Comparison Tables: BBOB 2013 Function Testbed with BBOB 2009 as Reference (Expensive Setting)

The BBOBies

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Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2013 with a focus on benchmarking black-box algorithms for small function evaluation budgets ("expensive setting"), see `http://coco.gforge.inria.fr/doku.php?id=bbob-2013`. About 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 [6, 4]. The experimental set-up is described in [5].

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 [2]) if an algorithm from BBOB-2009 reached the given target function value. The ERT value is given otherwise ($\mathrm{ERT}_{\mathrm{best}}$ is noted as infinite). See [5] for details on how ERT is obtained. Bold entries in the table correspond to values below 3 or the top-three best values. Table 1 gives an overview on all algorithms submitted to the noise-free testbed in 2013.

Table 1: Names and references of all algorithms submitted for the noise-free testbed

algorithm short name	paper	reference
BIPOP-aCMA-STEP los	BI-Population CMA-ES Algorithms with Surrogate Models and Line Searches (Page 1177)	[11]
BIPOP-saACM-k los	BI-Population CMA-ES Algorithms with Surrogate Models and Line Searches (Page 1177)	[11]
CMAES hut	An Evaluation of Sequential Model-Based Optimization for Expensive Blackbox Functions (Page 1209)	[8]
DE pal	Benchmarking a Hybrid Multi Level Single Linkage Algorithm on the BBOB Noiseless Testbed	[12]
HCMA los	BI-Population CMA-ES Algorithms with Surrogate Models and Line Searches (Page 1177)	[11]
HMLSL pal	Benchmarking a Hybrid Multi Level Single Linkage Algorithm on the BBOB Noiseless Testbed	[12]
IPOP-10DDr lia	Bounding the Population Size of IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 1161)	[9]
IPOP-500 lia	Bounding the Population Size of IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 1161)	[9]
IPOP-tany lia	Testing the Impact of Parameter Tuning on a Variant of IPOP-CMA-ES with a Bounded Maximum Population Size on the Noiseless BBOB Testbed (Page 1169)	[10]
IPOP-texp lia	Testing the Impact of Parameter Tuning on a Variant of IPOP-CMA-ES with a Bounded Maximum Population Size on the Noiseless BBOB Testbed (Page 1169)	[10]
IPOP lia	Bounding the Population Size of IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 1161) Testing the Impact of Parameter Tuning on a Variant of IPOP-CMA-ES with a Bounded Maximum Population Size on the Noiseless BBOB Testbed (Page 1169)	[9] [10]
MLSL pal	Benchmarking a Hybrid Multi Level Single Linkage Algorithm on the BBOB Noiseless Testbed	[12]
OQNLP pal	Comparison of Multistart Global Optimization Algorithms on the BBOB Noiseless Testbed (Page 1153)	[13]
P-DCN tra	Multiobjectivization with NSGA-II on the Noiseless BBOB Testbed (Page 1217)	[15]
P-zero tra	Multiobjectivization with NSGA-II on the Noiseless BBOB Testbed (Page 1217)	[15]
SMAC hut	An Evaluation of Sequential Model-Based Optimization for Expensive Blackbox Functions (Page 1209)	[8]
U-DCN tra	Multiobjectivization with NSGA-II on the Noiseless BBOB Testbed (Page 1217)	[15]
U-zero tra	Multiobjectivization with NSGA-II on the Noiseless BBOB Testbed (Page 1217)	[15]
fmincon pal	Comparison of Multistart Global Optimization Algorithms on the BBOB Noiseless Testbed (Page 1153)	[13]
fminunc pal	Comparison of Multistart Global Optimization Algorithms on the BBOB Noiseless Testbed (Page 1153)	[13]
ga100 hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
grid100 hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
grid16 hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
hill hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
lmmCMA aug	Benchmarking the Local Metamodel CMA-ES on the Noiseless BBOB'2013 Test Bed (Page 1225)	[1]
memPSODE vog	Adapt-MEMPSODE: A Memetic Algorithm with Adaptive Selection of Local Searches (Page 1137)	[16]
prcga saw	Benchmarking Projection-Based Real Coded Genetic Algorithm on BBOB-2013 Noiseless Function Testbed (Page 1193)	[14]
ring100 hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
ring16 hol	Benchmarking Cellular Genetic Algorithms on the BBOB Noiseless Testbed (Page 1201)	[7]
simplex pal	Comparison of Multistart Global Optimization Algorithms on the BBOB Noiseless Testbed (Page 1153)	[13]

Table 2: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*1.6e+1*:1.2	*4.0e+0*:2.6	*2.5e-2*:6.2	*1.0e-8*:6.2	*1.0e-8*:6.2	15/15
BIPOP-aCMA	**2.4**(1)	4.1(3)	5.2(1.0)	11(0.5)	11(0.5)	15/15
BIPOP-saAC	5.8(5)	6.5(6)	10(4)	21(2)	21(2)	15/15
CMAES hut	4.4(9)	4.1(5)	11(4)	166(150)	166(166)	3/15
DE pal	**2.4**(2)	**2.1**(2)	14(11)	76(9)	76(9)	15/15
HCMA los	3.3(2)	**2.2**(0)	**0.97**(0)$^{\star 4}$	**0.97**(0)$^{\star 4}$	**0.97**(0)$^{\star 4}$	15/15
HMLSL pal	**1.5**(1)	**1.5**(1)	**1.8**(0.5)	**3.1**(0.5)	**3.1**(0.5)	15/15
IPOP-10DDr	**1.7**(0.8)	**2.9**(2)	9.3(3)	36(3)	36(3)	15/15
IPOP-500 l	**1.7**(0.8)	**2.9**(2)	9.3(3)	36(3)	36(3)	15/15
IPOP-tany	**1.7**(0.8)	**2.7**(2)	10(2)	33(3)	33(3)	15/15
IPOP-texp	4.3(7)	4.8(5)	7.4(4)	35(5)	35(5)	15/15
IPOP lia	**1.7**(0.8)	**2.9**(2)	9.3(3)	36(3)	36(3)	15/15
MLSL pal	**1.5**(1)	**1.5**(1)	**1.8**(0.5)	**3.1**(0.5)	**3.1**(0.5)	15/15
OQNLP pal	3.3(5)	3.8(2)	**2.8**(0.6)	3.2(0.7)	3.2(0.7)	15/15
P-DCN tra	**1.3**(0.8)	3.5(3)	22(14)	281(150)	281(150)	15/15
P-zero tra	**1.3**(0.8)	3.3(4)	16(12)	1404(1414)	1404(1414)	15/15
SMAC hut	**1.6**(1)	**1.9**(1)	**2.4**(0.6)	∞	∞ *200*	0/15
U-DCN tra	**1.3**(0.8)	3.3(5)	29(26)	3261(4538)	3261(4538)	15/15
U-zero tra	**1.3**(0.8)	**2.2**(2)	32(31)	5.5e4(4e4)	5.5e4(4e4)	15/15
fmincon pa	**1.5**(1)	**1.5**(1)	**1.8**(0.5)	**3.1**(0.5)	**3.1**(0.5)	15/15
fminunc pa	**1.5**(1)	**2.0**(1)	**1.1**(0)	**1.1**(0)	**1.1**(0)	15/15
ga100 hol	**2.6**(3)	**2.8**(3)	65(48)	2.3e5(2e5)	2.3e5(3e5)	1/15
grid100 ho	**2.6**(2)	**2.5**(2)	103(80)	2.4e5(3e5)	2.4e5(2e5)	1/15
grid16 hol	**2.3**(2)	3.7(2)	44(32)	7.3e4(8e4)	7.3e4(8e4)	3/15
hill hol	6.5(8)	4.6(4)	18(12)	2.9e4(3e4)	2.9e4(3e4)	7/15
lmmCMA aug	**1.8**(2)	**2.9**(3)	3.6(0.9)	8.8(0.8)	8.8(0.8)	15/15
memPSODE v	3.2(3)	3.3(2)	18(8)	78(27)	78(27)	15/15
prcga saw	**1.9**(1)	**2.3**(2)	31(35)	247(165)	247(165)	15/15
ring100 ho	**2.1**(2)	**2.7**(3)	77(70)	7.5e4(8e4)	7.5e4(9e4)	3/15
ring16 hol	**1.9**(2)	**2.4**(3)	45(24)	5.5e4(6e4)	5.5e4(6e4)	4/15
simplex pa	8.0(13)	13(14)	12(4)	20(3)	20(3)	15/15

Table 3: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*1.0e+7*:1.4	*1.6e+6*:2.7	*1.0e+5*:6.1	*6.3e-1*:20	*1.0e-8*:30	15/15
BIPOP-aCMA	**1.7**(1)	3.4(3)	**2.7**(1)	**2.8**(0.4)	**3.7**(0.7)	15/15
BIPOP-saAC	**1.7**(1)	**2.5**(2)	**2.5**(3)	6.9(2)	7.5(2)	15/15
CMAES hut	**1.6**(1)	**2.1**(3)	3.1(3)	36(36)	∞ *206*	0/15
DE pal	**1.2**(0.4)	**1.4**(1)	**1.4**(1)	12(4)	23(4)	15/15
HCMA los	**2.4**(2)	**1.8**(0.9)	**0.98**(0.6)	4.2(4)	6.3(3)	15/15
HMLSL pal	**1.4**(1)	3.1(3)	**2.0**(1)	**1.4**(0.5)	**2.8**(0.6)	15/15
IPOP-10DDr	**1.1**(1)	**2.2**(1)	**2.8**(2)	27(2)	28(1)	15/15
IPOP-500 l	**1.1**(1)	**2.2**(1)	**2.8**(2)	27(2)	28(1)	15/15
IPOP-tany	**1.2**(1)	**2.3**(1)	**1.9**(1)	22(10)	27(1)	15/15
IPOP-texp	**1.4**(2)	**2.8**(2)	**2.0**(0.9)	20(11)	26(3)	15/15
IPOP lia	**1.1**(1)	**2.2**(1)	**2.8**(2)	27(2)	28(1)	15/15
MLSL pal	**1.4**(1)	3.1(3)	**2.0**(1)	**1.4**(0.5)	**2.8**(0.6)	15/15
OQNLP pal	**2.9**(4)	4.0(2)	**2.6**(2)	3.5(1)	103(118)	6/15
P-DCN tra	**0.95**(0.4)	**1.3**(0.9)	**3.0**(5)	17(15)	1575(357)	15/15
P-zero tra	**0.95**(0.4)	**1.6**(0.9)	3.2(4)	27(20)	1.0e5(1e5)	7/15
SMAC hut	**1.4**(1)	**1.4**(1)	**1.1**(0.7)	32(33)	∞ *200*	0/15
U-DCN tra	**0.95**(0.4)	**1.2**(0.9)	**1.8**(2)	177(238)	2.8e4(4e4)	11/15
U-zero tra	**0.95**(0.4)	**1.2**(0.9)	**1.9**(2)	1214(824)	∞ *2e6*	0/15
fmincon pa	**1.4**(1)	3.1(3)	**2.0**(1)	**1.4**(0.5)	**2.8**(0.6)	15/15
fminunc pa	**1.4**(1)	**2.4**(2)	**1.5**(0.7)	**2.9**(2)	**4.0**(0.8)	15/15
ga100 hol	**1.6**(1)	**1.5**(1)	**2.9**(3)	269(350)	∞ *1e5*	0/15
grid100 ho	**1.4**(2)	**2.0**(2)	3.6(4)	291(145)	∞ *1e5*	0/15
grid16 hol	**1.3**(0.7)	**1.6**(1)	3.9(5)	463(338)	∞ *1e5*	0/15
hill hol	5.0(4)	4.5(4)	3.8(3)	247(370)	∞ *1e5*	0/15
lmmCMA aug	**1.4**(1)	**2.3**(3)	**1.8**(1)	4.8(1)	5.3(0.6)	15/15
memPSODE v	**1.5**(1)	**2.6**(5)	**2.6**(2)	63(51)	58(21)	15/15
prcga saw	**1.8**(2)	**1.9**(2)	7.4(13)	18(7)	111(130)	15/15
ring100 ho	**1.3**(1)	**1.5**(1)	4.9(5)	657(1063)	∞ *1e5*	0/15
ring16 hol	**1.0**(0.7)	**1.3**(1)	6.8(10)	355(490)	∞ *1e5*	0/15
simplex pa	6.8(11)	10(7)	5.5(1.0)	4.8(2)	5.7(0.6)	15/15

Table 4: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*1.0e+2*:1.4	*4.0e+1*:4.1	*2.5e+1*:6.6	*6.3e+0*:26	*2.5e+0*:112	15/15
BIPOP-aCMA	**2.1**(2)	**2.5**(2)	**2.3**(1)	**1.9**(1)	**1.7**(3)	15/15
BIPOP-saAC	3.0(4)	**2.7**(3)	10(26)	5.6(7)	**2.8**(2)	15/15
CMAES hut	3.6(4)	3.4(5)	4.3(4)	3.4(3)	3.6(4)	6/15
DE pal	**2.3**(1)	**1.7**(2)	**2.3**(2)	**3.0**(2)	**1.3**(0.9)	15/15
HCMA los	**2.0**(2)	**2.3**(1)	**2.1**(2)	**1.7**(1)	**0.82**(0.5)	15/15
HMLSL pal	8.1(18)	6.0(7)	5.1(5)	4.5(3)	**2.0**(1)	15/15
IPOP-10DDr	**2.2**(2)	**1.7**(2)	**1.8**(1)	6.3(14)	4.7(4)	15/15
IPOP-500 l	**2.2**(2)	**1.7**(2)	**1.8**(1)	6.3(14)	4.7(4)	15/15
IPOP-tany	**2.2**(2)	**1.5**(2)	**2.4**(3)	**2.2**(2)	3.3(4)	15/15
IPOP-texp	**2.4**(2)	**1.8**(2)	**2.0**(2)	7.9(13)	5.2(3)	15/15
IPOP lia	**2.2**(2)	**1.7**(2)	**1.8**(1)	6.3(14)	4.7(4)	15/15
MLSL pal	8.2(17)	5.9(8)	5.3(6)	5.8(5)	**2.7**(2)	15/15
OQNLP pal	28(49)	19(18)	13(11)	10(3)	3.6(3)	15/15
P-DCN tra	**1.6**(1)	**1.5**(2)	**2.3**(2)	543(62)	297(477)	15/15
P-zero tra	**1.6**(1)	**1.4**(2)	**2.6**(2)	524(1632)	434(709)	15/15
SMAC hut	**1.5**(2)	**1.2**(1)	**1.7**(1)	**2.4**(2)	**1.7**(1)	11/15
U-DCN tra	**1.6**(1)	**1.4**(1)	**2.6**(2)	3.9(4)	**2.5**(2)	15/15
U-zero tra	**1.6**(1)	**1.4**(2)	3.4(3)	3.3(2)	**1.8**(2)	15/15
fmincon pa	8.2(17)	6.0(7)	5.2(4)	4.6(4)	**2.1**(2)	15/15
fminunc pa	6.7(12)	4.3(6)	6.3(8)	4.4(4)	**2.9**(3)	15/15
ga100 hol	**1.6**(1)	**2.0**(3)	**2.9**(2)	7.9(8)	3.5(3)	15/15
grid100 ho	**1.7**(1)	**2.5**(3)	4.4(6)	14(15)	10(5)	15/15
grid16 hol	**1.7**(2)	**1.5**(2)	3.6(4)	4.6(4)	**2.1**(2)	15/15
hill hol	4.1(6)	3.1(2)	**2.5**(2)	**2.2**(2)	**1.4**(0.9)	15/15
lmmCMA aug	**1.2**(1)	**1.8**(1)	**1.8**(0.9)	**2.8**(4)	**2.3**(2)	15/15
memPSODE v	**2.2**(1)	**1.7**(1)	**2.2**(3)	8.8(15)	3.4(5)	15/15
prcga saw	**1.4**(1)	**2.2**(2)	**2.9**(5)	**2.9**(3)	**1.9**(1)	15/15
ring100 ho	**1.4**(1)	**1.4**(0.7)	**2.7**(3)	15(16)	6.1(5)	15/15
ring16 hol	**1.2**(1)	**0.90**(0.9)	**1.3**(1.0)	6.2(6)	**2.5**(2)	15/15
simplex pa	45(54)	24(20)	18(11)	11(3)	4.4(4)	15/15

Table 5: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*6.3e+1*:2.4	*4.0e+1*:5.2	*2.5e+1*:8.5	*1.0e+1*:22	*2.5e+0*:120	5/5
BIPOP-aCMA	3.0(3)	**2.4**(2)	**2.6**(2)	**1.8**(1)	**1.8**(0.6)	15/15
BIPOP-saAC	**2.8**(2)	**1.7**(2)	**2.3**(2)	**2.7**(2)	4.5(4)	15/15
CMAES hut	3.6(5)	**2.8**(3)	**2.7**(3)	**2.2**(2)	4.4(5)	5/15
DE pal	**1**(0.6)	**1.3**(2)	**2.2**(2)	3.2(3)	**1.5**(0.8)	15/15
HCMA los	**2.4**(1)	**2.1**(0.8)	**2.0**(2)	**2.0**(1)	**1.2**(0.6)	15/15
HMLSL pal	5.6(11)	4.4(5)	3.4(3)	4.7(4)	**2.2**(2)	15/15
IPOP-10DDr	**1.6**(2)	**1.8**(2)	3.1(3)	10(16)	8.8(8)	15/15
IPOP-500 l	**1.6**(2)	**1.8**(2)	3.1(3)	10(16)	8.9(8)	15/15
IPOP-tany	**1.4**(1)	**1.1**(0.9)	**1.4**(1)	4.3(3)	13(12)	15/15
IPOP-texp	**2.3**(2)	**1.5**(2)	**1.3**(1)	**1.0**(1)	11(16)	15/15
IPOP lia	**1.6**(2)	**1.8**(2)	3.1(3)	10(16)	8.9(8)	15/15
MLSL pal	5.6(10)	4.6(6)	3.5(3)	4.9(5)	**2.9**(3)	15/15
OQNLP pal	20(29)	15(15)	10(10)	8.7(6)	11(14)	12/15
P-DCN tra	**1.5**(1)	**1.3**(1)	**1.9**(2)	5.4(4)	596(865)	15/15
P-zero tra	**1.5**(1)	**1.2**(1)	**1.7**(1)	**2.5**(1)	400(1111)	15/15
SMAC hut	**0.97**(1)	**0.95**(0.8)	**1.1**(0.9)	**2.5**(3)	**2.0**(2)	9/15
U-DCN tra	**1.5**(1)	**1.0**(0.7)	**2.1**(2)	3.7(2)	**1.8**(1)	15/15
U-zero tra	**1.5**(1)	**1.1**(0.8)	**2.5**(2)	3.3(2)	**2.3**(1)	15/15
fmincon pa	5.5(11)	4.5(6)	3.4(4)	4.6(4)	4.1(4)	15/15
fminunc pa	7.1(11)	3.8(5)	3.4(3)	3.6(3)	4.9(3)	15/15
ga100 hol	**1.8**(2)	**1.7**(2)	4.5(4)	6.9(6)	6.4(2)	15/15
grid100 ho	**1.4**(0.6)	**1.8**(2)	**2.3**(2)	14(12)	13(10)	15/15
grid16 hol	**1.6**(1)	**2.1**(3)	4.7(6)	6.0(5)	4.3(4)	15/15
hill hol	**2.9**(4)	**2.2**(2)	**2.2**(2)	**1.7**(2)	**2.0**(1)	15/15
lmmCMA aug	**1.6**(2)	**1.2**(0.8)	**1.4**(1)	**2.2**(2)	4.1(7)	13/15
memPSODE v	**2.5**(2)	3.6(3)	4.7(4)	3.6(2)	5.2(9)	15/15
prcga saw	**1.4**(1)	**1.1**(0.9)	**2.6**(3)	**2.9**(2)	6.1(10)	15/15
ring100 ho	**1.7**(1)	**2.2**(3)	**2.7**(3)	12(10)	10(5)	15/15
ring16 hol	**2.7**(1)	3.1(5)	4.3(4)	5.3(5)	**2.8**(2)	15/15
simplex pa	33(34)	29(18)	19(11)	11(5)	7.4(6)	15/15

Table 6: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*4.0e+1*:1.4	*1.6e+1*:3.5	*1.0e-8*:4.4	*1.0e-8*:4.4	*1.0e-8*:4.4	15/15
BIPOP-aCMA	**2.0**(1)	**1.1**(0.4)	**1.4**(0)	**1.4**(0)	**1.4**(0)	15/15
BIPOP-saAC	3.3(5)	3.1(2)	5.5(2)	5.5(2)	5.5(2)	15/15
CMAES hut	5.0(4)	3.5(3)	5.5(3)	5.5(3)	5.5(3)	15/15
DE pal	**1.9**(1)	**2.7**(3)	357(34)	357(34)	357(34)	15/15
HCMA los	**2.3**(1)	**1.2**(0.3)	**1.5**(0.2)	**1.5**(0.2)	**1.5**(0.2)	15/15
HMLSL pal	**2.9**(0)	**1.2**(0)	46(49)	46(49)	46(49)	15/15
IPOP-10DDr	3.0(1)	**1.9**(0.1)	**3.8**(0.5)	**3.8**(0.5)	**3.8**(0.5)	15/15
IPOP-500 l	3.0(1)	**1.9**(0.1)	**3.8**(0.5)	**3.8**(0.5)	**3.8**(0.5)	15/15
IPOP-tany	3.0(1)	**2.2**(0.3)	8.6(6)	8.6(6)	8.6(6)	15/15
IPOP-texp	6.7(2)	5.0(0.1)	43(27)	43(27)	43(27)	15/15
IPOP lia	3.0(1)	**1.9**(0.1)	**3.8**(0.5)	**3.8**(0.5)	**3.8**(0.5)	15/15
MLSL pal	**2.9**(0)	**1.2**(0)	26(34)	26(34)	26(34)	15/15
OQNLP pal	9.3(0)	4.3(0)	4.1(0)	4.1(0)	4.1(0)	15/15
P-DCN tra	**1.1**(0.4)	**1.3**(0.7)	226(38)	226(38)	226(38)	15/15
P-zero tra	**1.1**(0.4)	**1.3**(0.7)	115(43)	115(43)	115(43)	15/15
SMAC hut	**2.1**(0.7)	**1**(0.1)	**1.1**(0.2)	**1.1**(0.2)	**1.1**(0.2)	15/15
U-DCN tra	**1.1**(0.4)	**1.3**(0.7)	6.7e6(7e6)	6.7e6(7e6)	6.7e6(7e6)	1/15
U-zero tra	**1.1**(0.4)	**1.3**(0.7)	∞	∞	∞ *2e6*	0/15
fmincon pa	**2.9**(0)	**1.2**(0)	20(20)	20(20)	20(20)	15/15
fminunc pa	5.0(0)	**2.0**(0)	**3.0**(0)	**3.0**(0)	**3.0**(0)	15/15
ga100 hol	**2.3**(3)	**2.2**(2)	59(30)	59(30)	59(30)	15/15
grid100 ho	**1.7**(1)	**2.4**(2)	85(76)	85(76)	85(76)	15/15
grid16 hol	**2.1**(2)	**2.7**(2)	35(23)	35(23)	35(23)	15/15
hill hol	5.7(10)	3.5(4)	7.2(5)	7.2(5)	7.2(5)	15/15
lmmCMA aug	5.5(4)	3.8(2)	5.1(2)	5.1(2)	5.1(2)	15/15
memPSODE v	**2.9**(2)	**2.6**(1)	8.4(6)	8.4(6)	8.4(6)	15/15
prcga saw	**2.0**(2)	11(17)	3.6e5(4e5)	3.6e5(4e5)	3.6e5(4e5)	1/15
ring100 ho	**1.9**(1)	**2.0**(2)	78(40)	78(40)	78(40)	15/15
ring16 hol	**1.8**(2)	3.2(4)	33(20)	33(20)	33(20)	15/15
simplex pa	25(0)	11(0.1)	37(41)	37(41)	37(41)	15/15

Table 7: 02-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*6.3e+4*:1.4	*1.0e+2*:2.8	*1.6e+1*:10	*1.0e+0*:23	*2.5e-6*:103	15/15
BIPOP-aCMA	**1**(0.7)	**2.6**(2)	4.3(5)	4.7(3)	4.4(0.8)	15/15
BIPOP-saAC	3.5(4)	3.4(6)	**2.3**(4)	4.0(4)	4.3(3)	15/15
CMAES hut	3.1(6)	3.5(4)	**2.7**(2)	3.5(2)	∞ *206*	0/15
DE pal	**1.3**(0.7)	**2.9**(4)	**1.6**(1)	3.5(2)	10(3)	15/15
HCMA los	**1.4**(1)	**2.4**(2)	**3.0**(3)	5.9(3)	5.0(2)	15/15
HMLSL pal	**1.3**(1)	3.3(4)	**1.7**(1)	**1.6**(0.6)	**1.1**(0.4)	15/15
IPOP-10DDr	**1.7**(2)	**1.6**(1)	**1.2**(1)	3.8(3)	4.1(0.9)	15/15
IPOP-500 l	**1.7**(2)	**1.6**(1)	**1.2**(1)	3.8(3)	4.1(0.9)	15/15
IPOP-tany	**1.8**(2)	**1.9**(1)	**1.2**(2)	**3.0**(2)	4.2(0.7)	15/15
IPOP-texp	**2.8**(4)	3.5(3)	**2.1**(2)	3.9(3)	4.5(2)	15/15
IPOP lia	**1.7**(2)	**1.6**(1)	**1.2**(1)	3.8(3)	4.1(0.9)	15/15
MLSL pal	**1.3**(1)	3.3(4)	**1.7**(1)	**1.6**(0.6)	**1.1**(0.4)	15/15
OQNLP pal	**2.9**(5)	3.9(4)	**2.0**(1)	**2.5**(2)	**2.5**(2)	15/15
P-DCN tra	**1.0**(0.4)	4.0(2)	3.7(6)	6.7(6)	43(31)	15/15
P-zero tra	**1.0**(0.4)	6.0(3)	4.0(10)	8.2(7)	188(157)	15/15
SMAC hut	**0.90**(0.4)	**1.3**(1)	**0.98**(0.9)	9.2(9)	∞ *200*	0/15
U-DCN tra	**1.0**(0.4)	**1.3**(2)	**0.95**(0.8)	6.2(5)	6123(9749)	13/15
U-zero tra	**1.0**(0.4)	**1.2**(1)	**0.93**(1)	12(19)	2.0e4(3e4)	9/15
fmincon pa	**1.3**(1)	3.3(4)	**1.7**(1)	**1.6**(0.6)	**1.1**(0.4)	15/15
fminunc pa	**1.9**(2)	**2.9**(3)	**1.6**(1)	**2.6**(2)	**1.9**(1)	15/15
ga100 hol	**1**(0.4)	**1.5**(2)	**1.8**(2)	16(15)	∞ *1e5*	0/15
grid100 ho	**1.4**(1)	**1.9**(2)	**2.1**(3)	22(23)	∞ *1e5*	0/15
grid16 hol	**1.1**(0.7)	**2.9**(3)	**2.5**(3)	17(18)	7066(7757)	2/15
hill hol	**2.4**(3)	**2.1**(2)	**1.7**(2)	5.6(4)	7195(7757)	2/15
lmmCMA aug	**1**(1)	**1.3**(0.9)	**0.89**(0.8)	**2.6**(2)	**2.8**(0.6)	15/15
memPSODE v	**1.7**(1)	**2.0**(2)	**2.8**(2)	4.1(2)	7.3(3)	15/15
prcga saw	**1.5**(1)	**2.0**(2)	**2.0**(2)	26(43)	174(207)	15/15
ring100 ho	**1.2**(0.4)	**1.5**(2)	**2.0**(1)	13(15)	∞ *1e5*	0/15
ring16 hol	**1.3**(1)	**2.4**(2)	**2.5**(3)	13(9)	7039(7272)	2/15
simplex pa	6.7(12)	11(15)	5.1(3)	4.4(2)	**1.8**(0.5)	15/15

