6.1	3.2	3.2	3.6	3.8	3.7	3.6	3.5	3.4	3.4	3.3	iAMaLGaM IDEA [4]
(1+1)-ES		<i>49e+3/1e6</i>	.	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo		<i>37e+3/1e6</i>	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES		<i>52e+3/1e4</i>	.	.	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 17: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{117} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

117 Ellipsoid unif											
Δf_{target}	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
$\text{ERT}_{\text{best}}/D$	31300	1.35e5	2.11e5	2.97e5	3.4e5	3.65e5	4.33e5	4.57e5	4.79e5	5.28e5	$\text{ERT}_{\text{best}}/D$
ALPS	<i>31e+3/1e5</i>										ALPS [11]
AMaLGaM IDEa	4.3	11	23	<i>90e+0/1e6</i>							AMaLGaM IDEa [4]
BayEDAeG	<i>58e+3/2e3</i>										BayEDAeG [6]
BFGS	<i>16e+4/400</i>										BFGS [14]
BIPOP-CMA-ES	1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	<i>12e+4/1e4</i>										(1+1)-CMA-ES [2]
DASA	<i>82e+3/2e5</i>										DASA [12]
DEPSO	<i>18e+4/2e3</i>										DEPSO [7]
iAMaLGaM IDEa	14	15	71	<i>13e+1/1e6</i>							iAMaLGaM IDEa [4]
(1+1)-ES	<i>50e+3/1e6</i>										(1+1)-ES [1]
Monte Carlo	<i>37e+3/1e6</i>										Monte Carlo [3]
IPOP-SEP-CMA-ES	<i>14e+4/1e4</i>										IPOP-SEP-CMA-ES [13]

Table 18: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{118} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

118 Ellipsoid Cauchy												
	$\Delta\text{ftarget}$	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	$\Delta\text{ftarget}$
	$\text{ERT}_{\text{best}}/D$	139	363	980	1200	2050	2410	2720	2920	3110	3290	$\text{ERT}_{\text{best}}/D$
ALPS		35	<i>38e+1/1e5</i>									ALPS [11]
AMaLGaM IDEA		3.5	2.1	1	1	2	3.2	10	16	16	16	AMaLGaM IDEA [4]
BayEDA _{cG}		<i>28e+2/2e3</i>										BayEDA _{cG} [6]
BFGS		<i>16e+4/2e3</i>										BFGS [14]
BIPOP-CMA-ES		1	1.2	1	1.4	1.1	1.1	1.2	1.2	1.3	1.4	BIPOP-CMA-ES [10]
(1+1)-CMA-ES		7.7	<i>46e+1/1e4</i>									(1+1)-CMA-ES [2]
DASA		1.9e4	<i>13e+2/4e5</i>									DASA [12]
DEPSO		<i>24e+2/2e3</i>										DEPSO [7]
iAMaLGaM IDEA		1.6	1	1.8	6.5	7.3	18	23	26	24	23	iAMaLGaM IDEA [4]
(1+1)-ES		8500	<i>96e+1/1e6</i>									(1+1)-ES [1]
Monte Carlo		<i>38e+3/1e6</i>										Monte Carlo [3]
IPOP-SEP-CMA-ES		1.3	1.6	1.1	1.4	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]

Table 19: 40-D, running time excess ERT/ERT_{best} on f_{119} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

119 Sum of different powers Gauss												
	$\Delta \text{ftarget}$	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	$\Delta \text{ftarget}$
ERT_{best}/D	ERT_{best}/D	0.025	1.28	1060	3080	3930	13300	53000	1.18e5	2.51e5	3.2e5	ERT_{best}/D
ALPS	1	1.8	1	50	<i>88e-1/1e5</i>	24	8.8	3.9	2.2	1.2	1.3	ALPS [11]
AMaLGaM IDEA	1	1	4.8	17	<i>93e-1/2e3</i>	24	8.8	3.9	2.2	1.2	1.3	AMaLGaM IDEA [4]
BayEDA cG	1.1	1.2	2.2	2.2	<i>95e+0/1e3</i>	1	1	1	1	1	1	BayEDA cG [6]
BFGS	1	670	7.7	1	1	1	1	1	1	1	1	BFGS [14]
BIPOP-CMA-ES	1	180	51e+0/1e4	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	690	43e+0/2e5	1	1	1	1	1	1	1	1	(1+1)-CMA-ES [2]
DASA	1	8.6	35e+0/2e3	1	1	1	1	1	1	1	1	DASA [12]
DEPSO	1.1	8.6	35e+0/2e3	1	1	1	1	1	1	1	1	DEPSO [7]
iAMaLGaM IDEA	1	2.7	5.5	57	84	27	3.2	7	3.2	1.5	1.5	iAMaLGaM IDEA [4]
(1+1)-ES	1.7	72	36e+0/1e6	1	1	1	1	1	1	1	1	(1+1)-ES [1]
Monte Carlo	1	1.2	28e+0/1e6	1	1	1	1	1	1	1	1	Monte Carlo [3]
IPOP-SEP-CMA-ES	4.1	4	26e+0/1e4	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]

