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 ERT/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

Δftarget ERT$_{\text{best}}$/D	1e+03 0.025	1e+02 6.48	1e+01 14.6	1e+00 22.6	1e-01 31.4	1e-02 39.4	1e-03 47.8	1e-04 55.7	1e-05 63.9	1e-07 80.9	Δftarget 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	*25e-5/2e3*	.	.	BayEDAcG [6]
BFGS	**1**	*30e+1/2e3*	.	.	.	.	.	.	.	.	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	*17e-2/2e3*	.	.	.	.	.	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**	*14e+1/1e6*	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1.2**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	IPOP-SEP-CMA-ES [13]

Table 2: 40-D, running time excess ERT/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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.025	8.36	20.5	32.1	43.6	55.3	65.7	77.5	88.9	113	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	*29e-5/2e3*	.	.	BayEDAcG [6]
BFGS	**1**	*29e+1/2e3*	.	.	.	.	.	.	.	.	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	*19e-7/1e4*	(1+1)-CMA-ES [2]
DASA	**1**	5.3	14	16	100	1200	6.6e4	*42e-4/3e5*	.	.	DASA [12]
DEPSO	**1**	4	7.1	23	230	*16e-2/2e3*	.	.	.	.	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	*27e-1/1e6*	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	*13e+1/1e6*	.	.	.	.	.	.	.	.	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 ERT/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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.025	5.92	13.2	30.6	42.3	54	68	81.6	95.4	124	ERT$_{\text{best}}$/D
ALPS	**1**	15	34	28	120	*41e-3/1e5*	.	.	.	.	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	*33e-5/2e3*	.	.	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	*13e-3/1e4*	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	4.2	6.1	5.1	260	*36e-3/3e5*	.	.	.	.	DASA [12]
DEPSO	**1**	5.2	12	62	*79e-2/2e3*	.	.	.	.	.	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	*84e-4/1e6*	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	*14e+1/1e6*	.	.	.	.	.	.	.	.	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 ERT/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

Δftarget ERT$_{\text{best}}$/D	1e+03 18.6	1e+02 243	1e+01 77200	1e+00 89900	1e-01 91400	1e-02 92200	1e-03 92600	1e-04 93000	1e-05 93400	1e-07 94100	Δftarget ERT$_{\text{best}}$/D
ALPS	34	21	**1**	**3.4**	**9.5**	**20**	*14e-1/1e5*	.	.	.	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	*63e+0/2e3*	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*50e+4/1e3*	.	.	.	.	.	.	.	.	.	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**	*39e+0/1e4*	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	5.5	45	4.9	31	*74e-1/4e5*	.	.	.	.	.	DASA [12]
DEPSO	13	13	*96e+0/2e3*	.	.	.	.	.	.	.	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	*45e+0/1e6*	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	*93e+3/1e6*	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.3**	5.3	*37e+0/1e4*	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 5: 40-D, running time excess ERT/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

105 Rosenbrock moderate unif

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

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

106 Rosenbrock moderate Cauchy

Δftarget ERT$_{\text{best}}$/D	1e+03 16.9	1e+02 47.9	1e+01 1730	1e+00 2270	1e-01 2390	1e-02 2450	1e-03 2490	1e-04 2520	1e-05 2540	1e-07 2600	Δftarget ERT$_{\text{best}}$/D
ALPS	36	60	38	**160**	***39e-1/1e5***	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	26	18	*27e+0/1e6*	.	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	34	71	*10e+1/2e3*	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*12e+3/4e3*	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	**1.6**	**1.6**	**1**	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	**1.1**	**1**	*28e+0/1e4*	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	5.8	22	**14**	200	***73e-2/7e5***	.	.	.	.	.	DASA [12]
DEPSO	15	95	*11e+1/2e3*	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	10	6.5	*29e+0/1e6*	.	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	**2.2**	8300	*13e+0/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	*92e+3/1e6*	.	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.3**	**1.3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	IPOP-SEP-CMA-ES [13]