Table 8: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*4.0e+2*:1.6	*1.0e+1*:3.2	*2.5e+0*:14	*1.6e+0*:21	*1.6e-2*:188	15/15
BIPOP-aCMA	**1.2**(0.6)	4.3(4)	**2.8**(4)	3.4(3)	**1.2**(0.7)	15/15
BIPOP-saAC	**2.5**(4)	5.4(3)	**2.8**(3)	**2.9**(4)	**1.1**(0.9)	15/15
CMAES hut	**2.5**(2)	5.9(6)	3.0(3)	**2.8**(4)	**1.3**(1)	9/15
DE pal	**0.87**(0.3)	4.6(6)	3.1(3)	**2.5**(2)	**1.5**(0.5)	15/15
HCMA los	**1.5**(1)	**2.8**(1)	**2.5**(3)	3.2(3)	**1.6**(0.8)	15/15
HMLSL pal	**1.6**(1)	3.9(5)	**2.3**(2)	**2.8**(3)	**2.2**(2)	15/15
IPOP-10DDr	**0.96**(0.6)	4.1(4)	**1.7**(2)	3.9(7)	**1.7**(2)	15/15
IPOP-500 l	**0.96**(0.6)	4.1(4)	**1.7**(2)	3.9(7)	**1.7**(2)	15/15
IPOP-tany	**1.2**(0.6)	3.6(3)	**2.8**(2)	3.8(6)	**2.0**(2)	15/15
IPOP-texp	**2.0**(3)	3.9(4)	3.5(2)	3.2(5)	**1.6**(1.0)	15/15
IPOP lia	**0.96**(0.6)	4.1(4)	**1.7**(2)	3.9(7)	**1.7**(2)	15/15
MLSL pal	**2.5**(3)	4.7(5)	3.1(4)	5.0(7)	45(57)	13/15
OQNLP pal	4.0(4)	6.4(5)	**2.7**(2)	**2.5**(3)	**1.5**(0.5)	15/15
P-DCN tra	**1.9**(0.6)	22(30)	6610(97)	1.5e4(5e4)	1643(5312)	13/15
P-zero tra	**1.3**(0.6)	10(17)	1.0e4(313)	1.5e4(5e4)	1686(5316)	13/15
SMAC hut	**1.6**(1)	**2.0**(2)	**0.86**(0.8)	**0.89**(0.5)	**2.0**(2)	6/15
U-DCN tra	**1.5**(0.6)	5.6(7)	3.2(3)	3.6(3)	72(167)	15/15
U-zero tra	**1.3**(0.6)	5.0(5)	3.8(6)	**3.0**(4)	43(49)	15/15
fmincon pa	**1.8**(2)	3.9(5)	3.4(4)	4.3(4)	33(50)	14/15
fminunc pa	**1.9**(2)	4.9(5)	4.0(6)	3.7(4)	38(49)	14/15
ga100 hol	**1.1**(0.9)	**2.4**(2)	**2.2**(2)	**2.2**(2)	10(10)	15/15
grid100 ho	**1.2**(2)	6.4(7)	3.8(2)	4.4(6)	41(32)	15/15
grid16 hol	**1.0**(0.6)	4.2(4)	**1.9**(3)	**2.4**(3)	7.3(9)	15/15
hill hol	3.5(8)	6.2(10)	4.2(8)	4.6(6)	30(46)	15/15
lmmCMA aug	**1.9**(2)	**3.5**(3)	**2.5**(4)	**2.1**(3)	**0.56**(0.7)	15/15
memPSODE v	**1.5**(0.9)	5.5(8)	13(27)	16(23)	10(8)	15/15
prcga saw	**1.5**(2)	**3.5**(2)	**1.4**(1)	**2.2**(2)	3.8(5)	15/15
ring100 ho	**1.3**(0.6)	4.1(5)	**3.0**(4)	3.5(4)	15(12)	15/15
ring16 hol	**1.5**(2)	7.0(9)	4.5(4)	3.8(4)	10(10)	15/15
simplex pa	**1.9**(2)	5.5(6)	3.4(3)	3.6(2)	5.7(8)	15/15

Table 9: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*2.5e+3*:1.2	*1.0e+2*:3.2	*6.3e+0*:7.0	*1.6e-1*:27	*1.6e-6*:100	15/15
BIPOP-aCMA	**2.3**(2)	3.3(4)	7.7(5)	11(9)	5.5(3)	15/15
BIPOP-saAC	**1.7**(1)	3.1(3)	3.9(3)	6.5(6)	3.3(2)	15/15
CMAES hut	**2.8**(4)	3.4(3)	10(15)	13(12)	∞ *206*	0/15
DE pal	**1.9**(2)	**2.9**(3)	6.5(5)	12(8)	11(2)	15/15
HCMA los	**1.8**(0.8)	**2.0**(2)	**1.8**(2)	9.0(6)	4.2(2)	15/15
HMLSL pal	**1.8**(1)	**1.6**(2)	**2.8**(3)	**2.5**(2)	**1.0**(0.5)	15/15
IPOP-10DDr	**2.4**(0.8)	3.8(3)	**2.6**(2)	11(7)	6.2(1)	15/15
IPOP-500 l	**2.4**(0.8)	3.8(3)	**2.6**(2)	11(7)	6.2(1)	15/15
IPOP-tany	3.7(4)	3.4(2)	4.4(3)	10(3)	6.0(0.9)	15/15
IPOP-texp	7.8(10)	5.2(4)	4.6(3)	7.7(6)	5.9(0.9)	15/15
IPOP lia	**2.4**(0.8)	3.8(3)	**2.6**(2)	11(7)	6.2(1)	15/15
MLSL pal	**1.8**(1)	**1.6**(2)	**2.8**(3)	**2.5**(2)	**1.0**(0.5)	15/15
OQNLP pal	3.3(5)	**2.9**(3)	**2.2**(2)	**2.2**(2)	**1.1**(0.6)	15/15
P-DCN tra	**1.3**(0.8)	8.8(14)	11(8)	51(61)	383(370)	15/15
P-zero tra	**1.3**(0.8)	4.3(7)	79(222)	74(123)	927(1121)	15/15
SMAC hut	**1.7**(2)	**1.6**(1)	3.3(3)	10(11)	∞ *200*	0/15
U-DCN tra	**1.3**(0.8)	**2.6**(2)	8.4(5)	35(55)	∞ *2e6*	0/15
U-zero tra	**1.3**(0.8)	**2.7**(2)	6.1(4)	82(133)	∞ *2e6*	0/15
fmincon pa	**1.8**(1)	**1.6**(2)	**2.8**(3)	**2.5**(2)	**1.0**(0.5)	15/15
fminunc pa	**1.7**(1)	**1.9**(2)	**1.8**(2)	**1.9**(2)	**0.91**(0.4)	15/15
ga100 hol	**2.3**(2)	3.1(3)	7.9(7)	32(32)	∞ *1e5*	0/15
grid100 ho	**2.4**(2)	3.9(4)	5.6(4)	68(28)	∞ *1e5*	0/15
grid16 hol	**2.3**(2)	5.9(8)	13(18)	69(109)	∞ *1e5*	0/15
hill hol	4.0(6)	4.3(5)	14(22)	49(69)	∞ *1e5*	0/15
lmmCMA aug	**2.1**(3)	**1.7**(2)	**2.4**(1)	3.3(2)	**1.6**(0.5)	15/15
memPSODE v	3.7(3)	6.9(8)	14(25)	29(34)	18(6)	15/15
prcga saw	**1.6**(0.8)	**2.0**(3)	4.0(4)	55(146)	170(151)	15/15
ring100 ho	**1.7**(2)	**2.7**(2)	8.7(10)	54(41)	∞ *1e5*	0/15
ring16 hol	**2.2**(2)	4.7(6)	10(9)	47(24)	1.4e4(2e4)	1/15
simplex pa	7.5(13)	6.8(5)	6.0(6)	3.7(3)	**1.6**(0.7)	15/15

Table 10: 02-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*6.3e+0*:13	*4.0e+0*:15	*2.5e+0*:15	*2.5e-1*:21	*1.0e-8*:94	15/15
BIPOP-aCMA	**2.9**(3)	3.5(3)	4.9(7)	12(10)	6.6(3)	15/15
BIPOP-saAC	**2.4**(3)	**2.5**(3)	4.3(4)	8.8(6)	4.0(2)	15/15
CMAES hut	**2.9**(3)	4.1(5)	5.8(8)	13(15)	∞ *206*	0/15
DE pal	4.3(4)	4.1(4)	4.1(4)	9.0(8)	15(3)	15/15
HCMA los	**2.6**(3)	**2.7**(3)	3.1(4)	7.3(8)	3.6(1)	15/15
HMLSL pal	**0.87**(0)	**0.74**(0)	**0.74**(0)	**0.53**(0)	**0.62**(0.0)	15/15
IPOP-10DDr	**2.7**(1)	3.9(2)	4.9(3)	11(11)	7.4(3)	15/15
IPOP-500 l	**2.7**(1)	3.9(2)	4.9(3)	11(11)	7.4(3)	15/15
IPOP-tany	**2.2**(2)	**2.0**(1)	3.4(3)	7.3(8)	7.1(2)	15/15
IPOP-texp	**1.2**(0.4)	**1.1**(0.4)	**1.6**(1)	6.8(6)	6.6(2)	15/15
IPOP lia	**2.7**(1)	3.9(2)	4.9(3)	11(11)	7.4(3)	15/15
MLSL pal	**0.87**(0)	**0.74**(0)	**0.74**(0)	**0.53**(0)	**0.62**(0.0)	15/15
OQNLP pal	**0.63**(0)	**0.54**(0)	**0.61**(0)	**0.56**(0.0)	**1.4**(2)	15/15
P-DCN tra	16(5)	20(6)	25(21)	89(116)	1.2e4(2e4)	10/15
P-zero tra	27(75)	48(121)	57(128)	96(96)	5.2e4(6e4)	5/15
SMAC hut	**2.2**(2)	**2.6**(2)	3.6(2)	33(32)	∞ *200*	0/15
U-DCN tra	**1.6**(2)	**1.9**(2)	**2.0**(2)	46(76)	3.0e5(3e5)	1/15
U-zero tra	**2.1**(2)	**2.9**(2)	3.4(2)	95(213)	∞ *2e6*	0/15
fmincon pa	**0.87**(0)	**0.74**(0)	**0.74**(0)	**0.53**(0)	**0.62**(0.0)	15/15
fminunc pa	**0.56**(0)	**0.47**(0)*	**0.47**(0)*	**0.34**(0)$^{\star 3}$	**0.68**(0.0)	15/15
ga100 hol	4.1(4)	5.6(8)	9.1(9)	20(17)	∞ *1e5*	0/15
grid100 ho	7.5(7)	11(14)	13(15)	40(27)	∞ *1e5*	0/15
grid16 hol	4.4(4)	4.6(4)	10(6)	33(26)	∞ *1e5*	0/15
hill hol	4.6(6)	4.6(5)	5.4(6)	36(43)	∞ *1e5*	0/15
lmmCMA aug	**1.5**(1)	**1.7**(0.6)	**1.9**(0.9)	3.1(2)	**1.8**(0.5)	15/15
memPSODE v	10(13)	10(11)	12(11)	24(37)	19(7)	15/15
prcga saw	**2.9**(2)	**2.8**(2)	3.1(2)	47(59)	193(124)	15/15
ring100 ho	3.5(3)	6.0(6)	9.0(10)	37(27)	∞ *1e5*	0/15
ring16 hol	4.2(4)	4.6(4)	5.2(5)	25(16)	∞ *1e5*	0/15
simplex pa	**0.88**(0.1)	**1.4**(0.1)	**1.6**(0.1)	**1.3**(0.2)	**1.5**(0.1)	15/15

Table 11: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*1.6e+6*:2.0	*4.0e+5*:3.2	*6.3e+2*:8.8	*1.0e+1*:30	*2.5e-8*:101	15/15
BIPOP-aCMA	**2.4**(4)	**1.9**(2)	6.6(5)	8.0(5)	**5.8**(0.7)	15/15
BIPOP-saAC	**2.8**(3)	**2.2**(4)	5.8(4)	3.8(2)	**2.2**(0.3)	15/15
CMAES hut	4.8(5)	3.8(5)	6.5(6)	10(8)	∞ *206*	0/15
DE pal	**2.4**(3)	**2.4**(3)	12(7)	11(4)	15(2)	15/15
HCMA los	**2.4**(2)	**2.0**(1)	**1.4**(0.5)	3.6(2)	**2.6**(0.5)	15/15
HMLSL pal	**2.8**(3)	**2.2**(2)	**1.8**(0.6)	**0.71**(0.2)	38(38)	15/15
IPOP-10DDr	**1.4**(0.8)	**2.1**(3)	6.1(4)	12(8)	8.0(0.7)	15/15
IPOP-500 l	**1.4**(0.8)	**2.1**(3)	6.1(4)	12(8)	8.0(0.7)	15/15
IPOP-tany	**1.8**(2)	**2.0**(1)	5.4(4)	8.9(8)	7.9(0.6)	15/15
IPOP-texp	**1.9**(2)	**2.1**(2)	5.1(3)	9.4(6)	7.5(0.5)	15/15
IPOP lia	**1.4**(0.8)	**2.1**(3)	6.1(4)	12(8)	8.0(0.7)	15/15
MLSL pal	**2.8**(3)	**2.2**(2)	**1.8**(0.6)	**0.71**(0.2)	181(314)	10/15
OQNLP pal	4.3(3)	3.1(2)	**2.6**(2)	**1.2**(0.7)	61(64)	7/15
P-DCN tra	**2.3**(4)	4.3(7)	7.3(7)	392(597)	2.8e5(3e5)	1/15
P-zero tra	**2.5**(2)	3.6(6)	5.7(3)	385(880)	3.0e5(3e5)	1/15
SMAC hut	**1.5**(1)	**1.1**(0.8)	**1.8**(0.7)	**1.3**(1)	∞ *200*	0/15
U-DCN tra	**2.1**(2)	**2.8**(4)	13(9)	164(243)	∞ *2e6*	0/15
U-zero tra	**1.9**(2)	**2.2**(2)	12(12)	269(456)	∞ *2e6*	0/15
fmincon pa	**2.8**(3)	**2.2**(2)	**1.8**(0.6)	**0.71**(0.2)	141(190)	11/15
fminunc pa	**2.4**(2)	**1.8**(1)	**1.4**(0.7)	**1.1**(1.0)	303(387)	8/15
ga100 hol	**2.3**(2)	**2.0**(2)	29(23)	386(725)	∞ *1e5*	0/15
grid100 ho	**1.8**(2)	**2.7**(3)	25(35)	311(511)	∞ *1e5*	0/15
grid16 hol	**1.6**(2)	**2.5**(2)	19(16)	45(38)	∞ *1e5*	0/15
hill hol	**2.1**(2)	**2.2**(2)	16(22)	265(433)	∞ *1e5*	0/15
lmmCMA aug	3.3(3)	**2.9**(2)	3.2(1)	**2.4**(1)	**1.6**(0.2)	15/15
memPSODE v	3.2(4)	4.7(5)	10(3)	22(35)	28(14)	15/15
prcga saw	**2.9**(4)	3.3(3)	9.4(6)	88(128)	8766(9765)	2/15
ring100 ho	**2.2**(2)	**2.4**(3)	18(29)	58(71)	∞ *1e5*	0/15
ring16 hol	**2.2**(2)	**2.4**(2)	13(9)	63(61)	∞ *1e5*	0/15
simplex pa	11(9)	8.0(6)	4.6(2)	**2.4**(2)	**1.7**(0.2)	15/15

Table 12: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*1.0e+7*:1.1	*1.6e+6*:3.2	*1.0e+4*:6.6	*4.0e+1*:23	*4.0e-8*:100	15/15
BIPOP-aCMA	**1.9**(1)	**2.2**(2)	5.4(4)	6.2(6)	**5.7**(0.6)	15/15
BIPOP-saAC	3.8(5)	**2.8**(3)	4.1(3)	3.5(1)	**2.2**(0.4)	15/15
CMAES hut	**1.9**(2)	**2.1**(3)	4.2(4)	5.6(5)	∞ *206*	0/15
DE pal	**1.8**(0.9)	**1.2**(0.8)	6.2(5)	8.7(4)	14(1)	15/15
HCMA los	**2.0**(1)	**2.0**(1)	**1.5**(0.5)	**2.2**(3)	**2.6**(0.5)	15/15
HMLSL pal	**1.7**(1)	**2.3**(2)	**2.0**(1)	**0.84**(0.4)	19(27)	15/15
IPOP-10DDr	**1.6**(0.9)	**1.6**(1)	4.5(2)	6.5(10)	8.2(0.5)	15/15
IPOP-500 l	**1.6**(0.9)	**1.6**(1)	4.5(2)	6.5(10)	8.2(0.5)	15/15
IPOP-tany	**1.6**(0.9)	**2.3**(1)	4.6(3)	5.3(2)	8.1(0.6)	15/15
IPOP-texp	3.2(5)	3.7(3)	4.0(3)	4.5(2)	8.1(1.0)	15/15
IPOP lia	**1.6**(0.9)	**1.6**(1)	4.5(2)	6.5(10)	8.2(0.5)	15/15
MLSL pal	**1.7**(1)	**2.3**(2)	**2.0**(1)	**0.84**(0.4)	97(158)	12/15
OQNLP pal	**2.9**(3)	3.1(2)	3.5(2)	**1.6**(1)	72(83)	7/15
P-DCN tra	**1.4**(0.9)	3.7(8)	10(12)	25(72)	8.6e4(1e5)	3/15
P-zero tra	**1.4**(0.9)	**2.5**(2)	6.8(7)	6.9(3)	1.4e5(1e5)	2/15
SMAC hut	**1.6**(1)	**1.2**(0.8)	**1.6**(1)	**1.4**(0.7)	∞ *200*	0/15
U-DCN tra	**1.4**(0.9)	**1.8**(2)	5.8(7)	13(12)	∞ *2e6*	0/15
U-zero tra	**1.4**(0.9)	**1.8**(2)	6.3(6)	28(27)	∞ *2e6*	0/15
fmincon pa	**1.7**(1)	**2.3**(2)	**2.0**(1)	**0.84**(0.3)	115(172)	13/15
fminunc pa	**1.7**(1)	**1.9**(1)	**1.8**(0.9)	**0.84**(0.3)	66(124)	13/15
ga100 hol	**1.6**(0.9)	**1.4**(1)	13(23)	17(17)	∞ *1e5*	0/15
grid100 ho	**1.6**(0.9)	**1.4**(1)	11(8)	29(26)	∞ *1e5*	0/15
grid16 hol	**1.3**(0.5)	**1.3**(1)	10(9)	30(39)	∞ *1e5*	0/15
hill hol	4.7(6)	3.4(3)	4.2(3)	23(37)	∞ *1e5*	0/15
lmmCMA aug	**2.5**(2)	**2.0**(2)	**2.6**(1)	**1.6**(0.7)	**1.6**(0.2)	15/15
memPSODE v	**2.2**(1)	**1.7**(2)	7.4(5)	11(5)	34(25)	15/15
prcga saw	**2.1**(1)	**1.8**(1)	6.1(6)	5.5(2)	5861(6109)	3/15
ring100 ho	**1.7**(1)	**1.4**(1)	9.0(8)	33(24)	∞ *1e5*	0/15
ring16 hol	**1.4**(0.9)	**1.2**(0.9)	8.1(7)	20(16)	∞ *1e5*	0/15
simplex pa	5.9(9)	8.0(6)	5.7(1)	**2.2**(0.6)	**1.7**(0.1)	15/15

Table 13: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*2.5e+8*:1.3	*6.3e+6*:2.7	*6.3e+5*:6.3	*4.0e+1*:21	*1.6e-3*:101	15/15
BIPOP-aCMA	**0.95**(0)	**1.2**(1)	**1.3**(1)	4.7(3)	5.7(1)	15/15
BIPOP-saAC	**1.5**(2)	**1.9**(2)	**1.6**(2)	5.3(2)	4.5(5)	15/15
CMAES hut	**0.75**(0)	**1.7**(3)	**1.7**(2)	9.4(10)	∞ *206*	0/15
DE pal	**1.3**(0.4)	**1**(1)	**1.7**(2)	7.0(5)	16(10)	15/15
HCMA los	**1.1**(0.8)	**1.5**(1)	**1.2**(0.8)	4.0(4)	5.3(4)	15/15
HMLSL pal	**1.1**(1)	**1.4**(2)	**1.2**(1.0)	**1.0**(0.6)	**0.99**(2)	15/15
IPOP-10DDr	**1.1**(1)	**1.5**(0.9)	**1.5**(1)	7.3(7)	14(12)	15/15
IPOP-500 l	**1.1**(1)	**1.5**(0.9)	**1.5**(1)	7.3(7)	14(12)	15/15
IPOP-tany	**1.2**(1)	**1.6**(1)	**1.2**(1)	6.2(7)	8.3(4)	15/15
IPOP-texp	**1.2**(1)	**2.6**(2)	**1.9**(1)	4.0(2)	10(10)	15/15
IPOP lia	**1.1**(1)	**1.5**(0.9)	**1.5**(1)	7.3(7)	14(12)	15/15
MLSL pal	**1.1**(1)	**1.4**(2)	**1.2**(1.0)	**1.0**(0.6)	**0.99**(2)	15/15
OQNLP pal	**1.6**(3)	3.2(2)	**1.9**(1)	**1.9**(1)	4.5(3)	15/15
P-DCN tra	**0.95**(0.4)	**0.98**(0.5)	**0.78**(1)	4.7(4)	446(428)	15/15
P-zero tra	**0.95**(0.4)	**0.98**(0.5)	**0.78**(0.6)	3.8(1)	645(376)	15/15
SMAC hut	**0.85**(0.4)	**0.73**(0.5)	**0.44**(0.3)	3.0(2)	∞ *200*	0/15
U-DCN tra	**0.95**(0.4)	**1.1**(0.5)	**0.85**(1)	12(8)	1.9e4(3e4)	8/15
U-zero tra	**0.95**(0.4)	**0.98**(0.5)	**0.83**(1)	29(26)	2.4e4(3e4)	7/15
fmincon pa	**1.1**(1)	**1.4**(2)	**1.2**(1.0)	**1.0**(0.6)	**0.99**(2)	15/15
fminunc pa	**1.1**(1)	**2.2**(2)	**1.6**(2)	**1.0**(0.7)	**1.7**(2)	15/15
ga100 hol	**0.90**(0.4)	**1.2**(0.9)	**1.6**(2)	23(25)	2233(2601)	5/15
grid100 ho	**1**(0.4)	**0.88**(0.7)	**1.4**(1)	57(52)	3375(3479)	4/15
grid16 hol	**0.95**(0.4)	**1**(0.7)	**1.5**(2)	31(30)	1.4e4(2e4)	1/15
hill hol	**1.6**(2)	**2.6**(3)	**1.8**(2)	49(57)	7062(7455)	2/15
lmmCMA aug	**0.95**(0.8)	**1.4**(2)	**1.1**(1)	**1.8**(0.5)	3.5(3)	15/15
memPSODE v	**1.3**(1)	**1.5**(1)	**1.8**(2)	24(50)	17(8)	15/15
prcga saw	**0.90**(0.4)	**1.1**(1)	4.1(2)	17(9)	712(823)	9/15
ring100 ho	**0.90**(0.4)	**1.0**(0.7)	**1.6**(2)	32(29)	3187(3479)	4/15
ring16 hol	**0.75**(0)	**0.90**(0.5)	**1.3**(1)	16(11)	1.4e4(2e4)	1/15
simplex pa	**2.7**(5)	8.2(7)	5.6(4)	**3.0**(1)	**2.1**(2)	15/15