Table 20: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{120} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

	$\Delta \text{ft}_{\text{target}}$	$\text{ERT}_{\text{best}}/D$	$1e+03$	$1e+02$	$1e+01$	$1e+00$	43300	84100	$2.84e5$	$6.09e5$	$1e-04$	$1e-05$	$1e-07$	$\Delta \text{ft}_{\text{target}}$
	$\text{ERT}_{\text{best}}/D$		0.025	1.02	4090	17700	43300	84100	$2.84e5$	$6.09e5$	$1.08e6$	$5.96e6$	$\text{ERT}_{\text{best}}/D$	
ALPS	1	<i>1</i>	<i>23e+0/1e5</i>	<i>17</i>	<i>30e-1/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	ALPS [11]	
AMaLGaM IDEA	1	2.8	<i>17</i>	<i>53e+0/2e3</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	AMaLGaM IDEA [4]	
BayEDA cG	1	1.2	<i>550</i>	<i>82e+0/800</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	BayEDA cG [6]	
BFGS	3.7	550	82e+0/800	1	1	1	1	1	1	1	1	1	BFGS [14]	
BIPOP-CMA-ES	1	68	1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	400	<i>61e+0/1e4</i>	<i>47e+0/2e5</i>	<i>95e+0/2e3</i>	<i>48e-1/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	(1+1)-CMA-ES [2]	
DASA	1	1200	<i>47e+0/2e5</i>	<i>95e+0/2e3</i>	<i>48e-1/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	DASA [12]	
DEPSO	1	1300	<i>95e+0/2e3</i>	<i>48e-1/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	DEPSO [7]	
iAMaLGaM IDEA	1	5.4	<i>64</i>	<i>39e+0/1e6</i>	<i>29e+0/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	iAMaLGaM IDEA [4]	
(1+1)-ES	1	220	<i>39e+0/1e6</i>	<i>29e+0/1e6</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	(1+1)-ES [1]	
Monte Carlo	1	1.9	<i>29e+0/1e6</i>	<i>61e+0/1e4</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1500	<i>61e+0/1e4</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	<i>1</i>	IPOP-SEP-CMA-ES [13]	

Table 21: 40-D, running time excess ERT/ERT_{best} on f_{121} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

121 Sum of different powers Cauchy											
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
ERT_{best}/D	0.025	1.4	18.2	43.5	84	205	689	1430	2430	5040	ERT_{best}/D
ALPS	1	1	1600	<i>84e-1/1e5</i>	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	1	1.8	14	13	37	130	72	35	21	11	AMaLGaM IDEA [4]
BayEDA cG	1	2.3	33	35	<i>38e-2/2e3</i>	.	.	.	.	.	BayEDA cG [6]
BFGS	1	1600	<i>92e+0/2e3</i>	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1.8	1.1	1.1	1.1	1	1	1.3	1.6	2	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1.9	2400	<i>14e+0/1e4</i>	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1	35	<i>27e+0/2e5</i>	.	.	.	.	.	.	.	DASA [12]
DEPSO	1.1	3.4	28	<i>54e-1/2e3</i>	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	1	1.5	8.3	28	100	310	130	100	110	65	iAMaLGaM IDEA [4]
(1+1)-ES	1	2.7	4.8e4	<i>95e-1/1e6</i>	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	1.1	1.2	<i>28e+0/1e6</i>	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1	2.2	1	1	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]