Table 7: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\mathrm{best}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.025	225	960	1440	1870	2170	2440	2720	3010	3620	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	10	*35e+0/1e5*	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1.5**	**15**	**48**	**50**	**45**	**41**	**39**	**36**	**32**	AMaLGaM IDEA [4]
BayEDAcG	**1**	**2.7**	*22e+0/2e3*	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	*29e+1/1e3*	.	.	.	.	.	.	.	.	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**	*22e+1/1e4*	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	*20e+1/2e5*	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	*19e+1/2e3*	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1**	**130**	**110**	**140**	**170**	**150**	**140**	**130**	**110**	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	*17e+1/1e6*	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	*13e+1/1e6*	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	660	*17e+1/1e4*	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

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

108 Sphere unif

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

Table 9: 40-D, running time excess ERT/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

109 Sphere Cauchy

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

Table 10: 40-D, running time excess ERT/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

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

Table 11: 40-D, running time excess ERT/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

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

Table 12: 40-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ 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

Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D	1e+03 18.4	1e+02 72.3	1e+01 4450	1e+00 6350	1e-01 6670	1e-02 6800	1e-03 6890	1e-04 6960	1e-05 7030	1e-07 7160	Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	33	3900	***11e+1/1e5***	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	27	12	***21e+0/1e6***	.	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	32	28	***89e+0/2e3***	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*51e+4/2e3*	.	.	.	.	.	.	.	.	.	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	***63e+0/1e4***	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	5	4e3	***97e+0/3e5***	.	.	.	.	.	.	.	DASA [12]
DEPSO	15	*24e+1/2e3*	.	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	9.6	**5.1**	***28e+0/1e6***	.	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	94	***51e+0/1e6***	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	*89e+3/1e6*	.	.	.	.	.	.	.	.	.	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 ERT/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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	51.8	1430	11000	63500	67400	75000	75000	75000	75000	75100	ERT$_{\text{best}}$/D
ALPS	**2.1**	140	*10e+1/1e5*	.	.	.	.	.	.	.	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]
BayEDAcG	4	*18e+1/2e3*	.	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*19e+2/1e3*	.	.	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	870	*11e+2/1e4*	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	3200	*89e+1/2e5*	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	120	*13e+2/2e3*	.	.	.	.	.	.	.	.	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	*72e+1/1e6*	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	24	*52e+1/1e6*	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	59	*51e+1/1e4*	.	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 14: 40-D, running time excess ERT/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

114 Step-ellipsoid unif

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

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

115 Step-ellipsoid Cauchy

Δftarget ERT$_{\text{best}}$/D	1e+03 4.15	1e+02 26.7	1e+01 514	1e+00 4860	1e-01 9320	1e-02 10500	1e-03 10500	1e-04 10500	1e-05 10500	1e-07 10500	Δftarget ERT$_{\text{best}}$/D
ALPS	8.9	16	*41e+0/1e5*	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	11	12	**1.1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	AMaLGaM IDEA [4]
BayEDAcG	14	25	*25e+0/2e3*	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*17e+2/2e3*	.	.	.	.	.	.	.	.	.	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	*10e+1/1e4*	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	7.1	*17e+1/2e5*	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	3.8	24	*59e+0/2e3*	.	.	.	.	.	.	.	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	*12e+1/1e6*	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	420	*53e+1/1e6*	.	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1.1**	**1**	**1.1**	29	15	*31e-1/1e4*	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 16: 40-D, running time excess ERT/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

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

Table 17: 40-D, running time excess ERT/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

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

Table 18: 40-D, running time excess ERT/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