Table 14: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*4.0e+2*:1.6	*2.5e+2*:3.1	*6.3e+1*:8.7	*1.0e+1*:23	*4.0e-6*:100	15/15
BIPOP-aCMA	3.2(3)	**1.9**(2)	3.2(3)	3.9(2)	**6.0**(0.8)	15/15
BIPOP-saAC	**2.4**(2)	**1.9**(2)	3.2(5)	3.3(2)	**2.7**(0.6)	15/15
CMAES hut	**2.6**(3)	**1.9**(2)	**2.4**(2)	3.2(2)	∞ *206*	0/15
DE pal	**2.3**(2)	**2.0**(2)	**3.0**(2)	4.9(2)	14(2)	15/15
HCMA los	**2.7**(2)	**1.7**(1)	**2.9**(5)	**2.9**(3)	**3.2**(0.8)	15/15
HMLSL pal	**1.5**(1)	**1.2**(0.8)	**1.2**(0.6)	**0.77**(0.3)	31(24)	15/15
IPOP-10DDr	**2.4**(3)	**2.0**(2)	3.3(2)	4.3(7)	8.7(2)	15/15
IPOP-500 l	**2.4**(3)	**2.0**(2)	3.3(2)	4.3(7)	8.7(2)	15/15
IPOP-tany	**2.7**(3)	**1.9**(2)	**3.0**(2)	5.9(8)	8.4(0.7)	15/15
IPOP-texp	3.5(5)	**2.4**(3)	**2.6**(2)	7.4(10)	8.1(0.8)	15/15
IPOP lia	**2.4**(3)	**2.0**(2)	3.3(2)	4.3(7)	8.7(2)	15/15
MLSL pal	**1.5**(1)	**1.2**(0.8)	**1.2**(0.6)	**0.77**(0.3)	360(456)	6/15
OQNLP pal	3.5(4)	**2.7**(2)	**1.7**(0.5)	**1.2**(0.6)	19(17)	10/15
P-DCN tra	**1.9**(2)	**2.1**(3)	4.2(4)	21(30)	∞ *2e6*	0/15
P-zero tra	**1.9**(2)	**1.9**(2)	4.0(3)	37(102)	∞ *2e6*	0/15
SMAC hut	**1.5**(2)	**1.0**(1)	**1.3**(1.0)	**1.6**(1)	∞ *200*	0/15
U-DCN tra	**1.9**(2)	**1.8**(2)	3.2(4)	10(10)	∞ *2e6*	0/15
U-zero tra	**1.9**(2)	**1.6**(2)	**2.0**(2)	11(11)	∞ *2e6*	0/15
fmincon pa	**1.5**(1)	**1.2**(0.8)	**1.2**(0.6)	**0.77**(0.3)	172(237)	9/15
fminunc pa	**1.4**(0.9)	**1.7**(1)	**1.4**(0.9)	5.2(5)	∞ *2e4*	0/15
ga100 hol	**2.5**(4)	**2.1**(2)	3.5(3)	11(12)	∞ *1e5*	0/15
grid100 ho	**2.0**(2)	**1.4**(0.8)	**2.3**(2)	24(21)	∞ *1e5*	0/15
grid16 hol	**1.7**(0.9)	**1.9**(2)	4.0(5)	15(25)	∞ *1e5*	0/15
hill hol	4.6(5)	**2.8**(3)	10(9)	13(18)	∞ *1e5*	0/15
lmmCMA aug	**1.5**(1)	**1.1**(1)	**1.4**(0.9)	**2.0**(2)	**3.0**(0.7)	15/15
memPSODE v	4.1(2)	3.5(2)	3.2(3)	12(19)	15(7)	15/15
prcga saw	**1.9**(1)	**1.4**(0.8)	**2.0**(2)	33(63)	∞ *1e5*	0/15
ring100 ho	**1.9**(2)	**2.0**(2)	3.5(4)	15(17)	∞ *1e5*	0/15
ring16 hol	**2.5**(2)	**2.3**(2)	4.0(4)	10(8)	∞ *1e5*	0/15
simplex pa	8.3(10)	7.0(5)	5.5(4)	4.1(2)	**2.2**(0.5)	15/15

Table 15: 02-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*1.6e+1*:1.4	*2.5e+0*:4.2	*1.0e+0*:7.4	*2.5e-2*:21	*1.0e-8*:101	15/15
BIPOP-aCMA	**2.1**(2)	4.7(7)	4.8(6)	5.4(2)	**6.5**(1)	15/15
BIPOP-saAC	**1.9**(2)	**3.0**(5)	3.4(4)	3.5(2)	**2.9**(0.3)	15/15
CMAES hut	**1.2**(0.7)	**2.0**(2)	**2.5**(3)	4.2(2)	∞ *206*	0/15
DE pal	**1.5**(1)	**1.8**(2)	3.7(3)	7.7(3)	14(2)	15/15
HCMA los	**1.4**(1)	3.6(3)	3.0(5)	4.9(4)	**3.2**(0.5)	15/15
HMLSL pal	**1.8**(2)	**1.3**(1)	**1.1**(0.8)	**1.0**(0.4)	39(14)	15/15
IPOP-10DDr	**1**(0.7)	**1.4**(2)	**1.9**(2)	3.6(1)	8.2(0.7)	15/15
IPOP-500 l	**1**(0.7)	**1.4**(2)	**1.9**(2)	3.6(1)	8.2(0.7)	15/15
IPOP-tany	**1**(0.7)	**1.7**(2)	**2.0**(2)	3.7(1)	8.2(1.0)	15/15
IPOP-texp	**1.9**(2)	**2.3**(3)	**2.5**(2)	3.4(1)	7.9(0.9)	15/15
IPOP lia	**1**(0.7)	**1.4**(2)	**1.9**(2)	3.6(1)	8.2(0.7)	15/15
MLSL pal	**1.8**(2)	**1.3**(1)	**1.1**(0.8)	**1.0**(0.4)	629(757)	4/15
OQNLP pal	3.2(4)	**2.6**(3)	**2.1**(2)	**1.5**(0.7)	100(98)	5/15
P-DCN tra	**1.1**(0.7)	4.2(3)	6.2(7)	8.0(4)	2.7e4(3e4)	7/15
P-zero tra	**1.1**(0.7)	**2.4**(2)	5.8(9)	6.2(4)	2.9e5(3e5)	1/15
SMAC hut	**0.76**(0)	**1.1**(1.0)	**1.8**(1)	3.9(1)	∞ *200*	0/15
U-DCN tra	**1.1**(0.7)	**1.8**(3)	3.0(3)	23(14)	∞ *2e6*	0/15
U-zero tra	**1.1**(0.7)	**1.3**(2)	**2.4**(2)	31(42)	∞ *2e6*	0/15
fmincon pa	**1.8**(2)	**1.3**(1)	**1.1**(0.8)	**1.0**(0.4)	2964(3028)	1/15
fminunc pa	**1.4**(1)	**1.6**(2)	**1.7**(2)	**1.5**(1)	526(595)	5/15
ga100 hol	**1.9**(1)	**2.1**(2)	**2.3**(2)	41(13)	∞ *1e5*	0/15
grid100 ho	**1**(0.4)	**1.4**(2)	3.2(2)	50(44)	∞ *1e5*	0/15
grid16 hol	**1.2**(0.4)	**2.0**(3)	4.5(8)	37(23)	∞ *1e5*	0/15
hill hol	3.6(4)	3.5(4)	**2.5**(2)	21(38)	∞ *1e5*	0/15
lmmCMA aug	**0.95**(0)	**1.4**(1)	**1.8**(2)	**1.9**(0.6)	**2.4**(0.4)	15/15
memPSODE v	**1.7**(1)	3.0(2)	3.5(3)	5.9(3)	34(32)	15/15
prcga saw	**1.4**(1)	**1.8**(2)	**2.3**(2)	7.4(3)	1692(1930)	7/15
ring100 ho	**1.3**(0.7)	**2.5**(2)	4.2(4)	55(30)	∞ *1e5*	0/15
ring16 hol	**2.0**(1)	**3.0**(3)	3.3(4)	21(16)	∞ *1e5*	0/15
simplex pa	7.6(11)	6.9(9)	7.9(6)	4.4(1)	**1.7**(0.2)$^{\star 3}$	15/15

Table 16: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*1.6e+2*:1.2	*4.0e+1*:4.7	*2.5e+1*:10	*1.0e+1*:37	*2.5e+0*:118	5/5
BIPOP-aCMA	**1.2**(0.4)	**1.2**(1)	**1.8**(2)	**1.4**(2)	**2.0**(3)	15/15
BIPOP-saAC	**1.7**(2)	**1.5**(2)	**1.3**(1)	**1.1**(0.7)	**1.4**(2)	15/15
CMAES hut	**2.6**(2)	**1.7**(2)	**1.2**(1)	**0.98**(0.8)	**1.9**(2)	9/15
DE pal	**1.7**(1)	**0.77**(0.5)	**0.78**(0.9)	**1.6**(1)	**1.9**(1)	15/15
HCMA los	**2.3**(2)	**1.9**(1)	**1.5**(1)	**1.1**(0.8)	**1.7**(2)	15/15
HMLSL pal	4.7(1)	5.3(6)	4.8(4)	3.0(2)	**2.0**(1)	15/15
IPOP-10DDr	**2.4**(2)	**2.0**(2)	**1.6**(2)	**1.1**(0.7)	**2.2**(4)	15/15
IPOP-500 l	**2.4**(2)	**2.0**(2)	**1.6**(2)	**1.1**(0.7)	**2.2**(4)	15/15
IPOP-tany	**2.4**(2)	**1.7**(1.0)	**1.3**(0.8)	**0.91**(0.6)	**2.6**(3)	15/15
IPOP-texp	3.9(4)	3.2(2)	**2.0**(2)	**1.1**(0.9)	3.7(6)	15/15
IPOP lia	**2.4**(2)	**2.0**(2)	**1.6**(2)	**1.1**(0.7)	**2.2**(4)	15/15
MLSL pal	4.7(1)	6.0(7)	4.9(4)	**2.6**(2)	**2.7**(3)	15/15
OQNLP pal	25(58)	22(17)	11(8)	4.6(4)	**2.6**(1)	15/15
P-DCN tra	**1.2**(0.4)	**1.1**(1.0)	**1.1**(0.9)	5.7(13)	3109(8446)	13/15
P-zero tra	**1.2**(0.4)	**1.1**(1.0)	**1.3**(2)	4.9(6)	1847(5461)	15/15
SMAC hut	**1.7**(2)	**1.2**(1)	**0.93**(0.9)	**1.4**(1)	**2.4**(2)	9/15
U-DCN tra	**1.2**(0.4)	**1**(1)	**0.92**(0.7)	**2.0**(3)	5.5(7)	15/15
U-zero tra	**1.2**(0.4)	**1.0**(1)	**1.3**(1)	**1.3**(1)	8.9(13)	15/15
fmincon pa	4.3(1)	5.2(6)	4.9(4)	3.3(2)	**2.6**(1)	15/15
fminunc pa	3.5(1)	7.6(9)	5.2(5)	**3.0**(2)	**2.2**(2)	15/15
ga100 hol	**1.8**(2)	**2.4**(2)	**1.8**(2)	**2.7**(3)	5.6(5)	15/15
grid100 ho	**1.7**(0.8)	**1.5**(2)	**0.78**(1)	**2.7**(4)	12(9)	15/15
grid16 hol	**1.3**(0.8)	**1.5**(1.0)	**1.5**(2)	4.7(5)	5.2(6)	15/15
hill hol	3.6(5)	3.4(5)	**2.7**(3)	**2.6**(2)	4.5(5)	15/15
lmmCMA aug	**1.6**(2)	**1.5**(1)	**1.1**(0.8)	**0.74**(0.5)	**1.0**(1)	15/15
memPSODE v	**2.3**(2)	**1.4**(1)	**1.3**(2)	**1.6**(1)	4.5(7)	15/15
prcga saw	**1.9**(2)	**1.2**(1)	**1.4**(1)	**1.3**(1)	**1.5**(0.8)	15/15
ring100 ho	**1.3**(0.8)	**1.5**(1)	**1.8**(2)	3.1(5)	5.8(5)	15/15
ring16 hol	**1.7**(0.8)	**2.0**(2)	**1.9**(3)	3.1(2)	3.7(3)	15/15
simplex pa	32(61)	25(17)	13(8)	4.8(3)	5.0(4)	15/15

Table 17: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*1.0e+2*:1.1	*2.5e+1*:3.9	*1.6e+1*:6.5	*4.0e+0*:31	*2.5e-1*:127	5/5
BIPOP-aCMA	**1.5**(0.9)	**2.2**(3)	**2.3**(2)	3.5(2)	3.3(4)	15/15
BIPOP-saAC	**1.4**(0.4)	**2.5**(4)	**2.2**(2)	**1.5**(2)	**1.6**(0.9)	15/15
CMAES hut	**1.4**(0.4)	**1.7**(1)	**2.8**(3)	3.5(3)	**2.5**(2)	8/15
DE pal	**1.6**(0.9)	**2.3**(2)	3.4(5)	**2.5**(3)	5.3(4)	15/15
HCMA los	5.1(9)	3.9(2)	**2.7**(2)	**2.7**(2)	5.7(5)	15/15
HMLSL pal	**2.0**(3)	6.0(8)	8.0(7)	3.1(3)	5.4(8)	15/15
IPOP-10DDr	**1.5**(0.9)	**2.0**(3)	**1.8**(2)	**1.6**(2)	**2.3**(4)	15/15
IPOP-500 l	**1.5**(0.9)	**2.0**(3)	**1.8**(2)	**1.6**(2)	**2.3**(4)	15/15
IPOP-tany	**1.8**(0.9)	**2.1**(2)	**1.6**(2)	**1.7**(1)	**1.5**(0.8)	15/15
IPOP-texp	**1.5**(0.9)	**1.8**(2)	**2.1**(2)	**1.7**(1)	3.2(4)	15/15
IPOP lia	**1.5**(0.9)	**2.0**(3)	**1.8**(2)	**1.6**(2)	**2.3**(4)	15/15
MLSL pal	**2.0**(3)	6.4(9)	8.5(7)	4.6(4)	7.1(8)	15/15
OQNLP pal	**2.6**(3)	20(22)	21(19)	6.4(4)	8.5(6)	14/15
P-DCN tra	**1.5**(0.9)	**1.3**(1)	**1.6**(1)	4583(20)	1126(5)	14/15
P-zero tra	**1.5**(0.9)	**1.3**(1)	**1.5**(2)	7370(2e4)	1836(4792)	14/15
SMAC hut	**1.2**(0.4)	**1.8**(2)	**1.6**(1)	**0.88**(0.7)	**1.8**(2)	9/15
U-DCN tra	**1.5**(0.9)	**1.4**(0.9)	**1.6**(2)	**1.9**(2)	6.3(13)	15/15
U-zero tra	**1.5**(0.9)	**1.3**(1)	**1.3**(1)	**1.8**(2)	11(13)	15/15
fmincon pa	**2.0**(3)	6.2(8)	8.7(9)	4.6(6)	7.6(9)	15/15
fminunc pa	**1.6**(1)	13(17)	14(12)	4.1(3)	17(14)	15/15
ga100 hol	**1.3**(0.9)	**2.2**(2)	**1.8**(1)	3.3(5)	10(7)	15/15
grid100 ho	**1.3**(0.9)	**2.3**(2)	**1.9**(2)	**2.4**(2)	11(12)	15/15
grid16 hol	**1.5**(0.4)	**1.5**(2)	**2.0**(2)	**2.8**(5)	24(32)	15/15
hill hol	**1.5**(0.9)	3.2(7)	**2.8**(4)	**2.1**(2)	18(45)	15/15
lmmCMA aug	**1.6**(0.9)	**2.1**(2)	**2.1**(3)	**1.4**(1)	**2.2**(2)	14/15
memPSODE v	**1.5**(0.9)	**2.1**(2)	**2.5**(2)	4.3(5)	5.9(7)	15/15
prcga saw	**1.5**(0.9)	**1.5**(1)	**1.2**(1)	**2.3**(2)	4.3(2)	15/15
ring100 ho	**1.4**(0.9)	**2.6**(3)	**2.0**(2)	3.3(6)	13(17)	15/15
ring16 hol	**1.2**(0.4)	**0.97**(1)	**2.0**(3)	**2.3**(3)	8.5(7)	15/15
simplex pa	23(56)	33(8)	21(6)	5.5(2)	**2.7**(2)	15/15

Table 18: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*4.0e+1*:1.2	*1.0e+1*:2.7	*4.0e+0*:10	*2.5e+0*:28	*1.6e-1*:119	5/5
BIPOP-aCMA	**1.7**(0.4)	3.8(2)	6.1(3)	**2.4**(1)	**1.6**(0.9)	15/15
BIPOP-saAC	**1.8**(2)	10(8)	4.6(3)	**1.8**(1)	**1.5**(0.9)	15/15
CMAES hut	**2.0**(3)	3.2(5)	**2.2**(3)	**0.98**(1)	**1.0**(0.6)	14/15
DE pal	**1.8**(1)	**2.9**(3)	**2.1**(2)	**1.2**(0.9)	**2.1**(0.5)	15/15
HCMA los	**1.7**(2)	**2.4**(2)	4.9(2)	**2.5**(2)	**2.4**(2)	15/15
HMLSL pal	**2.3**(2)	12(17)	10(15)	4.6(6)	17(18)	15/15
IPOP-10DDr	**1.5**(0.8)	**2.4**(2)	**1.6**(1)	**2.4**(0.6)	3.5(4)	15/15
IPOP-500 l	**1.5**(0.8)	**2.4**(2)	**1.6**(1)	**2.4**(0.6)	3.5(4)	15/15
IPOP-tany	**1.9**(0.8)	3.0(4)	**1.6**(0.9)	**0.88**(0.7)	**2.6**(3)	15/15
IPOP-texp	4.6(10)	29(70)	16(25)	7.2(10)	6.1(6)	15/15
IPOP lia	**1.5**(0.8)	**2.4**(2)	**1.6**(1)	**2.4**(0.6)	3.5(4)	15/15
MLSL pal	**2.3**(2)	12(16)	10(17)	4.7(6)	59(49)	15/15
OQNLP pal	11(4)	25(27)	13(2)	5.5(2)	4.8(3)	15/15
P-DCN tra	**1.3**(0.8)	7.0(6)	18(33)	9.2(15)	6.0(7)	15/15
P-zero tra	**1.3**(0.8)	**2.6**(2)	5.8(7)	3.2(6)	16(32)	15/15
SMAC hut	**1.1**(0.4)	**1.5**(0.9)	**1.2**(2)	**0.74**(0.5)	24(28)	1/15
U-DCN tra	**1.3**(0.8)	**2.9**(3)	**2.6**(2)	**1.2**(0.9)	6.3(7)	15/15
U-zero tra	**1.3**(0.8)	**2.6**(3)	**1.9**(1)	**1.0**(0.8)	9.1(11)	15/15
fmincon pa	**2.3**(2)	12(17)	7.9(11)	3.6(4)	59(49)	15/15
fminunc pa	**2.3**(2)	5.3(5)	4.8(4)	**2.4**(2)	23(30)	15/15
ga100 hol	**1.4**(0.8)	**1.7**(2)	**1.8**(2)	**1.4**(1)	10(5)	15/15
grid100 ho	**1.2**(0.8)	**1.9**(2)	**2.2**(2)	**2.2**(2)	21(17)	15/15
grid16 hol	**1.8**(0.8)	**1.9**(2)	3.4(4)	**2.2**(2)	10(11)	15/15
hill hol	**1.7**(0.8)	4.1(8)	**2.2**(3)	**0.97**(1.0)	11(16)	15/15
lmmCMA aug	**1.3**(0.8)	**2.6**(2)	**1.4**(2)	**0.80**(0.6)	**1.2**(1)	15/15
memPSODE v	**2.3**(1)	**2.4**(2)	**2.5**(2)	**1.8**(2)	6.2(14)	15/15
prcga saw	**1.1**(0.4)	**1.6**(2)	**1.4**(1)	**0.84**(0.9)	3.6(6)	15/15
ring100 ho	**1.2**(0.4)	**3.0**(3)	**2.3**(2)	**2.6**(4)	20(14)	15/15
ring16 hol	**1.1**(0.4)	**2.5**(3)	3.5(3)	**2.2**(1)	9.0(5)	15/15
simplex pa	10(10)	18(18)	11(2)	4.6(1)	13(11)	15/15

Table 19: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*4.0e+2*:1.2	*1.0e+2*:3.2	*4.0e+1*:7.2	*6.3e+0*:32	*1.6e+0*:104	5/5
BIPOP-aCMA	**1.3**(0.8)	**1.6**(2)	**1.7**(1)	**1.6**(1)	**2.5**(4)	15/15
BIPOP-saAC	3.2(3)	4.1(5)	**2.4**(3)	3.9(7)	4.6(3)	15/15
CMAES hut	**1.4**(0.4)	**1.7**(2)	**1.1**(1)	**1.2**(2)	**1.4**(2)	11/15
DE pal	**1.4**(0.8)	**1.2**(1)	**1.5**(2)	**1.5**(1)	**1.7**(0.7)	15/15
HCMA los	**1.6**(2)	3.7(4)	**2.2**(2)	**3.0**(2)	3.4(3)	15/15
HMLSL pal	9.4(1)	12(23)	11(14)	11(12)	17(22)	15/15
IPOP-10DDr	**1.5**(0.8)	**1.9**(1)	**1.5**(2)	3.4(3)	6.7(11)	15/15
IPOP-500 l	**1.5**(0.8)	**1.9**(1)	**1.5**(2)	3.4(3)	6.7(11)	15/15
IPOP-tany	**1.8**(1)	**2.2**(2)	**1.6**(2)	**3.0**(2)	6.2(8)	15/15
IPOP-texp	9.4(2)	18(14)	18(46)	7.1(16)	6.5(8)	15/15
IPOP lia	**1.5**(0.8)	**1.9**(1)	**1.5**(2)	3.4(3)	6.7(11)	15/15
MLSL pal	9.4(1)	12(23)	11(13)	25(29)	30(34)	15/15
OQNLP pal	9.2(4)	19(21)	15(10)	5.7(2)	**2.9**(1)	15/15
P-DCN tra	**1.2**(0.4)	**1.8**(2)	8.8(11)	4.4(5)	276(148)	15/15
P-zero tra	**1.2**(0.4)	**1.7**(1)	3.7(7)	3.2(4)	2654(5128)	14/15
SMAC hut	**1.3**(1)	**1.7**(2)	**1.6**(2)	**1.2**(1)	3.1(3)	7/15
U-DCN tra	**1.2**(0.4)	**2.0**(3)	**2.2**(2)	**2.3**(2)	8.5(16)	15/15
U-zero tra	**1.2**(0.4)	**1.4**(1)	**1.2**(0.8)	**2.4**(2)	4.2(5)	15/15
fmincon pa	8.7(1)	13(21)	10(13)	14(5)	17(21)	15/15
fminunc pa	3.7(2)	4.8(6)	4.0(4)	3.3(2)	4.8(4)	15/15
ga100 hol	**1.6**(0.8)	**1.8**(0.9)	**1.5**(1)	**2.5**(4)	3.6(3)	15/15
grid100 ho	**1.1**(0.4)	**1.0**(0.6)	**1.5**(2)	5.0(6)	11(11)	15/15
grid16 hol	**1.3**(0.8)	**1.2**(0.9)	**0.87**(0.6)	**2.5**(2)	5.2(6)	15/15
hill hol	**1.1**(0.8)	**2.6**(3)	**2.0**(2)	3.9(4)	6.4(7)	15/15
lmmCMA aug	**1.4**(1)	6.9(2)	3.6(1)	**1.3**(0.5)	**1.5**(2)	15/15
memPSODE v	**2.0**(2)	**1.6**(1)	**1.3**(1)	4.0(2)	9.3(9)	15/15
prcga saw	**1.2**(0.8)	**1.5**(2)	**1.6**(1)	**1.4**(1)	**2.4**(1)	15/15
ring100 ho	**1.4**(0.8)	**1.6**(2)	**1.8**(2)	3.3(4)	7.4(7)	15/15
ring16 hol	**1.3**(0.4)	**1.7**(1)	**1.8**(2)	**3.0**(3)	3.9(4)	15/15
simplex pa	8.7(10)	16(16)	12(6)	5.6(2)	3.9(2)	15/15

Table 20: 02-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:23	*1.0e-1*:26	*6.3e-2*:38	*4.0e-2*:40	*1.0e-2*:216	15/15
BIPOP-aCMA	8.2(13)	8.9(11)	13(11)	21(32)	18(27)	15/15
BIPOP-saAC	4.0(3)	4.6(8)	5.1(6)	6.3(9)	13(18)	15/15
CMAES hut	8.3(10)	11(14)	8.6(9)	13(15)	14(15)	1/15
DE pal	8.0(6)	8.4(7)	7.3(5)	10(8)	71(95)	11/15
HCMA los	9.4(16)	10(13)	22(18)	28(30)	17(24)	15/15
HMLSL pal	**0.47**(0)	**0.64**(0)	**0.61**(0)	**0.58**(0)	**0.15**(0)	15/15
IPOP-10DDr	9.3(3)	13(31)	14(23)	16(24)	15(25)	15/15
IPOP-500 l	9.3(3)	13(31)	14(23)	16(24)	16(21)	15/15
IPOP-tany	23(19)	28(26)	25(21)	31(28)	26(35)	15/15
IPOP-texp	13(19)	21(25)	16(18)	19(25)	12(12)	15/15
IPOP lia	9.3(3)	13(31)	14(23)	16(24)	16(21)	15/15
MLSL pal	**0.47**(0)	**0.64**(0)	**0.61**(0)	**0.58**(0)	**0.15**(0)	15/15
OQNLP pal	**0.47**(0)	**0.45**(0)	**0.32**(0)	**0.30**(0)	8.7(8)	13/15
P-DCN tra	11(12)	11(10)	8.8(7)	11(11)	6.0e4(7e4)	2/15
P-zero tra	8.5(15)	10(17)	8.9(12)	13(11)	1.3e5(1e5)	1/15
SMAC hut	5.3(5)	6.5(6)	5.9(6)	8.7(9)	**6.5**(7)	2/15
U-DCN tra	10(11)	12(14)	18(28)	19(26)	53(69)	15/15
U-zero tra	11(13)	11(12)	19(28)	28(27)	117(134)	15/15
fmincon pa	**0.47**(0)	**0.64**(0)	**0.61**(0)	**0.58**(0)	**0.15**(0)	15/15
fminunc pa	**0.57**(0.1)	**0.55**(0.1)	**0.38**(0.1)	**0.37**(0.1)	8.9(10)	15/15
ga100 hol	13(12)	15(13)	16(14)	27(28)	20(15)	15/15
grid100 ho	17(18)	22(21)	25(18)	33(33)	22(17)	15/15
grid16 hol	11(10)	10(12)	11(8)	13(10)	24(53)	15/15
hill hol	7.0(8)	10(8)	11(11)	19(21)	32(40)	15/15
lmmCMA aug	5.2(11)	5.1(10)	6.1(8)	5.8(8)	**6.1**(7)	11/15
memPSODE v	14(11)	14(11)	17(40)	17(38)	47(106)	15/15
prcga saw	**2.4**(2)	**2.9**(3)	**2.3**(2)	4.5(4)	11(14)	15/15
ring100 ho	13(13)	18(21)	25(24)	35(25)	19(18)	15/15
ring16 hol	10(10)	12(11)	12(9)	24(33)	20(24)	15/15
simplex pa	**0.30**$(0.0)^{\star}_{\downarrow 4}$	**0.33**$(0.0)^{\star}_{\downarrow 4}$	**0.26**$(0.0)^{\star 2}_{\downarrow 4}$	**0.26**$(0.0)^{\star 2}_{\downarrow 4}$	9.2(9)	15/15