Table 23: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{123} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

123 Schaffer F7 unif												
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	0.025	0.025	331	59200	2.36e5	3.88e5	5.98e5	9.4e5	5.67e6	1.83e7	$\text{ERT}_{\text{best}}/D$	
ALPS	1	1.5	20	<i>82e-1/1e5</i>	•	•	•	•	•	•	ALPS [11]	
AMaLGaM IDEA	1	1.3	1	<i>43e-1/1e6</i>	•	•	•	•	•	•	AMaLGaM IDEA [4]	
BayEDAeG	1	1.1	<i>13e+0/2e3</i>	•	•	•	•	•	•	•	BayEDAeG [6]	
BFGS	1	28	<i>18e+0/900</i>	•	•	•	•	•	•	•	BFGS [14]	
BIPOP-CMA-ES	1	2.2	3.3	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	1	430	<i>14e+0/1e4</i>	•	•	•	•	•	•	(1+1)-CMA-ES [2]	
DASA	1	9.9	<i>12e+0/2e5</i>	•	•	•	•	•	•	•	DASA [12]	
DEPSO	1	1.1	<i>20e+0/2e3</i>	•	•	•	•	•	•	•	DEPSO [7]	
iAMaLGaM IDEA	1	1.1	11	<i>46e-1/1e6</i>	•	•	•	•	•	•	iAMaLGaM IDEA [4]	
(1+1)-ES	1	34	1.4e4	<i>11e+0/1e6</i>	•	•	•	•	•	•	(1+1)-ES [1]	
Monte Carlo	1	1.2	470	<i>88e-1/1e6</i>	•	•	•	•	•	•	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1	<i>13e+0/1e4</i>	•	•	•	•	•	•	•	IPOP-SEP-CMA-ES [13]	

Table 24: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{124} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

124 Schaffer F7 Cauchy											
Δf_{target} $\text{ERT}_{\text{best}}/D$	1e+03 0.025	1e+02 0.025	1e+01 14.3	1e+00 754	1e-01 5310	1e-02 6580	1e-03 9160	1e-04 20500	1e-05 28600	1e-07 56000	Δf_{target} $\text{ERT}_{\text{best}}/D$
ALPS [11]	1	1.2	13	<i>59e-1/1e5</i>	·	·	·	·	·	·	ALPS [11]
AMaLGaM IDEA [4]	1	1.1	9.9	1.4	5.4	4.6	3.5	1.6	1.3	1	AMaLGaM IDEA [4]
BayEDAeG [6]	1	1.1	20	5.2	<i>11e-1/2e3</i>	·	·	·	·	·	BayEDAeG [6]
BFGS [14]	1	180	<i>17e+0/2e3</i>	·	·	·	·	·	·	·	BFGS [14]
BIPOP-CMA-ES [10]	1	4.1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES [2]	1	1	500	<i>95e-1/1e4</i>	·	·	·	·	·	·	(1+1)-CMA-ES [2]
DASA [12]	1	1.3	1.6e5	<i>11e+0/2e5</i>	·	·	·	·	·	·	DASA [12]
DEPSO [7]	1	1.3	8.2	<i>58e-1/2e3</i>	·	·	·	·	·	·	DEPSO [7]
iAMaLGaM IDEA [4]	1	1.3	4.6	3.5	16	27	19	8.8	6.4	3.3	iAMaLGaM IDEA [4]
(1+1)-ES [1]	1	4.2	4600	<i>84e-1/1e6</i>	·	·	·	·	·	·	(1+1)-ES [1]
Monte Carlo [3]	1	1.4	1.2e4	<i>89e-1/1e6</i>	·	·	·	·	·	·	Monte Carlo [3]
IPOP-SEP-CMA-ES [13]	1	3.1	1	3.2	1.4	1.5	2.5	<i>16e-4/1e4</i>	·	·	IPOP-SEP-CMA-ES [13]

Table 25: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{125} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