Δftarget ERT$_{\text{best}}$/D	1e+03 139	1e+02 363	1e+01 980	1e+00 1200	1e-01 2050	1e-02 2410	1e-03 2720	1e-04 2920	1e-05 3110	1e-07 3290	Δftarget ERT$_{\text{best}}$/D
ALPS	35	*38e+1/1e5*	.	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	3.5	**2.1**	**1**	**1**	**2**	**3.2**	**10**	**16**	**16**	**16**	AMaLGaM IDEA [4]
BayEDAcG	*28e+2/2e3*	.	.	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	*16e+4/2e3*	.	.	.	.	.	.	.	.	.	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	*46e+1/1e4*	.	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	1.9e4	*13e+2/4e5*	.	.	.	.	.	.	.	.	DASA [12]
DEPSO	*24e+2/2e3*	.	.	.	.	.	.	.	.	.	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	*96e+1/1e6*	.	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	*38e+3/1e6*	.	.	.	.	.	.	.	.	.	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$_{\text{best}}$ 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

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

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

120 Sum of different powers unif

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

Table 21: 40-D, running time excess ERT/ERT$_{\text{best}}$ 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

Δftarget ERT$_{\text{best}}$/D	1e+03 0.025	1e+02 1.4	1e+01 18.2	1e+00 43.5	1e-01 84	1e-02 205	1e-03 689	1e-04 1430	1e-05 2430	1e-07 5040	Δftarget ERT$_{\text{best}}$/D
ALPS	**1**	**1**	1600	*84e-1/1e5*	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1.8**	14	**13**	**37**	**130**	**72**	**35**	**21**	**11**	AMaLGaM IDEA [4]
BayEDAcG	**1**	**2.3**	33	35	*38e-2/2e3*	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	1600	*92e+0/2e3*	.	.	.	.	.	.	.	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	*14e+0/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	35	*27e+0/2e5*	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1.1**	3.4	28	*54e-1/2e3*	.	.	.	.	.	.	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	*95e-1/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1.1**	**1.2**	*28e+0/1e6*	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**2.2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	IPOP-SEP-CMA-ES [13]

Table 22: 40-D, running time excess ERT/ERT$_{\text{best}}$ on f_{122}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

122 Schaffer F7 Gauss

Δftarget ERT$_{\text{best}}$/D	1e+03 0.025	1e+02 0.025	1e+01 123	1e+00 6830	1e-01 16100	1e-02 26800	1e-03 70200	1e-04 1.12e5	1e-05 3.02e5	1e-07 8.23e5	Δftarget ERT$_{\text{best}}$/D
ALPS	**1**	**1**	7.9	*58e-1/1e5*	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1.3**	**1.6**	**29**	**25**	**22**	**13**	**14**	***11e-5/1e6***	.	AMaLGaM IDEA [4]
BayEDAcG	**1**	**1**	3.1	*59e-1/2e3*	.	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	37	*18e+0/1e3*	.	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	**1**	4.3	**1.8**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	**1**	**1.8**	1200	*13e+0/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	11	*12e+0/2e5*	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	**1.1**	53	*12e+0/2e3*	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1**	**1**	**51**	**60**	**39**	**15**	**13**	**50**	***49e-6/1e6***	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	60	1.5e4	*10e+0/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	**1.2**	1200	*88e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	110	*99e-1/1e4*	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 23: 40-D, running time excess ERT/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

Δftarget ERT$_{\text{best}}$/D	1e+03 0.025	1e+02 0.025	1e+01 331	1e+00 59200	1e-01 2.36e5	1e-02 3.88e5	1e-03 5.98e5	1e-04 9.4e5	1e-05 5.67e6	1e-07 1.83e7	Δftarget ERT$_{\text{best}}$/D
ALPS	**1**	**1.5**	20	***82e-1/1e5***	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1.3**	**1**	***43e-1/1e6***	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	**1**	**1.1**	*13e+0/2e3*	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	28	*18e+0/900*	.	.	.	.	.	.	.	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	***14e+0/1e4***	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	9.9	*12e+0/2e5*	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	**1.1**	*20e+0/2e3*	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1.1**	**11**	***46e-1/1e6***	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	34	1.4e4	***11e+0/1e6***	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	**1.2**	470	***88e-1/1e6***	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	*13e+0/1e4*	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 24: 40-D, running time excess ERT/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