Table 21: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*4.0e+3*:1.9	*2.5e+2*:2.8	*4.0e+0*:6.3	*2.5e+0*:21	*6.3e-1*:139	15/15
BIPOP-aCMA	**2.2**(4)	4.5(6)	4.0(3)	**2.3**(2)	6.7(12)	15/15
BIPOP-saAC	**1.8**(2)	**2.3**(3)	**2.6**(2)	**1.6**(2)	**3.2**(2)	15/15
CMAES hut	**2.4**(3)	**2.3**(2)	**2.0**(3)	**1.6**(2)	**2.5**(3)	7/15
DE pal	**1.8**(2)	**2.9**(3)	3.3(4)	3.2(2)	23(2)	14/15
HCMA los	**2.5**(2)	**2.2**(1)	**1.6**(0.6)	**1.1**(1)	3.4(3)	15/15
HMLSL pal	**2.7**(0)	**2.9**(0)	**2.2**(0)	**1.4**(0)	**2.5**(1)	15/15
IPOP-10DDr	**2.2**(2)	3.9(4)	5.5(3)	**1.9**(0.7)	10(20)	15/15
IPOP-500 l	**2.2**(2)	3.9(4)	5.5(3)	**1.9**(0.7)	7.8(13)	15/15
IPOP-tany	**1.8**(1)	**1.6**(2)	**1.2**(1)	**2.0**(1)	10(12)	15/15
IPOP-texp	**2.5**(2)	3.1(3)	**1.8**(0.9)	**1.3**(0.8)	9.3(13)	15/15
IPOP lia	**2.2**(2)	3.9(4)	5.5(3)	**1.9**(0.7)	7.8(13)	15/15
MLSL pal	**2.7**(0)	**2.9**(0)	**2.2**(0)	**1.4**(0)	**2.9**(1)	15/15
OQNLP pal	5.4(0)	4.6(0)	5.9(0)	9.2(4)	5.2(4)	15/15
P-DCN tra	**1.1**(0.8)	**1.4**(0.9)	6.1(6)	5.6(5)	8854(1e4)	12/15
P-zero tra	**1.1**(0.8)	**1.4**(0.9)	4.1(3)	**1.9**(1)	2.2e4(3e4)	6/15
SMAC hut	**1.5**(0.5)	**1.3**(0.7)	**1.9**(3)	**1.8**(2)	6.4(7)	3/15
U-DCN tra	**1.1**(0.8)	**1.4**(0.9)	4.9(4)	3.7(3)	6.5(6)	15/15
U-zero tra	**1.1**(0.8)	**1.4**(0.9)	3.1(2)	**2.4**(3)	6.4(9)	15/15
fmincon pa	**2.7**(0)	**2.9**(0)	**2.2**(0)	**1.4**(0)	**2.1**(1)	15/15
fminunc pa	**2.1**(0)	**1.4**(0)	**1.1**(0)	6.7(3)	3.5(3)	15/15
ga100 hol	**1.2**(0.8)	**2.1**(2)	**2.3**(2)	3.5(3)	6.0(4)	15/15
grid100 ho	**1.8**(1)	3.2(4)	4.5(5)	7.0(8)	13(11)	15/15
grid16 hol	**1.3**(1)	**2.4**(2)	4.0(6)	**2.3**(2)	6.7(9)	15/15
hill hol	**2.4**(3)	5.2(6)	4.0(4)	**2.3**(2)	4.3(6)	15/15
lmmCMA aug	**2.5**(0.8)	**2.1**(1)	**1.8**(1)	**1.8**(0.9)	8.6(10)	11/15
memPSODE v	**2.5**(1)	3.6(1)	3.5(3)	3.1(2)	3.8(6)	15/15
prcga saw	**1.1**(1)	**1.2**(1)	**2.2**(3)	**1.8**(2)	8.6(7)	15/15
ring100 ho	**1.1**(0.5)	**2.0**(3)	3.5(5)	5.2(5)	10(8)	15/15
ring16 hol	**0.96**(0.5)	**1.9**(2)	4.1(4)	**2.9**(3)	4.7(4)	15/15
simplex pa	14(0.3)	12(0.2)	5.6(0.5)	3.4(4)	6.3(5)	15/15

Table 22: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*1.0e+1*:1.7	*6.3e+0*:2.6	*2.5e+0*:7.9	*1.6e+0*:30	*4.0e-1*:105	15/15
BIPOP-aCMA	**1.5**(0.9)	**1.6**(1)	**1.7**(2)	6.2(9)	10(18)	15/15
BIPOP-saAC	**1.5**(2)	**2.3**(3)	**1.8**(1)	5.3(7)	6.8(10)	15/15
CMAES hut	**1.2**(1)	**2.2**(3)	**1.7**(1)	**2.7**(4)	**1.6**(2)	9/15
DE pal	**2.0**(2)	**2.3**(2)	**1.1**(1)	**1.7**(2)	96(191)	12/15
HCMA los	**2.1**(2)	**2.6**(2)	**1.3**(1)	**3.0**(6)	7.8(9)	15/15
HMLSL pal	**2.3**(3)	**2.8**(2)	**1.6**(1)	**2.1**(3)	**2.1**(2)	15/15
IPOP-10DDr	**2.6**(2)	**2.6**(3)	**2.3**(2)	4.1(10)	12(14)	15/15
IPOP-500 l	**2.6**(2)	**2.6**(3)	**2.3**(2)	4.1(10)	11(14)	15/15
IPOP-tany	**2.2**(2)	**2.8**(3)	**1.9**(1)	6.5(12)	12(13)	15/15
IPOP-texp	**2.7**(2)	7.0(3)	7.2(2)	12(12)	30(41)	15/15
IPOP lia	**2.6**(2)	**2.6**(3)	**2.3**(2)	4.1(10)	11(14)	15/15
MLSL pal	**2.3**(3)	**2.8**(2)	**1.6**(1)	**1.6**(2)	**1.7**(2)	15/15
OQNLP pal	4.4(6)	7.1(4)	4.5(7)	**2.5**(2)	**1.4**(1)	15/15
P-DCN tra	**1.4**(1)	3.2(4)	1135(3)	3.3e4(7e4)	2.2e4(3e4)	7/15
P-zero tra	**1.4**(1)	**2.1**(3)	1.8e4(6)	4.4e4(7e4)	2.2e4(3e4)	7/15
SMAC hut	**0.92**(0.9)	**1.7**(2)	**1.6**(2)	**1.4**(1)	**0.74**(0.5)	15/15
U-DCN tra	**1.4**(1)	**1.8**(2)	**1.4**(0.9)	**0.85**(0.8)	**0.67**(1)	15/15
U-zero tra	**1.4**(1)	**2.0**(2)	**1.6**(2)	**1.1**(2)	**0.82**(1)	15/15
fmincon pa	**2.3**(3)	**2.8**(2)	**1.6**(1)	**1.2**(1)	**1.3**(1)	15/15
fminunc pa	**3.0**(3)	4.2(5)	**2.8**(3)	**1.7**(1)	**0.88**(0.4)	15/15
ga100 hol	**1**(0.6)	**2.3**(3)	**1.8**(2)	**1.8**(2)	**1.4**(2)	15/15
grid100 ho	**1.1**(0.9)	**1.9**(2)	**1.2**(0.9)	**1.1**(1)	**2.3**(4)	15/15
grid16 hol	**1.1**(0.6)	**1.4**(1)	**1.8**(2)	**1.9**(2)	21(22)	15/15
hill hol	**1.7**(2)	**2.9**(3)	**2.0**(2)	5.2(7)	161(476)	13/15
lmmCMA aug	**1**(0.9)	**0.92**(0.6)	**0.88**(0.9)	**2.4**(4)	4.1(8)	13/15
memPSODE v	**1.9**(2)	**2.8**(2)	**2.1**(2)	**1.8**(2)	**2.8**(4)	15/15
prcga saw	**1.6**(1)	**1.6**(1)	**1.5**(2)	**2.4**(4)	14(20)	15/15
ring100 ho	**1.8**(0.9)	**1.8**(1)	**1.3**(1)	**1.3**(2)	**1.7**(2)	15/15
ring16 hol	**1.1**(0.9)	**1.6**(1)	**0.97**(0.7)	3.3(4)	**2.6**(4)	15/15
simplex pa	15(22)	17(22)	10(9)	4.8(4)	**1.9**(0.9)	15/15

Table 23: 02-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*4.0e+1*:1.3	*1.6e+1*:3.2	*6.3e+0*:9.3	*1.6e+0*:25	*1.0e-1*:168	15/15
BIPOP-aCMA	**1.6**(2)	**2.5**(3)	**2.1**(2)	5.9(11)	4.3(4)	15/15
BIPOP-saAC	**1.5**(1)	**1.5**(2)	**1.5**(2)	10(24)	5.9(9)	15/15
CMAES hut	**1.1**(0.4)	**1.4**(2)	**1.7**(2)	8.3(12)	3.6(4)	4/15
DE pal	**1.5**(1)	**1.6**(2)	**1.1**(1)	**2.7**(3)	18(2)	14/15
HCMA los	**2.2**(2)	**2.4**(2)	**1.8**(2)	4.5(7)	3.5(5)	15/15
HMLSL pal	**3.0**(4)	**2.5**(2)	**2.2**(3)	3.5(3)	**1.2**(0.8)	15/15
IPOP-10DDr	**1.8**(2)	**1.7**(1)	**1.1**(0.8)	11(14)	10(12)	15/15
IPOP-500 l	**1.8**(2)	**1.7**(1)	**1.1**(0.8)	11(14)	8.5(10)	15/15
IPOP-tany	**1.8**(2)	**1.3**(2)	**1.1**(1)	**2.2**(1)	5.9(7)	15/15
IPOP-texp	**1.8**(1)	**2.3**(2)	4.7(2)	21(35)	11(16)	15/15
IPOP lia	**1.8**(2)	**1.7**(1)	**1.1**(0.8)	11(14)	8.5(10)	15/15
MLSL pal	**3.0**(4)	**2.5**(2)	**2.2**(3)	**2.8**(3)	**0.96**(0.8)	15/15
OQNLP pal	5.6(5)	4.5(4)	3.4(3)	4.3(5)	**1.4**(0.8)	15/15
P-DCN tra	**1.2**(0.8)	**1.7**(1)	**2.4**(5)	1.3e4(4e4)	1.1e4(1e4)	8/15
P-zero tra	**1.2**(0.8)	**1.3**(1)	1.5e4(5)	1.5e4(4e4)	1.1e4(2e4)	8/15
SMAC hut	**1.3**(0.8)	**1.3**(1)	**1.3**(1)	**0.74**(0.9)	**0.91**(0.9)	11/15
U-DCN tra	**1.2**(0.8)	**1.1**(1)	**1.3**(1)	**2.2**(3)	**1.3**(2)	15/15
U-zero tra	**1.2**(0.8)	**1.1**(1)	**0.88**(0.9)	**2.0**(2)	**2.4**(2)	15/15
fmincon pa	**3.0**(4)	**2.5**(2)	**2.5**(4)	3.9(3)	**0.87**(0.7)	15/15
fminunc pa	**2.8**(2)	**2.2**(1)	**3.0**(4)	**3.0**(2)	**0.88**(0.7)	15/15
ga100 hol	**1.5**(0.8)	**1.0**(0.5)	**1.5**(1)	**1.5**(1)	**2.3**(3)	15/15
grid100 ho	**1.7**(0.8)	**1.3**(0.9)	**0.59**(0.4)	**1.5**(2)	**2.8**(3)	15/15
grid16 hol	**1.9**(2)	**1.5**(1)	**1.6**(2)	3.0(3)	**2.0**(2)	15/15
hill hol	3.4(2)	**2.0**(2)	**1.8**(2)	287(8)	45(3)	14/15
lmmCMA aug	**1.8**(1)	**1.9**(2)	**2.0**(0.9)	**3.0**(5)	**2.5**(4)	14/15
memPSODE v	**2.4**(2)	**1.9**(2)	**2.6**(3)	**2.9**(2)	**2.3**(3)	15/15
prcga saw	**1.2**(0.8)	**0.98**(1)	**1.2**(1)	**1.8**(2)	4.3(8)	15/15
ring100 ho	**0.95**(0.4)	**1.1**(0.8)	**1.5**(1)	**2.8**(3)	**2.4**(3)	15/15
ring16 hol	**1.3**(1)	**1.7**(1)	**1.8**(2)	5.5(10)	3.3(3)	15/15
simplex pa	15(13)	16(25)	10(8)	7.2(4)	**1.5**(0.7)	15/15

Table 24: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*4.0e+1*:1.5	*2.5e+1*:2.6	*1.0e+1*:7.8	*4.0e+0*:55	*2.5e+0*:103	5/5
BIPOP-aCMA	**1.3**(1)	**1.2**(1)	**1.8**(2)	4.0(6)	4.4(7)	15/15
BIPOP-saAC	**1.1**(0.7)	**1.1**(1.0)	**2.0**(2)	**1.7**(2)	**1.8**(2)	15/15
CMAES hut	**1.3**(1.0)	**1.5**(2)	**2.0**(2)	**2.5**(3)	8.4(10)	3/15
DE pal	**1.6**(1.0)	**1.6**(1)	**2.3**(2)	**1.8**(2)	**2.1**(2)	15/15
HCMA los	**1.9**(2)	**2.4**(2)	**2.4**(2)	**2.0**(2)	3.3(5)	15/15
HMLSL pal	**2.7**(2)	11(24)	4.6(8)	**2.8**(3)	**2.1**(2)	15/15
IPOP-10DDr	**1.3**(1.0)	**1.1**(0.8)	**1.8**(2)	**1.3**(2)	3.1(4)	15/15
IPOP-500 l	**1.3**(1.0)	**1.1**(0.8)	**1.8**(2)	**1.3**(2)	3.1(4)	15/15
IPOP-tany	**1.5**(1.0)	**1.4**(1)	**2.4**(2)	**1.9**(2)	**1.7**(1)	15/15
IPOP-texp	**1.7**(2)	**1.3**(1.0)	**2.1**(1)	**2.6**(3)	3.4(4)	15/15
IPOP lia	**1.3**(1.0)	**1.1**(0.8)	**1.8**(2)	**1.3**(2)	3.1(4)	15/15
MLSL pal	**2.7**(2)	11(24)	4.5(8)	**2.1**(2)	**1.6**(1)	15/15
OQNLP pal	3.3(3)	19(34)	9.1(11)	4.1(3)	**2.9**(2)	15/15
P-DCN tra	**1.3**(1.0)	**0.97**(0.8)	**1.7**(2)	**1.7**(2)	**1.4**(1)	15/15
P-zero tra	**1.3**(1.0)	**0.97**(0.8)	**1.1**(0.8)	**2.1**(3)	**1.5**(2)	15/15
SMAC hut	**1.3**(1.0)	**1.6**(2)	**2.0**(2)	**1.8**(2)	**2.5**(3)	8/15
U-DCN tra	**1.3**(1.0)	**0.97**(0.8)	**1.7**(2)	**1.5**(2)	**2.2**(2)	15/15
U-zero tra	**1.3**(1.0)	**0.97**(0.8)	**1.7**(2)	**1.1**(1)	**3.0**(3)	15/15
fmincon pa	**2.7**(2)	8.3(22)	4.5(9)	**2.2**(2)	**2.4**(2)	15/15
fminunc pa	**1.8**(2)	12(18)	5.2(8)	**2.0**(2)	**2.2**(3)	15/15
ga100 hol	**2.1**(2)	**1.9**(2)	**1.7**(2)	**1.8**(2)	**2.9**(4)	15/15
grid100 ho	**1.6**(1)	**2.8**(3)	**2.5**(3)	**1.8**(2)	**1.9**(2)	15/15
grid16 hol	**1.3**(0.7)	**1.4**(1)	**1.7**(1)	3.4(7)	3.7(5)	15/15
hill hol	**1.3**(1.0)	**1.6**(1)	3.4(3)	3.5(5)	3.3(4)	15/15
lmmCMA aug	**1.7**(1)	**1.4**(1)	**2.1**(2)	**2.8**(2)	4.3(4)	15/15
memPSODE v	**1.4**(1.0)	**1.2**(1.0)	**1.6**(2)	3.5(6)	**3.0**(3)	15/15
prcga saw	**1.6**(1.0)	**1.4**(1.0)	**2.5**(3)	**2.2**(2)	**2.3**(2)	15/15
ring100 ho	**1.5**(1.0)	**1.8**(2)	**2.3**(2)	**1.9**(2)	**2.9**(2)	15/15
ring16 hol	**1.2**(1)	**1.2**(1.0)	**2.0**(2)	**2.5**(4)	3.3(4)	15/15
simplex pa	64(84)	54(50)	23(19)	4.8(3)	**2.9**(2)	15/15

Table 25: 02-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*4.0e+1*:1.1	*2.5e+1*:2.7	*1.6e+1*:7.7	*6.3e+0*:44	*2.5e+0*:275	5/5
BIPOP-aCMA	**1.4**(0.9)	**2.7**(3)	**1.9**(2)	**1.6**(1)	3.0(4)	15/15
BIPOP-saAC	**1.5**(0.9)	**2.8**(4)	**1.7**(2)	**1.4**(1)	3.6(2)	15/15
CMAES hut	**2.2**(2)	**2.6**(2)	3.0(3)	**1.9**(3)	**1.2**(1)	7/15
DE pal	**1.5**(0.9)	**1.4**(1)	**1.3**(1)	**1.8**(2)	**1.8**(2)	15/15
HCMA los	**2.7**(3)	**2.1**(2)	**1.3**(1)	**1.6**(2)	**2.5**(2)	15/15
HMLSL pal	**2.1**(2)	4.3(4)	3.8(5)	**2.2**(2)	**1.7**(2)	15/15
IPOP-10DDr	**1.2**(0.9)	**0.95**(0.8)	**1.6**(2)	**1.4**(1)	6.7(7)	15/15
IPOP-500 l	**1.2**(0.9)	**0.95**(0.8)	**1.6**(2)	**1.4**(1)	6.6(7)	15/15
IPOP-tany	**1.2**(0.9)	**0.90**(0.9)	**1.1**(0.6)	**1.8**(0.8)	7.1(11)	15/15
IPOP-texp	**1.2**(0.9)	**1.0**(0.9)	**1.9**(1.0)	**1.4**(1)	5.2(7)	15/15
IPOP lia	**1.2**(0.9)	**0.95**(0.8)	**1.6**(2)	**1.4**(1)	6.6(7)	15/15
MLSL pal	**2.1**(2)	4.2(4)	3.4(4)	**2.6**(2)	**1.6**(2)	15/15
OQNLP pal	**2.8**(3)	4.0(3)	**2.3**(2)	5.1(2)	**2.6**(2)	15/15
P-DCN tra	**1.6**(0.9)	**2.3**(2)	**1.9**(2)	**2.4**(2)	26(29)	15/15
P-zero tra	**1.6**(0.9)	**2.2**(2)	**2.3**(3)	9.2(1)	42(54)	15/15
SMAC hut	**1.1**(0.5)	**1.5**(1)	**1.6**(1)	**2.1**(2)	3.6(4)	3/15
U-DCN tra	**1.6**(0.9)	**2.3**(2)	**1.9**(2)	**1.9**(3)	3.2(3)	15/15
U-zero tra	**1.6**(0.9)	**2.3**(2)	**1.5**(1.0)	**1.6**(1)	8.5(6)	15/15
fmincon pa	**2.1**(2)	4.2(4)	3.3(4)	**2.1**(2)	**1.9**(3)	15/15
fminunc pa	**2.6**(4)	3.3(3)	**2.6**(2)	**2.3**(2)	**1.9**(2)	15/15
ga100 hol	**1.6**(0.9)	**1.2**(1)	**1.1**(1)	**2.5**(3)	8.9(11)	15/15
grid100 ho	**1.5**(0.5)	**1.4**(1)	**1.6**(1)	**2.0**(1)	6.4(8)	15/15
grid16 hol	**1.8**(0.9)	**1.8**(1)	**1.5**(2)	**2.1**(2)	8.8(13)	15/15
hill hol	**1.2**(0.9)	**2.4**(3)	**2.0**(2)	**1.7**(1)	5.5(7)	15/15
lmmCMA aug	**1.2**(0.9)	**1.5**(1)	**1.2**(0.8)	**1.6**(2)	**1.2**(0.8)	15/15
memPSODE v	3.7(4)	**2.6**(2)	3.1(4)	**1.9**(1)	5.6(10)	15/15
prcga saw	**1.6**(1)	**1.7**(2)	**1.0**(0.9)	**1.8**(2)	7.8(14)	15/15
ring100 ho	**2.1**(2)	**1.6**(1)	**1.4**(1)	**2.1**(2)	5.9(6)	15/15
ring16 hol	**1.4**(0.5)	**1.1**(1)	**1.5**(2)	**2.4**(2)	3.8(6)	15/15
simplex pa	4.2(7)	9.1(10)	5.2(3)	5.0(1)	3.3(3)	15/15

Table 26: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*1.6e+1*:3.0	*1.0e+1*:3.6	*1.0e-8*:8.0	*1.0e-8*:8.0	*1.0e-8*:8.0	15/15
BIPOP-aCMA	**2.6**(3)	**2.7**(2)	13(0.2)	13(0.2)	13(0.2)	15/15
BIPOP-saAC	3.0(3)	3.4(3)	21(1)	21(1)	21(1)	15/15
CMAES hut	3.8(5)	4.0(5)	∞	∞	∞ *303*	0/15
DE pal	**1.5**(1)	**2.6**(2)	115(11)	115(11)	115(11)	15/15
HCMA los	**1.8**(1)	**1.8**(1.0)	**1**(0)$^{\star 4}$	**1**(0)$^{\star 4}$	**1**(0)$^{\star 4}$	15/15
HMLSL pal	**0.87**(0.7)	**1.1**(0.6)	**3.7**(1)	**3.7**(1)	**3.7**(1)	15/15
IPOP-10DDr	**1.9**(2)	**2.0**(2)	52(2)	52(2)	52(2)	15/15
IPOP-500 l	**1.9**(2)	**2.0**(2)	52(2)	52(2)	52(2)	15/15
IPOP-tany	**2.0**(2)	**2.7**(3)	60(6)	60(6)	60(6)	15/15
IPOP-texp	**2.7**(3)	**2.9**(3)	54(10)	54(10)	54(10)	15/15
IPOP lia	**1.9**(2)	**2.0**(2)	52(2)	52(2)	52(2)	15/15
MLSL pal	**0.87**(0.7)	**1.1**(0.6)	**3.7**(1)	**3.7**(1)	**3.7**(1)	15/15
OQNLP pal	**2.1**(2)	**3.0**(2)	**2.9**(0.6)	**2.9**(0.6)	**2.9**(0.6)	15/15
P-DCN tra	**1.6**(2)	3.2(3)	482(252)	482(252)	482(252)	15/15
P-zero tra	**1.4**(2)	**2.4**(2)	1959(1123)	1959(1123)	1959(1123)	15/15
SMAC hut	**0.69**(0.5)	**1.0**(0.7)	∞	∞	∞ *300*	0/15
U-DCN tra	**1.4**(2)	**2.9**(3)	2968(3565)	2968(3565)	2968(3565)	15/15
U-zero tra	**1.4**(2)	**2.5**(3)	9.2e4(6e4)	9.2e4(6e4)	9.2e4(6e4)	15/15
fmincon pa	**0.87**(0.7)	**1.1**(0.6)	**3.7**(1)	**3.7**(1)	**3.7**(1)	15/15
fminunc pa	**1.0**(1)	**1.5**(1)	**1.1**(0)	**1.1**(0)	**1.1**(0)	15/15
ga100 hol	**2.9**(3)	**2.9**(3)	∞	∞	∞ *2e5*	0/15
grid100 ho	**2.4**(4)	3.2(3)	∞	∞	∞ *2e5*	0/15
grid16 hol	**1.8**(2)	4.1(5)	∞	∞	∞ *2e5*	0/15
hill hol	6.0(7)	6.1(6)	8.7e4(9e4)	8.7e4(9e4)	8.7e4(9e4)	3/15
lmmCMA aug	**1.0**(1)	**1.7**(2)	9.0(0.9)	9.0(0.9)	9.0(0.9)	15/15
memPSODE v	**2.8**(2)	**2.8**(3)	22(1)	22(1)	22(1)	15/15
prcga saw	**1.3**(1)	**1.5**(2)	617(714)	617(714)	617(714)	15/15
ring100 ho	**1.5**(2)	**2.9**(5)	8.9e4(9e4)	8.9e4(9e4)	8.9e4(9e4)	3/15
ring16 hol	**1.4**(1)	4.0(7)	1.3e5(2e5)	1.3e5(1e5)	1.3e5(1e5)	2/15
simplex pa	6.1(8)	11(13)	35(6)	35(6)	35(6)	15/15