125 Griewank-Rosenbrock Gauss												
Δf_{target} $\text{ERT}_{\text{best}}/\text{D}$	1e+03 0.025	1e+02 0.025	1e+01 0.025	1e+00 1.15	1e-01 2.64e6	1e-02 2.74e6	1e-03 1.36e7	1e-04 nan	1e-05 nan	1e-07 nan	Δf_{target} $\text{ERT}_{\text{best}}/\text{D}$	
ALPS	1	1	1.2	1.8	<i>64e-2/1e5</i>	·	·	·	·	·	ALPS [11]	
AMaLGaM IDEA	1	1	1	1.4	<i>44e-2/1e6</i>	·	·	·	·	·	AMaLGaM IDEA [4]	
BayEDAcG	1	1	1.1	2	<i>69e-2/2e3</i>	·	·	·	·	·	BayEDAcG [6]	
BFGS	1	1	1	<i>28e-1/2e3</i>	·	·	·	·	·	·	BFGS [14]	
BIPOP-CMA-ES	1	1	1	1.8	1	1	1	<i>41e-2/7e5</i>	·	·	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	1	1	<i>15e-1/1e4</i>	·	·	·	·	·	·	(1+1)-CMA-ES [2]	
DASA	1	1	7.1	<i>20e-1/2e5</i>	·	·	·	·	·	·	DASA [12]	
DEPSO	1	1	1	240	<i>12e-1/2e3</i>	·	·	·	·	·	DEPSO [7]	
iAMaLGaM IDEA	1	1	1	1	<i>44e-2/1e6</i>	·	·	·	·	·	iAMaLGaM IDEA [4]	
(1+1)-ES	1	1	3.5	<i>15e-1/1e6</i>	·	·	·	·	·	·	(1+1)-ES [1]	
Monte Carlo	1	1	1	<i>14e-1/1e6</i>	·	·	·	·	·	·	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1	1	1300	<i>11e-1/1e4</i>	·	·	·	·	·	IPOP-SEP-CMA-ES [13]	

Table 26: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{126} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{target} $\text{ERT}_{\text{best}}/D$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target} $\text{ERT}_{\text{best}}/D$
	0.025	0.025	0.025	218	nan	nan	nan	nan	nan	nan	
ALPS	1	1	1.1	10	<i>81e-2/1e5</i>	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	1	1	1.1	1	<i>50e-2/1e6</i>	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDA _{cG}	1	1	1.1	<i>12e-1/2e3</i>	.	.	.	.	.	.	BayEDA _{cG} [6]
BFGS	1	1	28	<i>29e-1/1e3</i>	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1	1	2.8	<i>50e-2/4e5</i>	.	.	.	.	.	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1	1	<i>16e-1/1e4</i>	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1	1	1	<i>20e-1/2e5</i>	.	.	.	.	.	.	DASA [12]
DEPSO	1	1	1.1	<i>23e-1/2e3</i>	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	1	1	1	4.3	<i>51e-2/1e6</i>	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	1	1	1	<i>16e-1/1e6</i>	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	1	1	1.1	<i>14e-1/1e6</i>	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1	1	1	<i>17e-1/1e4</i>	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 27: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{127} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

127 Griewank-Rosenbrock Cauchy

	Δf_{target}	$\text{ERT}_{\text{best}}/\text{D}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δf_{target}
	$\text{ERT}_{\text{best}}/\text{D}$		0.025	0.025	0.025	17.6	44700	2.63e5	3.78e5	6.24e5	6.49e5	6.66e5	$\text{ERT}_{\text{best}}/\text{D}$
ALPS	1	1	1	1	1.1	7.1	<i>70e-2/1e5</i>	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	1	1	1	1	1	7	2.3	56	<i>19e-3/1e6</i>	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	1	1	1	1	1.2	13	<i>59e-2/2e3</i>	.	.	.	.	.	BayEDAcG [6]
BFGS	1	1	1	1	300	<i>28e-1/2e3</i>	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	1	1	1	1	1	1	2.4	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1	1	1	1	<i>13e-1/1e4</i>	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1	1	1	1	1	<i>20e-1/2e5</i>	.	.	.	.	.	.	DASA [12]
DEPSO	1	1	1	1	1	53	<i>95e-2/2e3</i>	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	1	1	1	1	1.2	4	3.5	8.7	<i>11e-3/1e6</i>	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	1	1	1	1	1	8.4e5	<i>11e-1/1e6</i>	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	1	1	1	1	1.1	<i>15e-1/1e6</i>	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	1	1	1	1	1	1.1	1	<i>16e-2/1e4</i>	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 28: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{128} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