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

Table 25: 40-D, running time excess ERT/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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
ERT$_{\text{best}}$/D	0.025	0.025	0.025	115	2.64e6	2.74e6	1.36e7	nan	nan	nan	ERT$_{\text{best}}$/D
ALPS	**1**	**1**	**1.2**	**1.8**	***64e-2/1e5***	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1**	**1**	**1.4**	***44e-2/1e6***	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	**1**	**1**	**1.1**	**2**	***69e-2/2e3***	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	**1**	**1**	*28e-1/2e3*	.	.	.	.	.	.	BFGS [14]
BIPOP-CMA-ES	**1**	**1**	**1**	**1.8**	**1**	**1**	**1**	***41e-2/7e5***	.	.	BIPOP-CMA-ES [10]
(1+1)-CMA-ES	**1**	**1**	**1**	*15e-1/1e4*	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	7.1	*20e-1/2e5*	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	**1**	**1**	240	***12e-1/2e3***	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1**	**1**	**1**	***44e-2/1e6***	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	**1**	3.5	*15e-1/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	**1**	**1**	*14e-1/1e6*	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	**1**	1300	***11e-1/1e4***	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 26: 40-D, running time excess ERT/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

126 Griewank-Rosenbrock unif

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

Table 27: 40-D, running time excess ERT/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

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

Table 28: 40-D, running time excess ERT/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

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

Table 29: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\mathrm{best}}$ 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

Δftarget	1e+03	1e+02	1e+01	1e+00	1e-01	1e-02	1e-03	1e-04	1e-05	1e-07	Δftarget
$\mathrm{ERT}_{\mathrm{best}}$/D	0.025	0.025	8.67e5	9.4e5	2.54e6	2.55e6	2.56e6	2.58e6	2.59e6	2.62e6	$\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1**	***70e+0/1e5***	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1**	***66e+0/1e6***	.	.	.	.	.	.	.	AMaLGaM IDEA [4]
BayEDAcG	**1**	**1**	***81e+0/2e3***	.	.	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	**1**	***84e+0/800***	.	.	.	.	.	.	.	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**	***80e+0/1e4***	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	***79e+0/2e5***	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	**1**	***84e+0/2e3***	.	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1**	***66e+0/1e6***	.	.	.	.	.	.	.	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	**1**	***74e+0/1e6***	.	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	**1**	***68e+0/1e6***	.	.	.	.	.	.	.	Monte Carlo [3]
IPOP-SEP-CMA-ES	**1**	**1**	***84e+0/1e4***	.	.	.	.	.	.	.	IPOP-SEP-CMA-ES [13]

Table 30: 40-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best}}$ 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

Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D	1e+03 0.025	1e+02 0.025	1e+01 317	1e+00 6930	1e-01 42100	1e-02 42200	1e-03 42200	1e-04 42300	1e-05 42400	1e-07 42500	Δftarget $\mathrm{ERT}_{\mathrm{best}}$/D
ALPS	**1**	**1**	*42e+0/1e5*	.	.	.	.	.	.	.	ALPS [11]
AMaLGaM IDEA	**1**	**1**	7.5	100	95	95	95	95	**95**	**95**	AMaLGaM IDEA [4]
BayEDAcG	**1**	**1**	3.8	**1**	*17e-1/2e3*	.	.	.	.	.	BayEDAcG [6]
BFGS	**1**	**1**	*83e+0/2e3*	.	.	.	.	.	.	.	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**	*47e+0/1e4*	.	.	.	.	.	.	.	(1+1)-CMA-ES [2]
DASA	**1**	**1**	*75e+0/2e5*	.	.	.	.	.	.	.	DASA [12]
DEPSO	**1**	**1**	12	*20e+0/2e3*	.	.	.	.	.	.	DEPSO [7]
iAMaLGaM IDEA	**1**	**1**	**3.4**	66	**40**	**50**	**68**	**70**	97	97	iAMaLGaM IDEA [4]
(1+1)-ES	**1**	**1**	2.2e4	*20e+0/1e6*	.	.	.	.	.	.	(1+1)-ES [1]
Monte Carlo	**1**	**1**	*68e+0/1e6*	.	.	.	.	.	.	.	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.