Table 27: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*6.3e+6*:1.5	*6.3e+5*:4.3	*4.0e+4*:10	*1.0e+2*:32	*1.0e-8*:49	15/15
BIPOP-aCMA	**1.7**(2)	**2.7**(3)	**2.3**(2)	**1.9**(0.2)	**3.3**(0.2)	15/15
BIPOP-saAC	**2.9**(4)	**2.1**(2)	**2.9**(4)	3.9(1)	6.1(0.7)	15/15
CMAES hut	**1.1**(1.0)	**1.1**(2)	3.3(3)	10(6)	∞ *303*	0/15
DE pal	**1.2**(0.7)	**0.95**(0.9)	3.5(4)	6.9(2)	27(1)	15/15
HCMA los	**1.3**(2)	**1.4**(0.8)	**0.96**(0.3)	**1.1**(0.8)	**4.6**(3)	15/15
HMLSL pal	**1.7**(1)	3.3(2)	**2.4**(1)	**1.4**(0.6)	6.2(6)	15/15
IPOP-10DDr	**1.3**(0.7)	**1.9**(1)	**2.2**(2)	8.6(5)	26(3)	15/15
IPOP-500 l	**1.3**(0.7)	**1.9**(1)	**2.2**(2)	8.6(5)	26(3)	15/15
IPOP-tany	**1.9**(0.7)	**2.2**(2)	**2.1**(2)	7.7(4)	25(2)	15/15
IPOP-texp	5.2(11)	3.2(5)	**2.8**(3)	9.0(4)	26(2)	15/15
IPOP lia	**1.3**(0.7)	**1.9**(1)	**2.2**(2)	8.6(5)	26(3)	15/15
MLSL pal	**1.7**(1)	3.3(2)	**2.4**(1)	**1.4**(0.6)	**5.2**(4)	15/15
OQNLP pal	4.1(5)	3.3(0.2)	**2.7**(2)	**1.4**(0.4)	152(181)	5/15
P-DCN tra	**1.1**(0.3)	**2.4**(4)	5.1(5)	10(11)	852(958)	15/15
P-zero tra	**1.1**(0.3)	**2.1**(4)	4.1(6)	11(10)	6.8e4(7e4)	9/15
SMAC hut	**1.1**(1.0)	**0.77**(0.5)	**1.0**(0.7)	4.5(3)	∞ *300*	0/15
U-DCN tra	**1.1**(0.3)	**1.4**(2)	6.0(7)	45(38)	1.5e4(3e4)	13/15
U-zero tra	**1.1**(0.3)	**1.3**(2)	4.3(4)	65(74)	∞ *3e6*	0/15
fmincon pa	**1.7**(1)	3.3(2)	**2.4**(1)	**1.4**(0.6)	5.6(5)	15/15
fminunc pa	**2.0**(3)	**2.2**(1)	**1.3**(0.6)	**1.9**(0.8)	**4.7**(1)	15/15
ga100 hol	**1.5**(1)	**1.8**(1)	5.6(5)	44(29)	∞ *2e5*	0/15
grid100 ho	**1.3**(0.7)	**1.8**(2)	3.3(4)	70(54)	∞ *2e5*	0/15
grid16 hol	**1.5**(1)	**1.2**(0.9)	5.0(7)	31(38)	∞ *2e5*	0/15
hill hol	5.2(4)	4.1(4)	6.5(6)	20(14)	∞ *2e5*	0/15
lmmCMA aug	**2.0**(2)	**1.8**(2)	**1.5**(1)	**2.3**(0.6)	**5.0**(0.8)	15/15
memPSODE v	**2.7**(2)	**1.8**(2)	3.0(2)	3.5(0.5)	6.1(1.0)	15/15
prcga saw	**1.2**(1.0)	**1.3**(1)	3.5(4)	10(5)	698(946)	15/15
ring100 ho	**1.3**(0.7)	**0.95**(0.8)	**1.9**(3)	51(29)	∞ *2e5*	0/15
ring16 hol	**1.6**(1.0)	**1.4**(1)	8.7(9)	28(25)	∞ *2e5*	0/15
simplex pa	11(14)	10(1)	4.8(1.0)	6.4(2)	12(3)	15/15

Table 28: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*1.0e+2*:2.2	*6.3e+1*:6.1	*4.0e+1*:10	*1.6e+1*:32	*4.0e+0*:319	15/15
BIPOP-aCMA	**2.5**(3)	**1.8**(1)	**2.0**(0.3)	**1.6**(0.6)	**0.47**(0.1)	15/15
BIPOP-saAC	3.7(3)	**2.7**(2)	**2.2**(1)	**2.5**(2)	**1.8**(2)	15/15
CMAES hut	5.6(8)	**2.9**(3)	3.1(4)	**2.7**(1)	**1.6**(2)	7/15
DE pal	**2.2**(2)	**1.9**(1)	**2.0**(1)	**2.9**(2)	**1.1**(0.5)	15/15
HCMA los	3.1(3)	**2.0**(2)	**1.9**(2)	**1.5**(0.9)	**0.66**(0.3)	15/15
HMLSL pal	5.0(4)	4.8(9)	5.5(6)	7.5(5)	**1.6**(0.5)	15/15
IPOP-10DDr	**1.8**(2)	**1.7**(2)	**2.5**(2)	**2.0**(1)	**2.7**(3)	15/15
IPOP-500 l	**1.8**(2)	**1.7**(2)	**2.5**(2)	**2.0**(1)	**2.7**(3)	15/15
IPOP-tany	**1.8**(2)	**1.7**(2)	**2.2**(2)	4.7(2)	**2.9**(3)	15/15
IPOP-texp	**2.1**(3)	**1.3**(1)	**1.7**(2)	3.7(2)	3.6(2)	15/15
IPOP lia	**1.8**(2)	**1.7**(2)	**2.5**(2)	**2.0**(1)	**2.7**(3)	15/15
MLSL pal	4.8(4)	4.7(7)	6.3(8)	7.2(7)	**2.8**(2)	15/15
OQNLP pal	21(36)	15(14)	15(14)	10(5)	**2.7**(2)	15/15
P-DCN tra	**2.0**(3)	**2.4**(2)	4.5(4)	80(230)	95(118)	15/15
P-zero tra	**2.5**(3)	3.6(2)	7.9(3)	81(92)	50(32)	15/15
SMAC hut	**0.97**(1)	**0.98**(1.0)	**1.0**(1)	4.4(3)	3.2(3)	4/15
U-DCN tra	**1.9**(3)	**2.4**(3)	**2.4**(2)	4.0(3)	**1.2**(0.8)	15/15
U-zero tra	**2.5**(3)	**2.1**(2)	**2.1**(2)	**2.1**(2)	**0.83**(0.7)	15/15
fmincon pa	5.2(4)	4.8(8)	5.6(6)	7.1(7)	3.2(4)	15/15
fminunc pa	4.3(9)	5.4(6)	10(10)	8.7(6)	**2.2**(2)	15/15
ga100 hol	**2.5**(2)	**2.5**(3)	4.7(5)	10(8)	3.4(1)	15/15
grid100 ho	**1.1**(0.9)	**1.1**(0.9)	**2.9**(3)	17(13)	7.3(4)	15/15
grid16 hol	**1.5**(1)	**1.9**(3)	4.5(5)	6.1(4)	**2.3**(2)	15/15
hill hol	6.2(7)	3.1(3)	**2.1**(2)	**2.1**(1)	**0.60**(0.3)	15/15
lmmCMA aug	**1.4**(3)	**1.2**(1)	**1.5**(1)	**1.5**(0.8)	**1.3**(2)	15/15
memPSODE v	4.2(3)	**2.8**(3)	4.1(3)	8.2(11)	6.3(7)	15/15
prcga saw	**1.6**(2)	**1.0**(0.9)	**1.7**(2)	3.8(1)	**2.1**(0.9)	15/15
ring100 ho	**1.5**(2)	**1.5**(2)	3.8(5)	14(12)	5.6(2)	15/15
ring16 hol	**2.2**(3)	**2.5**(4)	4.0(4)	5.9(4)	**1.8**(1)	15/15
simplex pa	45(73)	29(30)	24(17)	15(7)	5.4(4)	15/15

Table 29: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*1.0e+2*:5.4	*6.3e+1*:10	*6.3e+1*:10	*2.5e+1*:36	*4.0e+0*:617	15/15
BIPOP-aCMA	**2.9**(2)	**2.9**(2)	**2.9**(2)	**2.0**(1)	**2.9**(6)	15/15
BIPOP-saAC	**0.98**(1)	**1.0**(1)	**1.0**(1)	**1.7**(1)	**2.6**(3)	15/15
CMAES hut	**1.8**(2)	**2.0**(2)	**2.0**(2)	**2.8**(2)	3.5(4)	2/15
DE pal	**1.8**(2)	**2.1**(2)	**2.1**(2)	**2.7**(2)	**0.78**(0.3)	15/15
HCMA los	**2.8**(3)	**2.6**(2)	**2.6**(2)	**1.7**(1)	**1.0**(2)	15/15
HMLSL pal	**2.0**(1)	**2.3**(2)	**2.3**(2)	3.7(4)	**1.1**(0.7)	15/15
IPOP-10DDr	**1.6**(2)	**2.7**(2)	**2.7**(2)	**1.9**(1)	4.5(5)	15/15
IPOP-500 l	**1.6**(2)	**2.7**(2)	**2.7**(2)	**1.9**(1)	4.6(5)	15/15
IPOP-tany	**1.5**(2)	**1.7**(2)	**1.7**(2)	**1.8**(0.9)	4.7(5)	15/15
IPOP-texp	**0.91**(1)	**1.2**(2)	**1.2**(2)	3.0(2)	4.6(6)	15/15
IPOP lia	**1.6**(2)	**2.7**(2)	**2.7**(2)	**1.9**(1)	4.6(5)	15/15
MLSL pal	**1.9**(1)	**2.3**(2)	**2.3**(2)	3.8(4)	3.5(4)	15/15
OQNLP pal	5.0(15)	9.1(10)	9.1(10)	6.6(5)	5.7(6)	11/15
P-DCN tra	**2.5**(2)	4.9(5)	4.9(5)	11(8)	28(33)	15/15
P-zero tra	**2.7**(3)	6.1(3)	6.1(3)	196(235)	76(112)	15/15
SMAC hut	**0.38**(0.5)	**1.4**(1)	**1.4**(1)	**2.8**(3)	∞ *300*	0/15
U-DCN tra	**1.8**(1)	**2.6**(2)	**2.6**(2)	**2.7**(2)	**1.1**(0.8)	15/15
U-zero tra	**2.0**(1)	**2.3**(2)	**2.3**(2)	**1.7**(0.9)	**1.6**(2)	15/15
fmincon pa	**2.0**(1)	**2.1**(2)	**2.1**(2)	3.7(3)	4.2(4)	15/15
fminunc pa	**2.6**(6)	4.0(5)	4.0(5)	6.3(8)	4.0(3)	15/15
ga100 hol	**1.8**(1)	**1.7**(2)	**1.7**(2)	7.9(6)	**2.8**(1)	15/15
grid100 ho	**1.3**(1)	3.6(3)	3.6(3)	17(12)	7.5(5)	15/15
grid16 hol	**2.2**(2)	4.1(4)	4.1(4)	4.8(2)	**1.5**(0.7)	15/15
hill hol	**2.9**(3)	**1.8**(2)	**1.8**(2)	**1.3**(0.9)	**0.59**(0.5)	15/15
lmmCMA aug	**0.40**(0.2)	**0.95**(0.9)	**0.95**(0.9)	**1.5**(0.7)	**1.8**(2)	13/15
memPSODE v	3.6(3)	3.9(3)	3.9(3)	5.7(6)	4.3(3)	15/15
prcga saw	**1.0**(0.8)	**1.9**(2)	**1.9**(2)	3.2(2)	3.8(3)	15/15
ring100 ho	**1.6**(3)	**2.1**(2)	**2.1**(2)	10(11)	4.7(1)	15/15
ring16 hol	**1.5**(3)	3.4(4)	3.4(4)	5.5(3)	**1.3**(0.6)	15/15
simplex pa	11(22)	17(20)	17(20)	8.7(7)	4.8(6)	15/15

Table 30: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*4.0e+1*:2.2	*2.5e+1*:4.8	*1.0e-8*:6.6	*1.0e-8*:6.6	*1.0e-8*:6.6	15/15
BIPOP-aCMA	**2.3**(1)	**1.3**(0.2)	**1.2**(0)	**1.2**(0)	**1.2**(0)	15/15
BIPOP-saAC	3.7(3)	**2.5**(2)	5.7(2)	5.7(2)	5.7(2)	15/15
CMAES hut	5.2(4)	3.6(2)	6.0(4)	6.0(4)	6.0(4)	15/15
DE pal	**2.5**(3)	3.8(6)	486(27)	486(27)	486(27)	15/15
HCMA los	**2.0**(1)	**1.1**(0.5)	**1.6**(0.5)	**1.6**(0.5)	**1.6**(0.5)	15/15
HMLSL pal	**2.3**(0)	**1.0**(0)	21(27)	21(27)	21(27)	15/15
IPOP-10DDr	**1.6**(2)	**2.3**(1)	16(33)	16(33)	16(33)	15/15
IPOP-500 l	**1.6**(2)	**2.3**(1)	16(33)	16(33)	16(33)	15/15
IPOP-tany	4.9(5)	3.2(2)	8.2(6)	8.2(6)	8.2(6)	15/15
IPOP-texp	13(13)	7.3(7)	40(32)	40(32)	40(32)	15/15
IPOP lia	**1.6**(2)	**2.3**(1)	16(33)	16(33)	16(33)	15/15
MLSL pal	**2.3**(0)	**1.0**(0)	37(54)	37(54)	37(54)	15/15
OQNLP pal	7.3(0)	3.5(0)	**3.0**(0)	**3.0**(0)	**3.0**(0)	15/15
P-DCN tra	**1.9**(1)	**2.0**(1)	218(47)	218(47)	218(47)	15/15
P-zero tra	**1.9**(1)	4.0(7)	146(59)	146(59)	146(59)	15/15
SMAC hut	**1.8**(0.9)	**1.2**(0.4)	**1.1**(0.2)	**1.1**(0.2)	**1.1**(0.2)	15/15
U-DCN tra	**1.9**(1)	**2.8**(2)	∞	∞	∞ *3e6*	0/15
U-zero tra	**1.9**(1)	**2.2**(2)	∞	∞	∞ *3e6*	0/15
fmincon pa	**2.3**(0)	**1.0**(0)	34(97)	34(97)	34(97)	15/15
fminunc pa	4.1(0)	**1.9**(0)	**3.2**(0)	**3.2**(0)	**3.2**(0)	15/15
ga100 hol	**1.6**(1)	**2.5**(3)	104(20)	104(20)	104(20)	15/15
grid100 ho	**2.8**(2)	4.3(4)	154(89)	154(89)	154(89)	15/15
grid16 hol	**2.8**(2)	4.0(7)	45(27)	45(27)	45(27)	15/15
hill hol	6.6(7)	4.4(4)	8.1(6)	8.1(6)	8.1(6)	15/15
lmmCMA aug	3.6(2)	**2.6**(1)	4.4(2)	4.4(2)	4.4(2)	15/15
memPSODE v	**1**(0.7)	**1.1**(1)	14(5)	14(5)	14(5)	15/15
prcga saw	4.5(3)	12(11)	∞	∞	∞ *2e5*	0/15
ring100 ho	**2.3**(2)	3.1(4)	134(38)	134(38)	134(38)	15/15
ring16 hol	**2.4**(2)	5.3(6)	34(9)	34(9)	34(9)	15/15
simplex pa	22(0.7)	11(0.6)	44(52)	44(52)	44(52)	15/15

Table 31: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*6.3e+4*:1.8	*6.3e+3*:3.7	*4.0e+1*:13	*1.0e+1*:34	*6.3e-4*:159	15/15
BIPOP-aCMA	**2.3**(2)	**2.8**(4)	**3.0**(2)	**2.7**(2)	3.0(0.3)	15/15
BIPOP-saAC	3.8(4)	4.5(3)	**2.9**(3)	3.3(2)	3.2(2)	15/15
CMAES hut	4.5(4)	3.5(3)	**2.6**(2)	**2.0**(1)	∞ *303*	0/15
DE pal	**1.8**(2)	**2.6**(4)	3.3(3)	3.3(3)	10(2)	15/15
HCMA los	**2.0**(2)	**1.6**(2)	**2.3**(2)	**2.9**(2)	4.5(2)	15/15
HMLSL pal	**2.3**(2)	3.1(3)	**2.4**(3)	**1.5**(1)	**1.2**(0.5)	15/15
IPOP-10DDr	**1.5**(1)	**2.0**(2)	**1.2**(1)	**2.2**(1)	3.1(0.5)	15/15
IPOP-500 l	**1.5**(1)	**2.0**(2)	**1.2**(1)	**2.2**(1)	3.1(0.5)	15/15
IPOP-tany	**1.5**(1)	**2.1**(2)	**1.5**(2)	**1.8**(0.9)	3.4(0.7)	15/15
IPOP-texp	**2.8**(4)	4.0(5)	**1.8**(2)	**1.8**(0.9)	3.6(0.7)	15/15
IPOP lia	**1.5**(1)	**2.0**(2)	**1.2**(1)	**2.2**(1)	3.1(0.5)	15/15
MLSL pal	**2.3**(2)	3.1(3)	**2.4**(3)	**1.5**(1)	**1.2**(0.5)	15/15
OQNLP pal	4.5(4)	4.1(4)	**1.8**(1)	**1.4**(0.7)	**2.8**(2)	15/15
P-DCN tra	**1.3**(2)	4.8(9)	8.3(9)	8.9(8)	29(24)	15/15
P-zero tra	**1.3**(2)	**2.1**(2)	13(26)	11(18)	47(91)	15/15
SMAC hut	**1.3**(0.8)	**1.4**(1)	**0.91**(1.0)	**1.1**(1)	∞ *300*	0/15
U-DCN tra	**1.3**(2)	3.1(5)	3.8(5)	3.6(3)	489(741)	15/15
U-zero tra	**1.3**(2)	**2.1**(3)	**2.3**(3)	3.4(3)	3459(3552)	14/15
fmincon pa	**2.3**(2)	3.1(3)	**2.4**(3)	**1.5**(1)	**1.2**(0.5)	15/15
fminunc pa	**2.8**(3)	3.0(3)	**1.3**(0.9)	**2.4**(2)	**2.0**(0.8)	15/15
ga100 hol	**2.0**(3)	3.0(6)	3.7(5)	10(7)	2358(2624)	5/15
grid100 ho	**1.9**(2)	5.3(10)	4.2(3)	10(13)	4314(4995)	3/15
grid16 hol	**2.0**(3)	4.4(5)	4.9(6)	5.1(5)	1861(2272)	6/15
hill hol	6.8(9)	10(6)	5.2(4)	3.4(4)	913(1010)	9/15
lmmCMA aug	**2.3**(2)	**2.5**(3)	**2.0**(2)	**2.6**(3)	**3.0**(1)	15/15
memPSODE v	**2.2**(2)	**2.5**(4)	**2.3**(2)	**2.0**(1.0)	**1.5**(0.5)	15/15
prcga saw	**2.4**(3)	4.4(6)	5.5(6)	7.4(14)	154(113)	15/15
ring100 ho	**2.1**(2)	4.4(6)	4.7(6)	8.8(13)	778(804)	11/15
ring16 hol	**1.7**(0.8)	3.6(6)	3.5(3)	4.9(6)	678(943)	10/15
simplex pa	13(13)	16(17)	5.4(4)	5.9(5)	3.5(2)	15/15

Table 32: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*2.5e+2*:1.5	*6.3e+1*:4.2	*1.0e+1*:11	*2.5e+0*:38	*4.0e-1*:174	15/15
BIPOP-aCMA	**2.6**(2)	**2.3**(2)	**3.0**(3)	**2.1**(2)	**1.0**(0.8)	15/15
BIPOP-saAC	**2.2**(2)	**2.0**(2)	**2.5**(2)	**1.7**(2)	**1.0**(0.7)	15/15
CMAES hut	**1.8**(2)	**1.7**(1)	**2.7**(2)	**2.1**(1)	**1.2**(1)	12/15
DE pal	**1.3**(1)	**2.8**(4)	4.0(3)	3.5(2)	**1.8**(0.7)	15/15
HCMA los	**2.8**(3)	**2.3**(1)	**1.9**(2)	**2.7**(4)	**1.2**(1)	15/15
HMLSL pal	**1.8**(2)	**1.9**(2)	3.8(3)	4.4(3)	**2.5**(1)	15/15
IPOP-10DDr	**1.6**(1.0)	**1.6**(2)	4.2(2)	3.7(3)	**2.0**(2)	15/15
IPOP-500 l	**1.6**(1.0)	**1.6**(2)	4.2(2)	3.7(3)	**2.0**(2)	15/15
IPOP-tany	**1.4**(1.0)	**1.7**(2)	3.2(3)	**2.0**(1.0)	**1.0**(0.7)	15/15
IPOP-texp	**1.5**(1)	**1.9**(2)	**2.2**(1)	4.7(10)	**2.8**(3)	15/15
IPOP lia	**1.6**(1.0)	**1.6**(2)	4.2(2)	3.7(3)	**2.0**(2)	15/15
MLSL pal	**2.0**(2)	**2.3**(2)	4.7(6)	15(13)	63(57)	14/15
OQNLP pal	4.1(6)	4.8(3)	4.9(6)	4.8(2)	**2.4**(1)	15/15
P-DCN tra	**1.3**(0.7)	8.1(2)	40(70)	978(53)	282(194)	15/15
P-zero tra	**1.3**(0.7)	**1.9**(2)	14(22)	37(50)	90(135)	15/15
SMAC hut	**1.1**(1)	**1.3**(2)	**1.2**(1)	**0.85**(0.7)	**0.82**(0.7)	14/15
U-DCN tra	**1.3**(0.7)	**2.0**(2)	6.8(9)	11(13)	211(553)	15/15
U-zero tra	**1.3**(0.7)	**1.9**(2)	4.4(4)	5.8(4)	295(746)	15/15
fmincon pa	**2.2**(3)	**2.2**(2)	5.0(4)	15(24)	25(30)	15/15
fminunc pa	**2.0**(2)	**1.9**(2)	4.0(4)	10(10)	42(53)	15/15
ga100 hol	**2.1**(2)	**1.5**(1)	4.7(5)	7.7(6)	5.8(2)	15/15
grid100 ho	**1.6**(2)	**1.8**(2)	5.6(4)	14(16)	34(70)	15/15
grid16 hol	**1.3**(1.0)	3.7(2)	6.1(6)	7.1(4)	11(14)	15/15
hill hol	**2.7**(3)	3.4(3)	6.0(7)	10(22)	79(108)	15/15
lmmCMA aug	**1.2**(1.0)	**1.4**(2)	**1.5**(1)	**2.6**(4)	**1.4**(2)	15/15
memPSODE v	**2.6**(2)	**2.6**(2)	6.3(3)	23(29)	16(16)	15/15
prcga saw	**1.7**(1)	**1.5**(1)	**2.6**(4)	3.1(3)	5.2(5)	15/15
ring100 ho	**1.4**(1.0)	**2.0**(3)	3.4(3)	8.6(8)	10(5)	15/15
ring16 hol	**1.9**(1)	**1.3**(1)	5.0(6)	3.9(6)	8.4(13)	15/15
simplex pa	**2.3**(3)	**2.2**(2)	**2.9**(3)	6.3(5)	15(17)	15/15

Table 33: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*1.0e+4*:1.8	*1.6e+3*:4.0	*1.0e+2*:15	*6.3e+0*:31	*1.0e-1*:152	15/15
BIPOP-aCMA	**1.7**(1)	**2.5**(3)	5.2(3)	4.4(1)	4.0(1)	15/15
BIPOP-saAC	**2.2**(2)	**2.1**(2)	**2.1**(2)	**2.9**(1)	**2.0**(0.9)	15/15
CMAES hut	3.5(4)	**2.9**(3)	3.5(2)	4.4(3)	30(30)	1/15
DE pal	**1.1**(0.8)	**2.4**(3)	4.8(4)	6.7(4)	9.4(5)	15/15
HCMA los	**2.1**(2)	**2.1**(1)	**2.0**(2)	4.3(4)	**2.7**(1)	15/15
HMLSL pal	**1.1**(1)	**1.4**(1)	**1.0**(1)	**1.0**(0.4)	**0.63**(0.5)	15/15
IPOP-10DDr	**1.1**(0.6)	3.3(3)	**2.8**(1)	3.1(1)	5.0(3)	15/15
IPOP-500 l	**1.1**(0.6)	3.3(3)	**2.8**(1)	3.1(1)	5.0(3)	15/15
IPOP-tany	**2.0**(3)	**2.5**(2)	**2.0**(1)	**2.4**(1)	4.7(2)	15/15
IPOP-texp	**3.0**(6)	4.0(4)	**2.7**(2)	**2.6**(1)	4.7(4)	15/15
IPOP lia	**1.1**(0.6)	3.3(3)	**2.8**(1)	3.1(1)	5.0(3)	15/15
MLSL pal	**1.1**(1)	**1.4**(1)	**1.0**(1)	**1.0**(0.4)	**0.63**(0.5)	15/15
OQNLP pal	**2.0**(4)	**2.4**(2)	**1.3**(1)	**1.1**(0.6)	**0.69**(0.3)	15/15
P-DCN tra	**1.9**(4)	3.5(4)	13(16)	16(12)	198(183)	15/15
P-zero tra	**1.9**(4)	3.1(4)	10(13)	180(393)	521(459)	15/15
SMAC hut	**0.89**(0.6)	**0.75**(0.6)	**1.4**(2)	4.7(4)	9.3(11)	3/15
U-DCN tra	**1.8**(2)	**2.8**(2)	5.1(4)	9.0(5)	2671(3435)	15/15
U-zero tra	**1.9**(3)	**2.8**(3)	3.8(2)	8.5(8)	6.0e4(7e4)	4/15
fmincon pa	**1.1**(1)	**1.4**(1)	**1.0**(1)	**1.0**(0.4)	**0.63**(0.6)	15/15
fminunc pa	**1**(1)	**1.2**(2)	**1.1**(1.0)	**0.90**(0.6)	**0.73**(0.3)	15/15
ga100 hol	**2.2**(1)	**2.0**(2)	3.2(3)	19(16)	238(304)	15/15
grid100 ho	**1.6**(2)	**2.5**(3)	9.4(11)	34(29)	1721(2020)	6/15
grid16 hol	**1.9**(2)	3.4(4)	7.0(5)	12(8)	4090(4947)	3/15
hill hol	5.4(4)	5.0(4)	**2.9**(2)	5.1(3)	1666(1980)	6/15
lmmCMA aug	**1.1**(0.8)	**1.3**(2)	**1.6**(1)	**1.6**(0.5)	**1.1**(0.3)	15/15
memPSODE v	**2.2**(2)	**2.5**(2)	3.5(2)	**2.7**(0.3)	**1.1**(0.7)	15/15
prcga saw	**1.6**(1)	**1.8**(2)	**2.0**(2)	4.5(3)	258(259)	14/15
ring100 ho	**1.4**(1)	**2.2**(3)	5.2(11)	29(23)	106(75)	15/15
ring16 hol	**2.0**(1)	3.5(6)	6.0(4)	11(7)	787(999)	9/15
simplex pa	4.7(11)	8.1(6)	5.3(5)	4.2(4)	**1.8**(0.9)	15/15