128 Gallagher Gauss												
	Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}
	$\text{ERT}_{\text{best}}/D$	0.025	0.025	$1.03e5$	$9.57e5$	$2.82e6$	$2.82e6$	$2.82e6$	$2.82e6$	$2.82e6$	$2.82e6$	$\text{ERT}_{\text{best}}/D$
	ALPS	1	1	$70e+0/1e5$	3.4	2.4	2.4	2.4	2.4	2.4	2.4	ALPS [11]
AMaLGaM IDEA	1	1	1	10	3.4	2.4	2.4	2.4	2.4	2.4	2.4	AMaLGaM IDEA [4]
BayEDA _{cG}	1	1	1	$73e+0/2e3$								BayEDA _{cG} [6]
BFGS	1	1	1	$84e+0/1e3$								BFGS [14]
BIPOP-CMA-ES	1	1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	1	1	1	$81e+0/1e4$								(1+1)-CMA-ES [2]
DASA	1	1	1	$79e+0/2e5$								DASA [12]
DEPSO	1	1	1	$80e+0/2e3$								DEPSO [7]
iAMaLGaM IDEA	1	1	1	32	4.8	2.5	2.5	2.5	2.5	2.5	2.5	iAMaLGaM IDEA [4]
(1+1)-ES	1	1	1	$74e+0/1e6$								(1+1)-ES [1]
Monte Carlo	1	1	1	$68e+0/1e6$								Monte Carlo [3]
IPOP-SEP-CMA-ES	1	1	1	$82e+0/1e4$								IPOP-SEP-CMA-ES [13]

Table 29: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{129} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

129 Gallagher unif												
	$\Delta\text{ftarget}$	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	$\Delta\text{ftarget}$
	$\text{ERT}_{\text{best}}/D$	0.025	0.025	8.67e5	9.4e5	2.54e6	2.55e6	2.56e6	2.58e6	2.59e6	2.62e6	$\text{ERT}_{\text{best}}/D$
ALPS		1	1	<i>70e+0/1e5</i>	•	•	•	•	•	•	•	ALPS [11]
AMaLGaM IDEA		1	1	<i>66e+0/1e6</i>	•	•	•	•	•	•	•	AMaLGaM IDEA [4]
BayEDAacG		1	1	<i>81e+0/2e3</i>	•	•	•	•	•	•	•	BayEDAacG [6]
BFGS		1	1	<i>84e+0/800</i>	•	•	•	•	•	•	•	BFGS [14]
BIPOP-CMA-ES		1	1	1	1	1	1	1	1	1	1	BIPOP-CMA-ES [10]
(1+1)-CMA-ES		1	1	<i>80e+0/1e4</i>	•	•	•	•	•	•	•	(1+1)-CMA-ES [2]
DASA		1	1	<i>79e+0/2e5</i>	•	•	•	•	•	•	•	DASA [12]
DEPSO		1	1	<i>84e+0/2e3</i>	•	•	•	•	•	•	•	DEPSO [7]
iAMaLGaM IDEA		1	1	<i>66e+0/1e6</i>	•	•	•	•	•	•	•	iAMaLGaM IDEA [4]
(1+1)-ES		1	1	<i>74e+0/1e6</i>	•	•	•	•	•	•	•	(1+1)-ES [1]
Monte Carlo		1	1	<i>68e+0/1e6</i>	•	•	•	•	•	•	•	Monte Carlo [3]
IPOP-SEP-CMA-ES		1	1	<i>84e+0/1e4</i>	•	•	•	•	•	•	•	IPOP-SEP-CMA-ES [13]

Table 30: 40-D, running time excess $\text{ERT}/\text{ERT}_{\text{best}}$ on f_{130} , in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