Table 34: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*1.0e+1*:21	*6.3e+0*:25	*4.0e+0*:32	*2.5e+0*:48	*6.3e-3*:152	15/15
BIPOP-aCMA	4.5(2)	5.8(5)	6.3(10)	5.9(10)	5.9(4)	15/15
BIPOP-saAC	**2.9**(2)	**2.7**(0.8)	**2.4**(0.9)	**2.2**(2)	**2.4**(0.8)	15/15
CMAES hut	3.4(1)	3.6(3)	3.9(2)	4.3(4)	∞ *303*	0/15
DE pal	8.6(4)	8.4(3)	8.0(5)	6.8(3)	12(4)	15/15
HCMA los	**2.7**(3)	3.0(3)	3.3(2)	3.6(2)	3.0(1)	15/15
HMLSL pal	**0.53**$(0)_{\downarrow 4}$	**0.44**$(0)_{\downarrow 4}$	**0.34**$(0)_{\downarrow 4}$	**0.23**$(0)_{\downarrow 4}$	**0.48**(0.0)	15/15
IPOP-10DDr	4.3(3)	4.3(2)	4.7(1)	4.6(4)	6.6(3)	15/15
IPOP-500 l	4.3(3)	4.3(2)	4.7(1)	4.6(4)	6.6(3)	15/15
IPOP-tany	3.0(1)	3.1(1)	3.1(1)	4.2(5)	6.1(2)	15/15
IPOP-texp	**1.9**(1)	**1.9**(1)	**1.8**(1)	3.1(3)	6.4(3)	15/15
IPOP lia	4.3(3)	4.3(2)	4.7(1)	4.6(4)	6.6(3)	15/15
MLSL pal	**0.53**$(0)_{\downarrow 4}$	**0.44**$(0)_{\downarrow 4}$	**0.34**$(0)_{\downarrow 4}$	**0.23**$(0)_{\downarrow 4}$	**0.48**(0.0)	15/15
OQNLP pal	**0.48**$(0)_{\downarrow 4}$	**0.45**$(0.0)_{\downarrow 4}$	**0.37**$(0)_{\downarrow 4}$	**0.25**$(0)_{\downarrow 4}$	**0.49**(0.0)	15/15
P-DCN tra	13(15)	493(1602)	755(2628)	557(1843)	668(681)	15/15
P-zero tra	13(13)	1684(4202)	2231(5617)	1639(4261)	1468(1665)	15/15
SMAC hut	7.0(6)	7.9(5)	12(12)	14(13)	∞ *300*	0/15
U-DCN tra	14(13)	18(14)	80(95)	58(65)	2.9e4(3e4)	7/15
U-zero tra	10(7)	21(16)	45(48)	33(36)	∞ *3e6*	0/15
fmincon pa	**0.53**$(0)_{\downarrow 4}$	**0.44**$(0)_{\downarrow 4}$	**0.34**$(0)_{\downarrow 4}$	**0.23**$(0)_{\downarrow 4}$	**0.48**(0.0)	15/15
fminunc pa	**0.43**$(0)^{\star}_{\downarrow 4}$	**0.36**$(0)^{\star 2}_{\downarrow 4}$	**0.28**$(0)^{\star 2}_{\downarrow 4}$	**0.19**$(0)^{\star 2}_{\downarrow 4}$	**0.45**(0.0)	15/15
ga100 hol	16(11)	18(10)	20(12)	21(11)	2302(2489)	5/15
grid100 ho	31(19)	41(39)	50(50)	52(42)	1.4e4(2e4)	1/15
grid16 hol	17(13)	130(38)	104(33)	75(22)	1.5e4(2e4)	1/15
hill hol	7.2(8)	64(19)	68(91)	292(220)	1.4e4(2e4)	1/15
lmmCMA aug	**1.6**(0.6)	**1.6**(0.5)	**1.4**(0.3)	**1.1**(0.5)	**1.5**(0.4)	15/15
memPSODE v	3.8(0.6)	3.7(0.7)	3.2(1)	**2.7**(2)	**1.6**(0.7)	15/15
prcga saw	4.8(4)	5.3(4)	4.7(3)	3.5(2)	1393(1626)	9/15
ring100 ho	30(28)	46(24)	44(25)	32(18)	1010(1097)	9/15
ring16 hol	13(7)	13(8)	14(11)	17(10)	∞ *2e5*	0/15
simplex pa	**1.3**(0.0)	**1.4**(0.1)	**1.6**(0.7)	**1.2**(0.6)	**1.5**(0.2)	15/15

Table 35: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*6.3e+6*:1.7	*1.6e+5*:4.4	*4.0e+4*:12	*4.0e+2*:37	*1.0e+0*:152	15/15
BIPOP-aCMA	**1.2**(0.6)	3.5(4)	**2.2**(2)	5.7(2)	3.8(0.7)	15/15
BIPOP-saAC	**2.0**(3)	**2.8**(3)	**2.4**(3)	**2.8**(0.7)	**1.3**(0.3)	15/15
CMAES hut	**2.0**(2)	4.0(3)	**2.2**(2)	4.8(2)	∞ *303*	0/15
DE pal	**1.4**(2)	3.9(4)	**2.2**(2)	8.7(4)	10(5)	15/15
HCMA los	**1.8**(1)	**2.3**(0.9)	**1.7**(1)	3.3(2)	**1.7**(0.2)	15/15
HMLSL pal	**1.5**(2)	3.6(5)	**1.7**(2)	**1.1**(0.9)	**0.38**(0.2)	15/15
IPOP-10DDr	**0.88**(0.3)	**1.9**(2)	3.6(6)	7.2(4)	5.8(1)	15/15
IPOP-500 l	**0.88**(0.3)	**1.9**(2)	3.6(6)	7.2(4)	5.8(1)	15/15
IPOP-tany	**0.88**(0.3)	**2.1**(3)	**2.1**(2)	7.6(3)	5.5(2)	15/15
IPOP-texp	**0.92**(0.3)	**2.3**(2)	**1.4**(1)	5.8(4)	4.4(2)	15/15
IPOP lia	**0.88**(0.3)	**1.9**(2)	3.6(6)	7.2(4)	5.8(1)	15/15
MLSL pal	**1.5**(2)	3.6(5)	**1.7**(2)	**1.1**(0.9)	**0.38**(0.2)	15/15
OQNLP pal	3.2(4)	3.5(2)	**1.4**(0.3)	**1.1**(0.4)	**0.45**(0.2)	15/15
P-DCN tra	**1.4**(0.9)	3.7(5)	3.5(3)	45(61)	2188(3783)	15/15
P-zero tra	**1.4**(0.9)	**2.6**(3)	**2.5**(2)	46(54)	1.0e4(1e4)	12/15
SMAC hut	**1.0**(0.9)	**1.2**(1)	**0.87**(0.5)	**2.3**(1)	∞ *300*	0/15
U-DCN tra	**1.4**(0.9)	**2.7**(3)	**2.1**(2)	35(53)	1.3e4(2e4)	10/15
U-zero tra	**1.4**(0.9)	**2.5**(2)	3.2(4)	79(129)	2.8e4(3e4)	7/15
fmincon pa	**1.5**(2)	3.6(5)	**1.7**(2)	**1.1**(0.9)	**0.38**(0.2)	15/15
fminunc pa	**1.6**(1)	**2.3**(2)	**1.1**(0.7)	**1.6**(1.0)	**0.95**(0.3)	15/15
ga100 hol	**1.1**(0.9)	4.3(6)	4.0(4)	26(27)	4164(4834)	3/15
grid100 ho	**1.4**(2)	3.4(4)	**2.7**(3)	66(80)	1.4e4(2e4)	1/15
grid16 hol	**1**(0.6)	3.7(3)	3.4(4)	55(90)	∞ *2e5*	0/15
hill hol	3.8(3)	3.2(4)	**2.3**(2)	36(24)	6686(7813)	2/15
lmmCMA aug	**1.4**(2)	**2.5**(2)	**1.5**(1)	**1.5**(0.8)	**1.1**(0.3)	15/15
memPSODE v	**1.8**(1)	4.3(3)	**3.0**(3)	**3.0**(0.6)	**1.6**(0.6)	15/15
prcga saw	**1.2**(1)	**2.9**(2)	**2.0**(2)	254(418)	1987(2588)	7/15
ring100 ho	**1.3**(1)	**2.0**(3)	3.2(4)	36(35)	3262(3630)	4/15
ring16 hol	**1.4**(0.9)	**2.7**(2)	4.1(4)	36(31)	3088(3714)	4/15
simplex pa	8.9(13)	8.7(5)	3.8(1)	5.5(2)	**2.7**(1)	15/15

Table 36: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*2.5e+6*:1.9	*4.0e+5*:4.5	*6.3e+4*:9.4	*2.5e+1*:36	*2.5e-1*:174	15/15
BIPOP-aCMA	**1.5**(1)	3.1(3)	**2.3**(2)	11(5)	3.4(0.9)	15/15
BIPOP-saAC	4.0(4)	**2.3**(2)	**2.0**(2)	4.4(2)	**1.2**(0.2)	15/15
CMAES hut	**2.2**(2)	**1.8**(2)	**2.1**(2)	22(22)	∞ *303*	0/15
DE pal	**1.6**(1)	**1.9**(2)	**2.8**(3)	12(6)	8.9(2)	15/15
HCMA los	**2.6**(2)	**1.8**(1)	**1.2**(0.3)	3.4(3)	**1.4**(0.2)	15/15
HMLSL pal	**2.6**(2)	**1.8**(0.6)	**1.2**(0.5)	**0.61**(0.2)	**0.18**(0.0)	15/15
IPOP-10DDr	**1.8**(2)	**1.9**(2)	**2.0**(2)	15(10)	5.6(1)	15/15
IPOP-500 l	**1.8**(2)	**1.9**(2)	**2.0**(2)	15(10)	5.6(1)	15/15
IPOP-tany	**2.1**(1)	**2.4**(2)	**2.3**(2)	12(10)	5.3(0.9)	15/15
IPOP-texp	5.3(7)	3.3(4)	**2.5**(2)	11(9)	5.1(0.9)	15/15
IPOP lia	**1.8**(2)	**1.9**(2)	**2.0**(2)	15(10)	5.6(1)	15/15
MLSL pal	**2.6**(2)	**1.8**(0.6)	**1.2**(0.5)	**0.61**(0.2)	**0.18**(0.0)	15/15
OQNLP pal	5.1(4)	3.2(0.6)	**1.8**(0.2)	**1.3**(0.3)	**0.46**(0.1)	15/15
P-DCN tra	**1.9**(2)	**2.1**(2)	**1.8**(1)	61(134)	394(233)	15/15
P-zero tra	**1.9**(2)	**2.3**(2)	**2.5**(3)	395(617)	843(369)	15/15
SMAC hut	**1.5**(1)	**1.1**(1)	**0.82**(0.4)	3.1(3)	∞ *300*	0/15
U-DCN tra	**1.7**(2)	**1.7**(1)	**2.0**(2)	21(30)	5109(4419)	15/15
U-zero tra	**1.9**(2)	**1.8**(2)	**2.2**(2)	74(131)	4146(5594)	15/15
fmincon pa	**2.6**(2)	**1.8**(0.6)	**1.2**(0.5)	**0.61**(0.2)	**0.18**(0.0)	15/15
fminunc pa	**2.7**(2)	**1.8**(1)	**1.2**(0.6)	**0.77**(0.3)	**0.98**(1.0)	15/15
ga100 hol	**1.3**(2)	**1.1**(0.9)	**2.2**(2)	690(2107)	5933(6311)	2/15
grid100 ho	**1.8**(2)	**1.4**(2)	**2.1**(2)	806(2111)	1.3e4(1e4)	1/15
grid16 hol	**1.6**(2)	**1.4**(1)	**3.0**(3)	155(306)	1861(1729)	6/15
hill hol	6.2(10)	3.5(5)	**2.0**(3)	195(236)	2782(3025)	4/15
lmmCMA aug	3.2(3)	**2.2**(2)	**1.6**(0.8)	**2.0**(1)	**1.1**(0.3)	15/15
memPSODE v	**2.2**(2)	**1.4**(0.6)	**1.6**(2)	4.6(2)	**1.7**(0.4)	15/15
prcga saw	**1.2**(1)	**1.1**(1)	**1.3**(1)	38(9)	2154(2461)	5/15
ring100 ho	**1.2**(1)	**1.2**(1)	**1.8**(2)	36(39)	1077(1297)	8/15
ring16 hol	**1.9**(2)	**2.0**(2)	**1.4**(1)	54(72)	1339(1451)	7/15
simplex pa	15(12)	9.2(1)	4.9(0.7)	3.2(2)	3.5(0.9)	15/15

Table 37: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*1.0e+8*:1.5	*1.0e+7*:3.6	*6.3e+5*:13	*6.3e+2*:31	*1.0e+0*:168	15/15
BIPOP-aCMA	**1.0**(0.7)	3.2(3)	3.6(2)	6.1(2)	8.4(9)	15/15
BIPOP-saAC	**2.6**(3)	3.4(4)	**2.9**(2)	3.2(0.4)	3.6(6)	15/15
CMAES hut	**0.96**(0.7)	**1.6**(2)	**2.5**(2)	5.0(2)	27(28)	1/15
DE pal	**1.8**(1)	**1.9**(2)	**2.6**(3)	15(6)	27(27)	15/15
HCMA los	**0.91**(0.7)	**1.9**(2)	**1.3**(0.5)	**2.8**(2)	4.6(5)	15/15
HMLSL pal	**1**(1)	**1.6**(2)	**1.2**(0.6)	**1.2**(0.5)	**0.77**(0.8)	15/15
IPOP-10DDr	**1.3**(1)	**1.5**(1)	**2.4**(2)	4.6(1)	6.8(6)	15/15
IPOP-500 l	**1.3**(1)	**1.5**(1)	**2.4**(2)	4.6(1)	6.8(6)	15/15
IPOP-tany	**1.7**(2)	**1.9**(2)	**1.8**(2)	4.7(2)	7.4(7)	15/15
IPOP-texp	**2.1**(3)	**2.9**(3)	**2.1**(1)	4.0(1)	10(10)	15/15
IPOP lia	**1.3**(1)	**1.5**(1)	**2.4**(2)	4.6(1)	6.8(6)	15/15
MLSL pal	**1**(1)	**1.6**(2)	**1.2**(0.6)	**1.2**(0.5)	**0.77**(0.8)	15/15
OQNLP pal	**1.8**(4)	**2.9**(2)	**1.5**(0.5)	**1.6**(0.6)	**1.4**(1)	15/15
P-DCN tra	**1.0**(0.3)	**1.5**(0.8)	5.0(4)	7.3(4)	1.6e4(2e4)	9/15
P-zero tra	**1.0**(0.3)	**1.4**(0.8)	6.1(6)	6.1(4)	4.9e4(6e4)	4/15
SMAC hut	**0.87**(0.7)	**0.96**(1.0)	**1.2**(2)	9.0(10)	∞ *300*	0/15
U-DCN tra	**1.0**(0.3)	**1.5**(0.8)	4.0(3)	43(42)	2.7e4(4e4)	6/15
U-zero tra	**1.0**(0.3)	**1.4**(0.8)	3.2(4)	49(55)	3.6e4(4e4)	5/15
fmincon pa	**1**(1)	**1.6**(2)	**1.2**(0.6)	**1.2**(0.5)	**0.77**(0.8)	15/15
fminunc pa	**1.3**(1)	**2.0**(2)	**1.3**(1)	**0.98**(0.9)	**0.80**(0.8)	15/15
ga100 hol	**1.2**(1)	**1.5**(2)	7.5(8)	72(37)	3758(4446)	3/15
grid100 ho	**0.83**(0.3)	**1.3**(2)	**2.9**(4)	138(61)	2852(3164)	4/15
grid16 hol	**0.91**(0.7)	**0.96**(1)	3.7(5)	64(43)	5967(7036)	2/15
hill hol	4.3(6)	3.4(5)	**2.4**(2)	30(31)	2503(3132)	4/15
lmmCMA aug	**0.87**(0.7)	**1.6**(2)	**1.4**(1)	**1.7**(0.4)	**1.6**(1)	15/15
memPSODE v	**1.7**(3)	**2.4**(3)	3.2(3)	3.3(0.4)	**2.6**(2)	15/15
prcga saw	**0.91**(0.3)	**1.4**(1)	3.7(5)	10(3)	213(315)	12/15
ring100 ho	**1.1**(0.7)	**1.6**(2)	7.4(13)	103(61)	712(680)	11/15
ring16 hol	**1.0**(1.0)	**1.3**(1)	5.0(6)	41(24)	1983(2640)	5/15
simplex pa	7.2(14)	12(7)	7.7(4)	4.8(1)	**2.9**(2)	15/15

Table 38: 03-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*1.0e+3*:1.6	*4.0e+2*:6.8	*2.5e+2*:11	*4.0e+1*:30	*2.5e-3*:182	15/15
BIPOP-aCMA	**1.2**(2)	**2.1**(2)	**2.1**(1)	4.0(1)	3.4(0.6)	15/15
BIPOP-saAC	**0.96**(0.3)	**1.1**(1)	**1.4**(1)	**2.2**(0.9)	**1.5**(0.4)	15/15
CMAES hut	3.6(4)	**2.6**(2)	**2.2**(2)	3.2(2)	∞ *303*	0/15
DE pal	**0.87**(0.3)	**1.4**(1)	**1.7**(2)	4.7(2)	17(3)	15/15
HCMA los	**1.3**(2)	**1.0**(0.7)	**0.96**(0.3)	**1.8**(2)	**1.8**(0.4)	15/15
HMLSL pal	**0.79**(0)	**1.2**(1.0)	**1.3**(0.7)	**0.96**(0.2)	**0.63**(0.1)	15/15
IPOP-10DDr	**1.1**(0.6)	**1.8**(2)	**2.2**(2)	3.3(0.8)	5.6(1)	15/15
IPOP-500 l	**1.1**(0.6)	**1.8**(2)	**2.2**(2)	3.3(0.8)	5.6(1)	15/15
IPOP-tany	**1.1**(0.6)	**1.7**(1)	**1.6**(1)	**2.8**(0.9)	5.5(1)	15/15
IPOP-texp	**1.9**(1)	**2.2**(2)	**2.3**(2)	**2.9**(1)	5.2(1)	15/15
IPOP lia	**1.1**(0.6)	**1.8**(2)	**2.2**(2)	3.3(0.8)	5.6(1)	15/15
MLSL pal	**0.79**(0)	**1.2**(1.0)	**1.3**(0.7)	**0.96**(0.2)	**0.63**(0.1)	15/15
OQNLP pal	**1.2**(0)	**2.1**(2)	**1.8**(0.5)	**1.4**(0.4)	3.6(3)	15/15
P-DCN tra	**1.3**(2)	3.6(4)	5.7(5)	15(20)	3.0e4(3e4)	6/15
P-zero tra	**1.3**(2)	**1.9**(2)	4.1(4)	55(96)	2.3e5(2e5)	1/15
SMAC hut	**0.87**(0.6)	**0.84**(0.8)	**0.79**(0.4)	**0.98**(0.5)	∞ *300*	0/15
U-DCN tra	**1.3**(2)	**1.5**(1)	**2.9**(3)	13(10)	∞ *3e6*	0/15
U-zero tra	**1.3**(2)	**1.5**(1)	**2.3**(1)	13(7)	∞ *3e6*	0/15
fmincon pa	**0.79**(0)	**1.2**(1.0)	**1.3**(0.7)	**0.96**(0.2)	**0.63**(0.1)	15/15
fminunc pa	**1.1**(0)	**1.4**(0.9)	**1.2**(0.5)	**0.97**(0.4)	**0.87**(0.2)	15/15
ga100 hol	**1.1**(0.6)	**1.3**(1)	3.9(4)	15(14)	∞ *2e5*	0/15
grid100 ho	**1.7**(2)	**1.4**(1)	3.7(4)	32(19)	∞ *2e5*	0/15
grid16 hol	**0.92**(0.6)	**1.3**(1)	**2.8**(4)	21(12)	∞ *2e5*	0/15
hill hol	4.2(7)	**2.4**(2)	**2.2**(2)	57(92)	∞ *2e5*	0/15
lmmCMA aug	**1.3**(2)	**1.2**(1)	**1.2**(0.9)	**1.6**(0.4)	**1.5**(0.3)	15/15
memPSODE v	**2.0**(2)	**1.8**(2)	**2.5**(2)	**2.9**(1)	**1.7**(0.6)	15/15
prcga saw	**1.5**(0.6)	**2.5**(1)	**2.8**(6)	5.7(5)	1507(1864)	6/15
ring100 ho	**1.2**(0.9)	**1.5**(1)	**2.4**(2)	27(20)	∞ *2e5*	0/15
ring16 hol	**1.1**(0.6)	**2.7**(4)	3.9(3)	10(9)	∞ *2e5*	0/15
simplex pa	**2.5**(0)	6.7(5)	7.7(4)	7.4(5)	4.5(2)	15/15

Table 39: 03-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*1.0e+1*:2.2	*6.3e+0*:4.2	*2.5e+0*:10	*6.3e-2*:31	*2.5e-6*:160	15/15
BIPOP-aCMA	3.7(5)	3.8(4)	3.7(3)	4.2(2)	3.9(0.7)	15/15
BIPOP-saAC	**2.9**(3)	**2.4**(3)	**2.4**(3)	3.3(1)	**2.0**(0.2)	15/15
CMAES hut	3.2(4)	**2.3**(3)	3.1(3)	3.8(1)	∞ *303*	0/15
DE pal	**1.4**(2)	**2.1**(2)	**2.4**(2)	7.9(2)	15(4)	15/15
HCMA los	4.3(4)	**2.8**(3)	**1.9**(2)	3.9(2)	**2.3**(0.3)	15/15
HMLSL pal	**1.3**(1)	**1**(1.0)	**0.83**(0.5)	**0.82**(0.2)	10(14)	15/15
IPOP-10DDr	**2.3**(3)	**2.0**(2)	3.1(3)	3.7(2)	6.6(0.9)	15/15
IPOP-500 l	**2.3**(3)	**2.0**(2)	3.1(3)	3.7(2)	6.6(0.9)	15/15
IPOP-tany	**2.7**(4)	**1.7**(2)	**2.0**(2)	3.5(0.9)	6.0(0.8)	15/15
IPOP-texp	**2.8**(6)	**1.9**(3)	**2.0**(2)	**3.0**(2)	5.4(1)	15/15
IPOP lia	**2.3**(3)	**2.0**(2)	3.1(3)	3.7(2)	6.6(0.9)	15/15
MLSL pal	**1.3**(1)	**1**(1.0)	**0.83**(0.5)	**0.82**(0.2)	140(201)	9/15
OQNLP pal	**2.7**(3)	**2.2**(2)	**1.7**(0.6)	**1.2**(0.6)	10(9)	15/15
P-DCN tra	**1.7**(2)	**1.4**(2)	4.7(6)	11(7)	1.9e4(2e4)	9/15
P-zero tra	**1.5**(2)	**1.2**(1)	4.0(4)	8.8(6)	4.6e4(5e4)	5/15
SMAC hut	**1**(0.9)	**0.90**(0.8)	**1.6**(1)	4.4(1)	∞ *300*	0/15
U-DCN tra	**1.9**(2)	**1.4**(2)	**2.3**(2)	21(13)	∞ *3e6*	0/15
U-zero tra	**1.5**(2)	**1.5**(1)	**2.5**(2)	17(14)	∞ *3e6*	0/15
fmincon pa	**1.3**(1)	**1**(1.0)	**0.83**(0.5)	**0.82**(0.2)	137(200)	9/15
fminunc pa	**1.5**(2)	**1.1**(1.0)	**0.98**(0.4)	**1.0**(0.5)	**1.2**(1)	15/15
ga100 hol	**2.0**(1)	**2.0**(2)	4.0(6)	29(17)	∞ *2e5*	0/15
grid100 ho	**2.4**(2)	**1.7**(2)	3.3(4)	70(38)	∞ *2e5*	0/15
grid16 hol	**2.4**(3)	**2.2**(3)	3.9(4)	18(10)	∞ *2e5*	0/15
hill hol	4.6(4)	**2.8**(2)	3.0(2)	10(10)	∞ *2e5*	0/15
lmmCMA aug	**1.7**(2)	**1.4**(2)	**1.6**(1)	**1.7**(0.5)	**1.6**(0.2)	15/15
memPSODE v	3.5(3)	3.5(2)	4.0(4)	3.2(0.6)	**1.4**(0.2)	15/15
prcga saw	**2.0**(1)	**1.4**(1)	3.1(4)	10(7)	1395(1556)	8/15
ring100 ho	3.2(2)	**2.2**(3)	**3.0**(5)	54(37)	∞ *2e5*	0/15
ring16 hol	**1.8**(2)	**2.0**(1)	4.4(5)	17(8)	∞ *2e5*	0/15
simplex pa	8.5(10)	6.8(5)	7.2(4)	6.5(2)	**2.0**(0.3)	15/15