130 Gallagher Cauchy												
Δf_{target}	$1e+03$	$1e+02$	$1e+01$	$1e+00$	$1e-01$	$1e-02$	$1e-03$	$1e-04$	$1e-05$	$1e-07$	Δf_{target}	
$\text{ERT}_{\text{best}}/D$	0.025	0.025	317	6930	42100	42200	42200	42300	42400	42500	$\text{ERT}_{\text{best}}/D$	
ALPS	1	1	<i>$42e+0/1e5$</i>	1	95	95	95	95	95	95	ALPS [11]	
AMaLGaM IDEA	1	1	<i>7.5</i>	1	<i>$17e-1/2e3$</i>	95	95	95	95	95	AMaLGaM IDEA [4]	
BayEDAcG	1	1	<i>3.8</i>	1	<i>$17e-1/2e3$</i>	95	95	95	95	95	BayEDAcG [6]	
BFGS	1	1	<i>$83e+0/2e3$</i>	1	7.9	7.9	7.9	7.9	7.9	7.9	BFGS [14]	
BIPOP-CMA-ES	1	1	1	24	7.9	7.9	7.9	7.9	7.9	7.9	BIPOP-CMA-ES [10]	
(1+1)-CMA-ES	1	1	<i>$47e+0/1e4$</i>	1	7.9	7.9	7.9	7.9	7.9	7.9	(1+1)-CMA-ES [2]	
DASA	1	1	<i>$75e+0/2e5$</i>	1	7.9	7.9	7.9	7.9	7.9	7.9	DASA [12]	
DEPSO	1	1	<i>12</i>	<i>$20e+0/2e3$</i>	7.9	7.9	7.9	7.9	7.9	7.9	DEPSO [7]	
iAMaLGaM IDEA	1	1	3.4	66	40	50	68	70	97	97	iAMaLGaM IDEA [4]	
(1+1)-ES	1	1	<i>$2.2e4$</i>	<i>$20e+0/1e6$</i>	40	50	68	70	97	97	(1+1)-ES [1]	
Monte Carlo	1	1	<i>$68e+0/1e6$</i>	<i>$20e+0/1e6$</i>	40	50	68	70	97	97	Monte Carlo [3]	
IPOP-SEP-CMA-ES	1	1	1	1.6	1	1	1	1	1	1	IPOP-SEP-CMA-ES [13]	

References

- [1] Anne Auger. Benchmarking the (1+1)-ES with one-fifth success rule on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2453–2458.
- [2] Anne Auger and Nikolaus Hansen. Benchmarking the (1+1)-CMA-ES on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2467–2472.
- [3] Anne Auger and Raymond Ros. Benchmarking the pure random search on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2485–2490.
- [4] Peter A. N. Bosman, Jörn Grahl, and Dirk Thierens. AMaLGaM IDEAs in noisy black-box optimization benchmarking. In Rothlauf [15], pages 2351–2358.
- [5] S. Finck, N. Hansen, R. Ros, and A. Auger. Real-parameter black-box optimization benchmarking 2009: Presentation of the noisy functions. Technical Report 2009/21, Research Center PPE, 2009.
- [6] Marcus R. Gallagher. Black-box optimization benchmarking: results for the BayEDAcG algorithm on the noisy function testbed. In Rothlauf [15], pages 2383–2388.
- [7] José García-Nieto, Enrique Alba, and Javier Apolloni. Particle swarm hybridized with differential evolution: black box optimization benchmarking for noisy functions. In Rothlauf [15], pages 2343–2350.
- [8] N. Hansen, A. Auger, S. Finck, and R. Ros. Real-parameter black-box optimization benchmarking 2009: Experimental setup. Technical Report RR-6828, INRIA, 2009.
- [9] 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.
- [10] Nikolaus Hansen. Benchmarking a bi-population CMA-ES on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2397–2402.
- [11] Gregory S. Hornby. The Age-Layered Population Structure (ALPS) evolutionary algorithm, July 2009. Noisy testbed.
- [12] Peter Korosec and Jurij Silc. A stigmergy-based algorithm for black-box optimization: noisy function testbed. In Rothlauf [15], pages 2375–2382.
- [13] Raymond Ros. Benchmarking sep-CMA-ES on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2441–2446.
- [14] Raymond Ros. Benchmarking the BFGS algorithm on the BBOB-2009 noisy testbed. In Rothlauf [15], pages 2415–2420.
- [15] Franz Rothlauf, editor. *Genetic and Evolutionary Computation Conference, GECCO 2009, Proceedings, Montreal, Québec, Canada, July 8-12, 2009, Companion Material*. ACM, 2009.