Table 40: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*1.6e+2*:1.6	*6.3e+1*:5.6	*4.0e+1*:12	*1.6e+1*:68	*6.3e+0*:221	15/15
BIPOP-aCMA	3.2(6)	**2.6**(2)	**2.8**(3)	**1.5**(0.7)	**1.3**(0.7)	15/15
BIPOP-saAC	**2.2**(3)	**1.8**(2)	**2.2**(2)	**1.1**(1)	**1.2**(0.6)	15/15
CMAES hut	5.7(7)	4.0(3)	**2.9**(2)	**1.5**(0.8)	**1.1**(0.8)	12/15
DE pal	**1.7**(0.9)	**1.8**(2)	**2.5**(2)	**1.7**(1)	**1.8**(2)	15/15
HCMA los	**2.5**(2)	**1.9**(1)	**2.1**(1.0)	**1.8**(1)	**1.3**(0.6)	15/15
HMLSL pal	10(28)	7.7(9)	7.2(6)	3.7(2)	**1.8**(0.7)	15/15
IPOP-10DDr	**1.5**(0.9)	**2.5**(2)	**2.6**(2)	**1.1**(0.5)	**1.7**(2)	15/15
IPOP-500 l	**1.5**(0.9)	**2.5**(2)	**2.6**(2)	**1.1**(0.5)	**1.7**(2)	15/15
IPOP-tany	**1.8**(0.9)	**2.3**(2)	**2.0**(2)	**1.2**(0.7)	**1.6**(1)	15/15
IPOP-texp	8.1(10)	4.2(4)	3.2(3)	**1.4**(0.6)	**2.3**(3)	15/15
IPOP lia	**1.5**(0.9)	**2.5**(2)	**2.6**(2)	**1.1**(0.5)	**1.7**(2)	15/15
MLSL pal	10(28)	7.7(10)	6.8(5)	3.3(2)	**1.9**(2)	15/15
OQNLP pal	29(55)	17(16)	13(12)	4.4(2)	**1.9**(0.4)	15/15
P-DCN tra	**1.7**(2)	**1.5**(2)	**2.2**(2)	4672(9712)	1516(3118)	14/15
P-zero tra	**1.7**(2)	14(3)	16(3)	6942(2e4)	4407(6811)	12/15
SMAC hut	**1.7**(2)	**1.0**(1.0)	**1.3**(1)	**1.3**(0.8)	4.6(5)	4/15
U-DCN tra	**1.7**(2)	**1.4**(2)	**1.6**(1)	3.1(3)	5.5(4)	15/15
U-zero tra	**1.7**(2)	**1.2**(1)	**1.9**(2)	3.4(5)	25(26)	15/15
fmincon pa	11(31)	7.9(10)	7.5(6)	3.4(2)	**2.6**(2)	15/15
fminunc pa	16(37)	9.4(12)	6.1(6)	**2.9**(2)	**2.3**(2)	15/15
ga100 hol	**1.3**(0.9)	**2.4**(4)	**2.7**(2)	3.6(3)	4.1(4)	15/15
grid100 ho	**1.7**(2)	**2.0**(2)	3.0(4)	7.3(7)	11(10)	15/15
grid16 hol	**1.2**(0.9)	**1.9**(2)	3.5(4)	4.1(4)	4.9(2)	15/15
hill hol	7.2(10)	3.2(3)	**2.5**(3)	**2.6**(1)	4.1(5)	15/15
lmmCMA aug	**1.8**(1)	**1.6**(2)	**1.3**(0.8)	**1.1**(0.5)	**0.91**(0.8)	15/15
memPSODE v	**1.9**(2)	**2.7**(3)	3.9(2)	7.1(13)	8.5(10)	15/15
prcga saw	**1.9**(2)	**1.8**(2)	**2.6**(2)	**2.1**(0.8)	6.3(16)	15/15
ring100 ho	**1.5**(2)	**1.2**(1)	**2.1**(1)	6.9(5)	8.7(6)	15/15
ring16 hol	**2.2**(2)	**2.3**(2)	4.0(5)	**2.5**(2)	4.6(3)	15/15
simplex pa	49(91)	27(27)	18(14)	6.7(2)	4.4(4)	15/15

Table 41: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*6.3e+1*:1.5	*2.5e+1*:8.2	*1.6e+1*:10	*1.0e+1*:41	*2.5e+0*:208	15/15
BIPOP-aCMA	**2.2**(2)	**1.9**(2)	3.3(3)	**1.9**(2)	**1.9**(3)	15/15
BIPOP-saAC	**1.7**(1.0)	**2.1**(3)	4.2(4)	**2.4**(2)	**2.4**(3)	15/15
CMAES hut	**1.4**(2)	**1.7**(2)	**2.4**(3)	**1.2**(1)	**1.3**(1)	11/15
DE pal	**1.7**(1.0)	**1.5**(1)	**2.3**(2)	**1.2**(2)	**2.4**(4)	15/15
HCMA los	3.6(4)	**2.4**(3)	3.2(4)	**1.3**(1)	**2.5**(4)	15/15
HMLSL pal	7.7(3)	6.6(10)	7.7(8)	3.0(3)	4.6(5)	15/15
IPOP-10DDr	**1.9**(2)	**1.2**(1)	**2.1**(3)	**1.1**(1)	**1.0**(0.9)	15/15
IPOP-500 l	**1.9**(2)	**1.2**(1)	**2.1**(3)	**1.1**(1)	**1.0**(0.9)	15/15
IPOP-tany	**2.0**(2)	**1.3**(1)	**2.1**(2)	**1.5**(3)	3.3(4)	15/15
IPOP-texp	**1.7**(1)	**1.7**(2)	3.4(4)	**2.2**(3)	**1.4**(1)	15/15
IPOP lia	**1.9**(2)	**1.2**(1)	**2.1**(3)	**1.1**(1)	**1.0**(0.9)	15/15
MLSL pal	7.7(3)	6.8(10)	8.7(8)	3.3(4)	**2.9**(4)	15/15
OQNLP pal	35(57)	14(13)	18(14)	5.1(3)	5.9(8)	15/15
P-DCN tra	**2.1**(0.7)	**1.2**(1)	**2.4**(4)	**0.93**(1)	**1.5**(1)	15/15
P-zero tra	**1.5**(0.7)	**0.99**(1)	11(1.0)	3.1(0.8)	1092(161)	14/15
SMAC hut	**2.2**(2)	**1.3**(1)	**1.7**(1)	**0.64**(0.8)	**0.59**(0.7)	14/15
U-DCN tra	**1.5**(0.7)	**1.1**(1)	**1.6**(2)	**1.0**(1)	**2.0**(2)	15/15
U-zero tra	**1.5**(0.7)	**0.97**(0.9)	**1.9**(2)	**1.2**(1)	**2.6**(3)	15/15
fmincon pa	7.7(3)	6.3(9)	8.2(9)	3.4(3)	4.1(3)	15/15
fminunc pa	30(76)	15(16)	13(14)	4.7(4)	13(13)	15/15
ga100 hol	**2.4**(3)	**1.6**(2)	4.1(6)	**1.9**(2)	3.2(2)	15/15
grid100 ho	**1.5**(2)	**2.3**(3)	**2.6**(3)	**1.5**(1)	4.6(5)	15/15
grid16 hol	**1.2**(0.7)	**1.1**(1.0)	**2.8**(3)	**1.2**(2)	9.4(6)	15/15
hill hol	**2.5**(3)	**2.0**(2)	**2.0**(2)	**1.4**(2)	4.9(9)	15/15
lmmCMA aug	**2.9**(3)	**1.5**(1)	4.2(6)	**1.5**(1)	**1.7**(2)	15/15
memPSODE v	**2.3**(4)	**1.4**(2)	**2.9**(4)	**2.0**(1)	10(13)	15/15
prcga saw	**1.6**(2)	**1.2**(1)	**2.3**(3)	**1.7**(2)	**1.8**(2)	15/15
ring100 ho	**2.3**(2)	**1.2**(1)	**1.8**(2)	**1.3**(2)	**2.9**(3)	15/15
ring16 hol	**1.3**(0.7)	**1.4**(1)	**2.7**(3)	**1.2**(1)	**2.0**(3)	15/15
simplex pa	119(104)	27(19)	25(6)	7.4(2)	**2.4**(0.7)	15/15

Table 42: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*1.6e+1*:1.8	*1.0e+1*:3.6	*6.3e+0*:14	*2.5e+0*:34	*2.5e-1*:189	5/5
BIPOP-aCMA	**1.6**(0.6)	**2.6**(3)	**1.4**(2)	**2.0**(1)	**2.1**(3)	15/15
BIPOP-saAC	5.4(7)	5.4(6)	**2.4**(2)	5.1(2)	**2.3**(3)	15/15
CMAES hut	**2.0**(3)	**2.6**(3)	**1.6**(1)	**1.7**(2)	**0.99**(0.5)	14/15
DE pal	**2.1**(1)	**2.7**(3)	**2.1**(2)	**3.0**(2)	**2.6**(1)	15/15
HCMA los	4.9(3)	4.2(5)	3.1(3)	**2.9**(2)	**2.6**(3)	15/15
HMLSL pal	21(47)	23(49)	14(17)	21(14)	14(19)	15/15
IPOP-10DDr	**2.7**(4)	**2.5**(2)	**1.5**(1)	**1.9**(1)	**1.7**(0.5)	15/15
IPOP-500 l	**2.7**(4)	**2.5**(2)	**1.5**(1)	**1.9**(1)	**1.7**(0.5)	15/15
IPOP-tany	**2.7**(3)	**3.0**(2)	**1.4**(0.9)	**1.7**(0.9)	**2.1**(0.4)	15/15
IPOP-texp	4.9(7)	20(16)	10(24)	6.9(13)	**2.5**(3)	15/15
IPOP lia	**2.7**(4)	**2.5**(2)	**1.5**(1)	**1.9**(1)	**1.7**(0.5)	15/15
MLSL pal	21(46)	23(51)	15(18)	21(16)	139(173)	12/15
OQNLP pal	16(36)	15(18)	7.6(5)	6.4(3)	22(30)	12/15
P-DCN tra	**2.3**(3)	**2.4**(3)	**1.2**(1)	24(44)	1.5e4(2e4)	8/15
P-zero tra	**2.1**(3)	**2.3**(2)	**1.3**(1)	92(142)	3.2e4(4e4)	5/15
SMAC hut	**1.2**(1)	**1.9**(2)	**0.93**(1.0)	**1.7**(2)	12(13)	2/15
U-DCN tra	**1.9**(2)	**2.3**(2)	**1.2**(1)	**3.0**(3)	2560(6257)	15/15
U-zero tra	**2.0**(3)	**2.3**(3)	**1.5**(1)	3.3(3)	592(462)	15/15
fmincon pa	18(47)	21(37)	13(16)	34(89)	164(184)	13/15
fminunc pa	13(36)	10(18)	5.2(4)	6.7(3)	35(48)	15/15
ga100 hol	**1.9**(1)	3.3(3)	**1.7**(2)	4.2(6)	11(6)	15/15
grid100 ho	**2.8**(3)	3.1(4)	**2.3**(2)	7.6(10)	74(46)	15/15
grid16 hol	**2.4**(2)	3.2(5)	**1.8**(3)	6.7(6)	134(335)	14/15
hill hol	5.0(6)	5.5(5)	**2.5**(3)	5.0(4)	75(80)	14/15
lmmCMA aug	**0.93**(0.6)	**0.94**(1)	**0.77**(0.8)	**1.3**(0.8)	**0.85**(0.9)	15/15
memPSODE v	3.0(2)	3.2(2)	6.3(16)	19(25)	22(10)	15/15
prcga saw	**1.1**(0.8)	**1.5**(2)	**0.91**(1)	**2.1**(2)	12(18)	15/15
ring100 ho	**2.2**(2)	3.6(5)	**2.8**(3)	6.0(6)	22(10)	15/15
ring16 hol	**2.7**(3)	**2.4**(2)	**1.4**(1)	3.1(3)	20(17)	15/15
simplex pa	29(64)	24(32)	12(9)	12(5)	55(78)	14/15

Table 43: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*6.3e+1*:1.8	*4.0e+1*:4.8	*2.5e+1*:13	*1.0e+1*:40	*6.3e-1*:184	15/15
BIPOP-aCMA	5.0(5)	3.2(4)	**2.7**(2)	**2.1**(2)	**2.6**(5)	15/15
BIPOP-saAC	5.0(6)	3.4(4)	**1.9**(2)	**1.3**(0.9)	**2.9**(3)	15/15
CMAES hut	3.6(4)	**2.7**(3)	**1.3**(1)	**1.3**(0.9)	**3.4**(3)	6/15
DE pal	**2.5**(3)	4.7(6)	**2.4**(2)	**1.8**(1)	**3.7**(2)	15/15
HCMA los	7.2(8)	3.4(3)	**1.8**(2)	**1.5**(1)	4.6(5)	15/15
HMLSL pal	25(29)	19(24)	8.4(12)	8.4(6)	16(7)	15/15
IPOP-10DDr	3.7(4)	18(2)	7.5(2)	3.1(1)	5.5(8)	15/15
IPOP-500 l	3.7(4)	18(2)	7.5(2)	3.1(1)	5.5(8)	15/15
IPOP-tany	3.1(4)	**2.9**(3)	**1.8**(2)	**1.6**(0.9)	4.2(6)	15/15
IPOP-texp	9.1(14)	6.1(7)	3.2(3)	**1.5**(1)	5.7(8)	15/15
IPOP lia	3.7(4)	18(2)	7.5(2)	3.1(1)	5.5(8)	15/15
MLSL pal	26(29)	20(27)	9.3(10)	10(6)	151(126)	13/15
OQNLP pal	28(49)	19(22)	11(8)	7.7(3)	19(16)	14/15
P-DCN tra	3.5(4)	**2.2**(3)	**1.7**(2)	36(22)	1.4e4(2e4)	8/15
P-zero tra	3.1(3)	**2.6**(3)	**1.8**(2)	37(5)	1.9e4(2e4)	7/15
SMAC hut	**2.2**(2)	**1.4**(2)	**0.95**(1)	**1.0**(0.9)	∞ *300*	0/15
U-DCN tra	4.4(4)	**2.2**(2)	**1.4**(1)	**2.8**(4)	1711(2367)	14/15
U-zero tra	3.2(3)	**1.6**(1)	**1.3**(1)	**2.3**(3)	1640(1808)	15/15
fmincon pa	26(29)	20(22)	9.1(9)	8.1(4)	213(216)	12/15
fminunc pa	16(27)	11(11)	5.4(4)	4.9(3)	133(143)	11/15
ga100 hol	3.4(3)	**2.8**(1)	**1.6**(1)	**2.9**(3)	25(11)	15/15
grid100 ho	**2.4**(3)	**1.8**(2)	**2.1**(3)	4.7(5)	270(419)	13/15
grid16 hol	**2.9**(4)	3.1(4)	**1.7**(2)	5.2(3)	474(817)	10/15
hill hol	14(21)	7.2(8)	4.4(4)	**2.9**(3)	209(412)	13/15
lmmCMA aug	**1.6**(2)	**1.3**(1)	**1.1**(1)	**0.74**(0.4)	**1.5**(2)	15/15
memPSODE v	4.8(5)	4.2(3)	**2.3**(2)	14(21)	49(40)	15/15
prcga saw	**2.4**(2)	**1.7**(1)	**1.3**(2)	**2.0**(2)	41(74)	15/15
ring100 ho	5.7(5)	4.3(4)	**2.8**(3)	6.3(8)	36(22)	15/15
ring16 hol	**2.4**(2)	3.1(4)	**2.1**(3)	3.5(3)	30(29)	15/15
simplex pa	46(63)	27(26)	16(10)	9.1(1)	39(30)	15/15

Table 44: 03-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:81	*1.0e-1*:109	*6.3e-2*:109	*4.0e-2*:119	*1.6e-2*:1230	15/15
BIPOP-aCMA	33(33)	57(90)	118(91)	117(82)	19(22)	15/15
BIPOP-saAC	37(48)	40(39)	62(51)	76(82)	13(13)	15/15
CMAES hut	56(56)	41(43)	∞	∞	∞ *303*	0/15
DE pal	15(12)	22(17)	35(30)	47(59)	16(19)	14/15
HCMA los	25(40)	38(40)	56(58)	100(101)	13(13)	15/15
HMLSL pal	**0.21**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.14**(0)$_{\downarrow}$	**0.03**(0)$_{\downarrow 4}$	15/15
IPOP-10DDr	163(367)	152(270)	165(274)	311(331)	41(52)	15/15
IPOP-500 l	163(367)	152(270)	165(274)	295(331)	31(37)	15/15
IPOP-tany	128(269)	177(265)	282(249)	374(532)	57(73)	15/15
IPOP-texp	142(305)	135(296)	199(374)	312(377)	35(38)	15/15
IPOP lia	163(367)	152(270)	165(274)	295(331)	31(37)	15/15
MLSL pal	**0.21**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.14**(0)$_{\downarrow}$	**0.03**(0)$_{\downarrow 4}$	15/15
OQNLP pal	**0.15**(0)$_{\downarrow}$	**0.11**(0)$^{\star 4}_{\downarrow}$	**0.11**(0)$^{\star 4}_{\downarrow}$	**0.10**(4e-3)$^{\star 4}_{\downarrow}$	**0.03**(4e-4)$_{\downarrow 4}$	15/15
P-DCN tra	136(135)	171(362)	207(385)	311(352)	346(729)	14/15
P-zero tra	2504(3741)	2382(4313)	2867(5331)	3042(4972)	497(584)	15/15
SMAC hut	∞	∞	∞	∞	∞ *300*	0/15
U-DCN tra	41(47)	353(919)	924(1290)	2851(4708)	934(1257)	13/15
U-zero tra	59(67)	304(723)	468(725)	1671(3158)	1359(1717)	11/15
fmincon pa	**0.21**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.16**(0)$_{\downarrow}$	**0.14**(0)$_{\downarrow}$	**0.03**(0)$_{\downarrow 4}$	15/15
fminunc pa	**0.21**(0.0)$_{\downarrow}$	**0.16**(0.0)$_{\downarrow}$	**0.16**(0.0)$_{\downarrow}$	**0.15**(0.0)$_{\downarrow}$	**0.02**(2e-3)$^{\star 4}_{\downarrow 4}$	15/15
ga100 hol	38(23)	58(42)	78(70)	181(226)	44(39)	15/15
grid100 ho	104(66)	122(152)	426(654)	738(809)	216(246)	6/15
grid16 hol	66(80)	216(487)	447(558)	623(806)	147(178)	8/15
hill hol	68(93)	81(107)	188(206)	441(492)	276(335)	5/15
lmmCMA aug	29(30)	27(24)	47(46)	58(59)	5.6(6)	4/15
memPSODE v	76(70)	78(49)	124(96)	135(76)	26(23)	15/15
prcga saw	6.3(4)	12(5)	44(44)	89(170)	22(31)	15/15
ring100 ho	67(58)	77(77)	151(143)	337(320)	113(127)	10/15
ring16 hol	32(33)	48(18)	106(133)	355(560)	87(96)	11/15
simplex pa	**0.14**(0.0)$_{\downarrow}$	**0.14**(0.0)$_{\downarrow}$	**0.16**(0.0)$_{\downarrow}$	**0.16**(0.0)$_{\downarrow}$	**0.03**(6e-3)$_{\downarrow 4}$	15/15

Table 45: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*4.0e+3*:3.5	*2.5e+3*:4.3	*4.0e+0*:13	*1.6e+0*:41	*1.0e+0*:385	5/5
BIPOP-aCMA	3.5(3)	3.4(3)	3.0(1)	7.2(12)	3.2(4)	15/15
BIPOP-saAC	**1.8**(2)	**1.5**(1)	**2.0**(2)	11(13)	**2.1**(2)	15/15
CMAES hut	**1.6**(2)	**1.5**(2)	**2.6**(1)	**3.9**(4)	**2.6**(3)	4/15
DE pal	**1.1**(1)	**1.2**(0.9)	4.4(4)	7.5(3)	**2.0**(1)	15/15
HCMA los	**1.9**(1)	**1.7**(1)	**1.0**(0.5)	8.7(12)	4.2(5)	15/15
HMLSL pal	**1.7**(0)	**1.4**(0)	**1.2**(0)	10(3)	**1.6**(1)	15/15
IPOP-10DDr	**0.77**(0.9)	**2.7**(2)	**2.9**(1)	**5.0**(2)	4.6(4)	15/15
IPOP-500 l	**0.77**(0.9)	**2.7**(2)	**2.9**(1)	**5.0**(2)	4.6(4)	15/15
IPOP-tany	**0.77**(0.9)	**1.1**(0.7)	3.2(1)	19(20)	8.5(8)	15/15
IPOP-texp	**0.46**(0.3)	**0.89**(0.8)	**1.6**(1)	15(13)	**2.5**(2)	15/15
IPOP lia	**0.77**(0.9)	**2.7**(2)	**2.9**(1)	**5.0**(2)	4.6(4)	15/15
MLSL pal	**1.7**(0)	**1.4**(0)	**1.2**(0)	8.6(2)	**1.5**(2)	15/15
OQNLP pal	3.5(0)	3.0(0)	**2.2**(0)	7.6(2)	**2.0**(2)	15/15
P-DCN tra	**1.4**(1)	**2.3**(2)	3.9(3)	14(26)	485(928)	15/15
P-zero tra	**1.4**(1)	**2.6**(3)	6.5(6)	8924(2e4)	3223(3570)	15/15
SMAC hut	**1.2**(0.4)	**1.2**(0.4)	**1.4**(2)	6.4(6)	5.7(6)	2/15
U-DCN tra	**1.4**(1)	**2.3**(2)	3.5(3)	7.2(8)	8.7(2)	15/15
U-zero tra	**1.4**(1)	**2.2**(2)	**2.9**(2)	19(19)	30(18)	15/15
fmincon pa	**1.7**(0)	**1.4**(0)	**1.2**(0)	8.7(6)	**1.6**(1)	15/15
fminunc pa	**1.4**(0)	**1.2**(0)	**2.9**(0)	9.1(2)	**2.2**(2)	15/15
ga100 hol	**1.7**(2)	**1.5**(2)	12(13)	14(10)	3.9(3)	15/15
grid100 ho	**1.9**(2)	**1.8**(2)	11(14)	35(20)	8.0(7)	15/15
grid16 hol	**1.5**(1)	**1.3**(1)	6.2(7)	15(5)	4.0(4)	15/15
hill hol	**2.8**(3)	**2.8**(3)	3.8(3)	**5.1**(4)	8.2(16)	15/15
lmmCMA aug	**1.4**(0.7)	**1.3**(0.7)	**1.6**(1.0)	15(24)	8.6(8)	7/15
memPSODE v	**2.6**(2)	**2.9**(2)	4.1(2)	14(25)	7.0(6)	15/15
prcga saw	**0.81**(0.7)	**0.95**(0.8)	**1.9**(2)	16(8)	8.1(13)	15/15
ring100 ho	**0.98**(0.9)	**0.89**(0.7)	7.2(6)	22(12)	6.3(3)	15/15
ring16 hol	**1.3**(1)	**1.7**(2)	7.1(7)	12(6)	**2.2**(1)	15/15
simplex pa	10(0.3)	8.9(0.2)	5.2(2)	14(11)	3.6(3)	15/15

Table 46: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*1.6e+1*:2.5	*1.0e+1*:5.9	*6.3e+0*:14	*2.5e+0*:41	*1.6e+0*:167	15/15
BIPOP-aCMA	3.8(5)	**2.6**(3)	**2.4**(2)	4.9(10)	4.5(6)	15/15
BIPOP-saAC	**1.3**(1)	**1.1**(0.9)	**1.3**(1)	**0.94**(1)	**2.1**(5)	15/15
CMAES hut	3.4(3)	**2.1**(0.9)	**1.7**(1)	**2.1**(4)	**1.4**(2)	10/15
DE pal	**2.1**(3)	**2.1**(2)	**2.4**(2)	**1.7**(1)	**2.2**(1)	15/15
HCMA los	3.4(3)	**2.3**(2)	**2.1**(2)	**1.2**(1)	**1.4**(2)	15/15
HMLSL pal	5.2(3)	4.2(6)	4.1(4)	**2.9**(3)	**1.9**(1)	15/15
IPOP-10DDr	**1.9**(2)	**1.6**(1)	**2.0**(2)	3.2(3)	**2.0**(3)	15/15
IPOP-500 l	**1.9**(2)	**1.6**(1)	**2.0**(2)	3.2(3)	**2.0**(3)	15/15
IPOP-tany	**1.3**(1.0)	**1.1**(1)	**1.5**(2)	**2.6**(2)	**2.3**(3)	15/15
IPOP-texp	**1.8**(2)	**1.3**(2)	4.8(1)	5.6(11)	**2.5**(6)	15/15
IPOP lia	**1.9**(2)	**1.6**(1)	**2.0**(2)	3.2(3)	**2.0**(7)	15/15
MLSL pal	5.1(3)	4.0(6)	4.7(5)	**2.3**(2)	**1.1**(1.0)	15/15
OQNLP pal	5.1(4)	4.0(4)	**2.7**(2)	**2.7**(3)	**1.3**(1)	15/15
P-DCN tra	**1.7**(2)	**1.5**(2)	**2.5**(4)	1.1e4(4e4)	2.7e4(4e4)	6/15
P-zero tra	**1.7**(2)	**1.4**(2)	**1.8**(3)	1.1e4(4e4)	2.0e4(3e4)	7/15
SMAC hut	**1.2**(1.0)	**1.2**(1)	**1.8**(2)	**0.93**(0.7)	**0.68**(0.4)	15/15
U-DCN tra	**1.5**(2)	**1.2**(2)	**1.4**(2)	**2.0**(3)	**1.8**(1)	15/15
U-zero tra	**1.6**(2)	**0.99**(1)	**0.88**(1)	**2.3**(3)	3.7(6)	15/15
fmincon pa	5.1(2)	4.3(6)	4.5(4)	**2.6**(3)	**1.5**(1)	15/15
fminunc pa	4.4(6)	4.7(7)	4.5(4)	**2.4**(2)	**1.4**(0.9)	15/15
ga100 hol	**1.8**(2)	**0.87**(0.8)	**1.5**(2)	**2.1**(2)	**2.5**(4)	15/15
grid100 ho	**1.2**(1)	**1.3**(2)	**1.2**(1)	**1.8**(1)	5.3(3)	15/15
grid16 hol	**1.4**(1.0)	**1.1**(0.9)	**1.2**(1)	**2.3**(2)	**1.9**(2)	15/15
hill hol	5.7(7)	5.5(9)	3.4(6)	3.4(4)	67(5)	14/15
lmmCMA aug	**2.2**(2)	**2.2**(2)	**2.9**(2)	**1.6**(3)	**0.69**(1)	15/15
memPSODE v	**2.6**(2)	**2.3**(2)	3.3(3)	7.4(6)	3.5(6)	15/15
prcga saw	**1.4**(1.0)	**0.72**(0.9)	**1.4**(2)	**1.6**(2)	10(10)	15/15
ring100 ho	**2.2**(2)	**1.5**(2)	**1.6**(2)	**2.9**(6)	**1.7**(2)	15/15
ring16 hol	**2.2**(3)	**1.5**(2)	**1.9**(2)	**1.6**(2)	**1.9**(2)	15/15
simplex pa	20(20)	19(21)	13(10)	6.9(5)	**2.4**(2)	15/15

Table 47: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*4.0e+1*:2.9	*2.5e+1*:5.2	*1.0e+1*:18	*6.3e+0*:33	*1.0e+0*:170	5/5
BIPOP-aCMA	**1.7**(2)	**2.2**(2)	**1.4**(1.0)	3.0(2)	6.9(7)	15/15
BIPOP-saAC	10(4)	6.1(2)	**2.4**(1)	**1.8**(1)	4.5(5)	15/15
CMAES hut	**2.8**(3)	**2.3**(3)	**3.0**(3)	**2.1**(2)	**1.7**(2)	9/15
DE pal	**1.7**(1)	**1.3**(1)	**1.4**(1)	**1.5**(2)	56(177)	13/15
HCMA los	**2.6**(2)	**2.3**(1.0)	**1.3**(1)	**1.9**(1)	3.5(8)	15/15
HMLSL pal	4.2(4)	4.1(8)	**2.3**(3)	3.1(3)	**1.7**(2)	15/15
IPOP-10DDr	**2.0**(2)	**1.5**(2)	**1.7**(2)	**1.5**(1)	3.4(3)	15/15
IPOP-500 l	**2.0**(2)	**1.5**(2)	**1.7**(2)	**1.5**(1)	3.4(3)	15/15
IPOP-tany	**1.8**(2)	**1.2**(0.9)	**1.4**(2)	6.5(13)	8.3(9)	15/15
IPOP-texp	**1.5**(0.9)	**1.8**(2)	5.0(2)	6.5(14)	11(12)	15/15
IPOP lia	**2.0**(2)	**1.5**(2)	**1.7**(2)	**1.5**(1)	3.4(3)	15/15
MLSL pal	4.3(4)	4.0(8)	**2.0**(2)	**2.9**(3)	**1.3**(0.8)	15/15
OQNLP pal	4.9(4)	5.8(8)	**3.0**(4)	**2.7**(3)	3.3(4)	13/15
P-DCN tra	**1.1**(0.9)	**1.3**(2)	**2.0**(3)	6496(3)	1.2e4(2e4)	9/15
P-zero tra	**1.1**(0.9)	**1.5**(2)	**2.3**(2)	2.3e4(5e4)	3.5e4(4e4)	5/15
SMAC hut	**1.4**(1)	**0.96**(0.8)	**0.80**(0.8)	**0.85**(0.6)	**0.58**(0.6)	15/15
U-DCN tra	**1.1**(0.9)	**0.96**(1.0)	**1.4**(2)	**1.9**(2)	**2.3**(2)	15/15
U-zero tra	**1.1**(0.9)	**1.5**(2)	**1.8**(2)	**2.7**(2)	3.5(3)	15/15
fmincon pa	4.3(4)	4.2(8)	**2.4**(3)	**2.5**(2)	**1.1**(0.8)	15/15
fminunc pa	3.5(4)	3.7(5)	**1.8**(2)	**2.7**(3)	**1.2**(1.0)	15/15
ga100 hol	**1.7**(2)	**1.6**(1)	**1.7**(1)	**1.7**(2)	65(3)	14/15
grid100 ho	**1.4**(1)	**1.2**(1)	**1.6**(2)	**1.9**(2)	**2.7**(3)	15/15
grid16 hol	**1.0**(0.9)	**0.83**(0.5)	**1.8**(2)	3.3(4)	7.4(4)	15/15
hill hol	4.9(5)	4.2(4)	**2.1**(2)	**1.7**(2)	298(442)	12/15
lmmCMA aug	**1.6**(1)	**1.7**(2)	**1.3**(1.0)	**1.5**(0.8)	5.1(7)	12/15
memPSODE v	**2.7**(3)	**2.9**(2)	**1.2**(0.9)	**1.0**(1)	17(26)	15/15
prcga saw	**1.2**(0.5)	**1.6**(2)	**1.5**(2)	**1.6**(2)	9.4(20)	15/15
ring100 ho	**1.3**(1)	**1.4**(1)	**2.0**(2)	**2.2**(2)	3.3(4)	15/15
ring16 hol	**0.98**(0.7)	**1.8**(1)	**3.0**(3)	3.7(5)	4.2(8)	15/15
simplex pa	24(30)	21(31)	10(9)	9.1(6)	3.3(3)	15/15

Table 48: 03-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*1.0e+1*:2.6	*6.3e+0*:16	*4.0e+0*:44	*2.5e+0*:79	*1.6e+0*:198	15/15
BIPOP-aCMA	5.9(6)	**1.6**(2)	**1.7**(2)	3.0(3)	6.2(7)	15/15
BIPOP-saAC	3.4(3)	**2.2**(3)	3.5(4)	7.2(7)	6.3(6)	15/15
CMAES hut	3.7(3)	**2.7**(4)	**2.9**(4)	12(13)	∞ *303*	0/15
DE pal	4.1(4)	**1.7**(1)	**2.2**(2)	**3.0**(3)	5.2(5)	15/15
HCMA los	7.4(8)	3.2(3)	3.5(4)	5.2(6)	5.0(5)	15/15
HMLSL pal	14(16)	6.2(8)	3.2(4)	3.8(3)	**2.0**(2)	15/15
IPOP-10DDr	3.8(4)	**1.8**(1)	**2.1**(2)	5.1(5)	5.4(6)	15/15
IPOP-500 l	3.8(4)	**1.8**(1)	**2.1**(2)	5.1(5)	5.4(6)	15/15
IPOP-tany	**2.9**(2)	**2.1**(3)	**2.1**(2)	4.4(4)	6.0(4)	15/15
IPOP-texp	3.7(4)	**2.5**(4)	**1.5**(1)	4.9(5)	4.8(3)	15/15
IPOP lia	3.8(4)	**1.8**(1)	**2.1**(2)	5.1(5)	5.4(6)	15/15
MLSL pal	15(16)	6.4(9)	3.3(4)	**3.0**(3)	**1.7**(1)	15/15
OQNLP pal	14(33)	4.5(8)	4.9(5)	4.5(4)	**2.9**(4)	15/15
P-DCN tra	3.6(5)	**2.3**(2)	**1.9**(2)	**2.6**(2)	3.2(2)	15/15
P-zero tra	3.8(4)	**1.8**(1)	**1.4**(1)	3.9(5)	4.7(6)	15/15
SMAC hut	3.5(3)	**1.5**(2)	**2.0**(2)	4.5(5)	11(11)	2/15
U-DCN tra	**2.9**(3)	**1.9**(2)	**1.9**(2)	4.2(6)	5.2(4)	15/15
U-zero tra	**2.6**(3)	**1.5**(1)	**1.8**(3)	3.0(2)	9.3(17)	15/15
fmincon pa	13(15)	4.3(8)	3.2(4)	**2.4**(2)	**1.6**(2)	15/15
fminunc pa	11(21)	5.0(6)	3.2(3)	3.1(2)	**1.7**(1)	15/15
ga100 hol	4.7(3)	**1.4**(1)	**1.4**(1)	4.7(7)	9.0(10)	15/15
grid100 ho	4.2(3)	**1.7**(3)	**1.8**(2)	**2.3**(2)	12(12)	15/15
grid16 hol	3.3(5)	**1.5**(2)	**2.0**(2)	7.1(5)	13(17)	15/15
hill hol	6.4(7)	**2.7**(3)	**1.5**(2)	4.6(6)	6.3(10)	15/15
lmmCMA aug	5.5(5)	**2.0**(1)	**2.9**(3)	**2.7**(2)	3.9(5)	13/15
memPSODE v	**2.7**(3)	**1.8**(2)	**2.1**(0.7)	**2.8**(0.3)	**2.6**(5)	15/15
prcga saw	4.5(5)	**2.1**(3)	**2.5**(3)	4.1(4)	4.7(6)	15/15
ring100 ho	**3.2**(3)	**2.3**(2)	**1.7**(2)	3.9(5)	5.3(7)	15/15
ring16 hol	4.2(6)	**1.8**(2)	**2.8**(4)	7.6(7)	7.4(6)	15/15
simplex pa	80(104)	19(18)	10(7)	7.7(3)	3.2(1)	15/15

Table 49: 03-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*4.0e+1*:4.6	*2.5e+1*:13	*1.6e+1*:47	*1.6e+1*:47	*6.3e+0*:382	15/15
BIPOP-aCMA	**2.6**(2)	**3.0**(1)	**1.9**(1)	**1.9**(1)	**1.5**(1)	15/15
BIPOP-saAC	**2.8**(3)	**2.2**(2)	**1.3**(0.8)	**1.3**(0.8)	**2.1**(3)	15/15
CMAES hut	**1.2**(1)	**1.9**(2)	**1.5**(1.0)	**1.5**(1)	**1.4**(1)	7/15
DE pal	**1.6**(1)	**1.9**(1)	**2.6**(1)	**2.6**(1)	**2.3**(2)	15/15
HCMA los	**1.8**(1)	**1.2**(0.7)	**1.8**(1)	**1.8**(1)	**1.3**(1)	15/15
HMLSL pal	3.8(3)	**2.9**(1)	**2.3**(3)	**2.3**(3)	**1.7**(0.8)	15/15
IPOP-10DDr	**1.4**(2)	**2.1**(1)	**1.5**(0.8)	**1.5**(0.8)	**2.4**(3)	15/15
IPOP-500 l	**1.4**(2)	**2.1**(1)	**1.5**(0.8)	**1.5**(0.8)	**2.4**(3)	15/15
IPOP-tany	**1.4**(2)	**2.1**(2)	**1.3**(0.6)	**1.3**(0.6)	**2.2**(2)	15/15
IPOP-texp	**0.74**(0.5)	**1.2**(1)	**1.0**(0.8)	**1.0**(0.8)	**2.1**(3)	15/15
IPOP lia	**1.4**(2)	**2.1**(1)	**1.5**(0.8)	**1.5**(0.8)	**2.4**(3)	15/15
MLSL pal	3.7(3)	**2.9**(1)	**2.4**(3)	**2.4**(3)	**1.6**(2)	15/15
OQNLP pal	**2.5**(2)	**2.2**(2)	5.8(2)	5.8(2)	**1.3**(0.6)	15/15
P-DCN tra	**2.5**(2)	3.4(3)	8.3(19)	8.3(19)	64(109)	15/15
P-zero tra	**2.8**(2)	3.1(2)	120(181)	120(181)	264(262)	15/15
SMAC hut	**2.0**(2)	**2.6**(2)	**2.2**(1)	**2.2**(1)	3.6(4)	3/15
U-DCN tra	**2.0**(1)	**3.0**(1)	**2.7**(3)	**2.7**(3)	6.2(10)	15/15
U-zero tra	**2.0**(1)	**1.7**(1)	**1.5**(2)	**1.5**(2)	4.4(4)	15/15
fmincon pa	3.7(3)	**2.9**(1)	**2.1**(2)	**2.1**(2)	**1.2**(1)	15/15
fminunc pa	**2.0**(2)	**2.7**(3)	**3.0**(3)	**3.0**(3)	**2.5**(2)	15/15
ga100 hol	**1.6**(2)	**2.4**(2)	3.7(3)	3.7(3)	6.3(6)	15/15
grid100 ho	**2.3**(3)	3.6(3)	5.8(7)	5.8(7)	14(13)	15/15
grid16 hol	**2.7**(3)	4.3(4)	**2.8**(3)	**2.8**(3)	6.0(7)	15/15
hill hol	**2.6**(3)	**2.5**(3)	3.6(4)	3.6(4)	5.8(6)	15/15
lmmCMA aug	**1.5**(1)	**2.3**(2)	**1.7**(1)	**1.7**(1)	**0.98**(1)	15/15
memPSODE v	**2.5**(2)	5.1(4)	10(20)	10(20)	6.9(8)	15/15
prcga saw	**1.8**(2)	**2.3**(2)	**1.4**(2)	**1.4**(2)	4.6(10)	15/15
ring100 ho	**2.1**(3)	3.6(3)	4.7(5)	4.7(5)	6.2(4)	15/15
ring16 hol	**2.3**(3)	3.2(3)	**2.8**(2)	**2.8**(2)	3.8(3)	15/15
simplex pa	6.3(6)	5.5(2)	8.1(2)	8.1(2)	3.1(3)	15/15

Table 50: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*2.5e+1*:4.8	*1.6e+1*:7.6	*1.0e-8*:12	*1.0e-8*:12	*1.0e-8*:12	15/15
BIPOP-aCMA	3.2(3)	3.5(2)	15(0.6)	15(0.6)	15(0.6)	15/15
BIPOP-saAC	4.3(3)	3.7(3)	21(2)	21(2)	21(2)	15/15
CMAES hut	**2.4**(2)	**2.1**(2)	∞	∞	∞ *506*	0/15
DE pal	**1.8**(2)	3.9(4)	180(7)	180(7)	180(7)	15/15
HCMA los	**1.9**(1)	**1.5**(0)	**0.98**(0)$^{\star 4}$	**0.98**(0)$^{\star 4}$	**0.98**(0)$^{\star 4}$	15/15
HMLSL pal	**1.0**(0.6)	**0.76**(0.4)	**4.5**(0.7)	**4.5**(0.7)	**4.5**(0.7)	15/15
IPOP-10DDr	**2.1**(2)	**2.9**(2)	58(5)	58(5)	58(5)	15/15
IPOP-500 l	**2.1**(2)	**2.9**(2)	58(5)	58(5)	58(5)	15/15
IPOP-tany	**1.4**(2)	**2.9**(3)	62(4)	62(4)	62(4)	15/15
IPOP-texp	**2.3**(3)	**2.4**(3)	62(5)	62(5)	62(5)	15/15
IPOP lia	**2.1**(2)	**2.9**(2)	58(5)	58(5)	58(5)	15/15
MLSL pal	**1.0**(0.6)	**0.76**(0.4)	**4.5**(0.7)	**4.5**(0.7)	**4.5**(0.7)	15/15
OQNLP pal	**2.5**(2)	**2.0**(1)	**2.6**(0.0)	**2.6**(0.0)	**2.6**(0.0)	15/15
P-DCN tra	**2.5**(4)	5.5(10)	712(331)	712(331)	712(331)	15/15
P-zero tra	8.7(7)	10(13)	2005(871)	2005(871)	2005(871)	15/15
SMAC hut	**0.79**(0.7)	**0.84**(0.5)	∞	∞	∞ *500*	0/15
U-DCN tra	**2.4**(2)	**2.6**(3)	3045(1610)	3045(1610)	3045(1610)	15/15
U-zero tra	**2.3**(2)	**2.3**(2)	9.8e4(6e4)	9.8e4(6e4)	9.8e4(6e4)	15/15
fmincon pa	**1.0**(0.6)	**0.76**(0.4)	**4.5**(0.7)	**4.5**(0.7)	**4.5**(0.7)	15/15
fminunc pa	**1.1**(0.6)	**1.2**(0.8)	**1.1**(0)	**1.1**(0)	**1.1**(0)	15/15
ga100 hol	**2.1**(2)	3.2(2)	∞	∞	∞ *2e5*	0/15
grid100 ho	3.6(4)	3.9(5)	∞	∞	∞ *2e5*	0/15
grid16 hol	6.2(10)	11(13)	∞	∞	∞ *2e5*	0/15
hill hol	4.8(5)	4.1(4)	∞	∞	∞ *2e5*	0/15
lmmCMA aug	**1.2**(2)	**1.5**(1)	9.1(0.6)	9.1(0.6)	9.1(0.6)	15/15
memPSODE v	4.2(5)	5.1(6)	7.6(0.2)	7.6(0.2)	7.6(0.2)	15/15
prcga saw	**1.8**(2)	**2.3**(3)	2503(3948)	2503(3948)	2503(3948)	15/15
ring100 ho	**2.3**(3)	5.7(9)	∞	∞	∞ *2e5*	0/15
ring16 hol	**2.4**(2)	4.4(4)	∞	∞	∞ *2e5*	0/15
simplex pa	12(8)	17(17)	96(12)	96(12)	96(12)	15/15

Table 51: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*1.6e+6*:2.9	*4.0e+5*:11	*4.0e+4*:15	*6.3e+2*:58	*1.0e-8*:95	15/15
BIPOP-aCMA	**1.9**(2)	**1.8**(1)	3.8(1)	**1.6**(0.2)	**3.0**(0.2)	15/15
BIPOP-saAC	3.6(4)	**2.3**(2)	6.1(4)	3.4(0.7)	5.6(0.7)	15/15
CMAES hut	3.7(5)	**1.9**(2)	6.1(3)	8.2(5)	∞ *506*	0/15
DE pal	**1.8**(2)	**2.2**(2)	7.2(6)	8.0(2)	32(1)	15/15
HCMA los	3.7(2)	**1.0**(0)	**0.97**(0.2)	**1.2**(0.7)	**3.8**(0.2)	15/15
HMLSL pal	10(12)	3.7(4)	5.2(5)	**2.2**(2)	10(9)	15/15
IPOP-10DDr	**2.6**(2)	**1.4**(1)	5.7(4)	9.3(5)	24(3)	15/15
IPOP-500 l	**2.6**(2)	**1.4**(1)	5.7(4)	9.3(5)	24(3)	15/15
IPOP-tany	3.3(4)	**1.6**(1)	5.3(3)	10(4)	24(1)	15/15
IPOP-texp	4.8(4)	**1.6**(1)	6.3(7)	9.4(3)	25(2)	15/15
IPOP lia	**2.6**(2)	**1.4**(1)	5.7(4)	9.3(5)	24(3)	15/15
MLSL pal	10(12)	3.7(4)	5.2(5)	**2.2**(2)	7.3(6)	15/15
OQNLP pal	5.9(3)	**1.9**(1)	**3.1**(2)	**1.3**(0.1)	456(460)	3/15
P-DCN tra	**1.1**(1)	**2.8**(4)	10(7)	11(8)	881(819)	15/15
P-zero tra	**1.1**(1)	**1.9**(2)	7.4(7)	10(8)	8.9e4(9e4)	7/15
SMAC hut	**1.0**(0.9)	**0.74**(0.7)	**1.7**(2)	8.0(7)	∞ *500*	0/15
U-DCN tra	**1.1**(1)	**1.0**(2)	6.2(6)	19(24)	1.7e4(3e4)	12/15
U-zero tra	**1.1**(1)	**1.0**(2)	7.8(8)	23(26)	∞ *5e6*	0/15
fmincon pa	10(12)	3.7(4)	4.8(5)	**2.0**(1)	**4.7**(2)	15/15
fminunc pa	5.2(4)	**2.0**(1)	**3.1**(2)	**2.7**(1)	7.7(2)	15/15
ga100 hol	**1.6**(2)	**1.4**(1)	16(16)	31(17)	∞ *2e5*	0/15
grid100 ho	**1.7**(2)	**1.4**(2)	24(31)	76(35)	∞ *2e5*	0/15
grid16 hol	**1.3**(0.9)	**1.2**(1)	11(9)	22(10)	∞ *2e5*	0/15
hill hol	8.7(9)	3.4(3)	6.1(6)	13(11)	∞ *2e5*	0/15
lmmCMA aug	**1.6**(2)	**0.83**(0.9)	**2.4**(2)	**2.5**(0.7)	**5.5**(1)	15/15
memPSODE v	**1.7**(2)	**1.3**(1)	7.4(4)	3.5(2)	**5.2**(3)	15/15
prcga saw	**1.5**(1)	**1.0**(1)	5.3(5)	8.3(2)	1122(1443)	15/15
ring100 ho	**1.1**(1)	**1.1**(0.9)	25(24)	54(21)	∞ *2e5*	0/15
ring16 hol	**1.5**(1)	**1.7**(2)	10(7)	17(12)	∞ *2e5*	0/15
simplex pa	22(13)	6.6(3)	15(16)	11(9)	28(3)	15/15

Table 52: 05-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*1.6e+2*:4.1	*1.0e+2*:15	*6.3e+1*:23	*2.5e+1*:73	*1.0e+1*:716	15/15
BIPOP-aCMA	**2.9**(4)	**1.8**(1)	**1.8**(0.5)	**1.1**(0.6)	**0.27**(0.1)	15/15
BIPOP-saAC	4.1(2)	**2.7**(2)	**2.6**(1)	3.1(1)	**1.1**(0.9)	15/15
CMAES hut	**2.9**(3)	**1.7**(1)	**2.3**(2)	**2.6**(1)	**1.2**(0.8)	8/15
DE pal	**1.7**(2)	**1.7**(2)	4.8(3)	4.5(0.9)	**1.2**(0.4)	15/15
HCMA los	**2.6**(2)	**1.8**(2)	**1.6**(1)	**1.1**(0.6)	**0.29**(0.1)	15/15
HMLSL pal	7.1(18)	6.4(7)	11(10)	8.0(5)	**1.3**(0.2)	15/15
IPOP-10DDr	**2.5**(3)	**2.0**(1)	**2.5**(1)	**2.4**(2)	**0.99**(1)	15/15
IPOP-500 l	**2.5**(3)	**2.0**(1)	**2.5**(1)	**2.4**(2)	**0.99**(1)	15/15
IPOP-tany	**2.0**(2)	**1.5**(1)	**2.0**(1.0)	**2.3**(1)	**0.94**(1)	15/15
IPOP-texp	**1.5**(1)	**1.1**(0.9)	**1.6**(0.9)	**2.5**(2)	**1.1**(1)	15/15
IPOP lia	**2.5**(3)	**2.0**(1)	**2.5**(1)	**2.4**(2)	**0.99**(1)	15/15
MLSL pal	7.5(20)	7.7(8)	12(9)	18(20)	5.6(5)	15/15
OQNLP pal	13(26)	9.3(12)	12(9)	25(30)	8.6(12)	13/15
P-DCN tra	**0.98**(0.8)	7.3(2)	7.3(1)	7.5(11)	7.5(11)	15/15
P-zero tra	**0.98**(0.8)	**1.6**(2)	3.3(3)	42(40)	9.4(9)	15/15
SMAC hut	**0.73**(0.6)	**0.74**(1.0)	**2.6**(4)	4.4(5)	5.1(5)	2/15
U-DCN tra	**0.98**(0.8)	**1.4**(1)	**2.6**(1)	3.3(1)	**0.85**(0.5)	15/15
U-zero tra	**0.98**(0.8)	**1.3**(1)	**1.6**(0.7)	**1.5**(0.5)	**0.62**(0.5)	15/15
fmincon pa	7.4(19)	7.1(8)	9.1(9)	12(15)	5.2(6)	15/15
fminunc pa	9.1(20)	6.9(7)	9.0(6)	13(9)	5.3(5)	15/15
ga100 hol	**1.6**(2)	**0.99**(1)	5.4(6)	11(3)	**2.3**(0.6)	15/15
grid100 ho	**1.1**(1)	4.3(4)	17(13)	25(12)	5.3(4)	15/15
grid16 hol	**2.2**(2)	3.5(3)	5.3(5)	6.1(3)	**1.1**(0.5)	15/15
hill hol	7.3(5)	**2.6**(1)	**2.0**(1)	**1.5**(0.8)	**0.36**(0.2)	15/15
lmmCMA aug	**1.4**(1)	**0.92**(0.8)	**1.4**(1)	**2.4**(1)	**0.45**(0.1)	15/15
memPSODE v	3.2(3)	8.4(14)	20(18)	15(12)	3.6(3)	15/15
prcga saw	**1.6**(2)	**1.2**(1)	**2.5**(3)	5.0(2)	**1.3**(0.6)	15/15
ring100 ho	**1.6**(2)	**2.2**(2)	12(10)	20(7)	4.4(1)	15/15
ring16 hol	**2.0**(1)	3.0(3)	4.7(4)	4.6(2)	**0.98**(0.3)	15/15
simplex pa	91(112)	50(34)	43(13)	25(14)	12(7)	15/15

Table 53: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*2.5e+2*:2.6	*1.6e+2*:10	*1.0e+2*:19	*4.0e+1*:65	*1.6e+1*:434	15/15
BIPOP-aCMA	3.6(4)	**2.1**(2)	**2.6**(1)	**1.6**(0.5)	**0.38**(0.1)	15/15
BIPOP-saAC	4.3(5)	**2.2**(2)	**2.3**(3)	3.3(0.8)	**1.9**(2)	15/15
CMAES hut	4.1(4)	**2.5**(4)	**2.5**(3)	**2.5**(1)	**1.2**(0.7)	11/15
DE pal	**3.0**(3)	**2.6**(3)	3.6(2)	4.2(2)	**1.5**(0.6)	15/15
HCMA los	6.3(6)	3.2(2)	3.0(2)	**1.8**(0.4)	**0.45**(0.3)	15/15
HMLSL pal	**0.69**(0)	**0.94**(1)	5.4(11)	7.3(6)	**1.9**(1)	15/15
IPOP-10DDr	**1.0**(0.2)	**1.5**(2)	**2.6**(2)	**2.4**(1.0)	**2.9**(3)	15/15
IPOP-500 l	**1.0**(0.2)	**1.5**(2)	**2.6**(2)	**2.4**(1.0)	**2.9**(3)	15/15
IPOP-tany	**0.64**(0.2)	**1.0**(1)	**1.7**(1)	**2.5**(1)	**1.9**(3)	15/15
IPOP-texp	**0.64**(0.2)	**0.86**(1.0)	**1.3**(0.6)	**1.3**(0.6)	**2.5**(3)	15/15
IPOP lia	**1.0**(0.2)	**1.5**(2)	**2.6**(2)	**2.4**(1.0)	**2.9**(3)	15/15
MLSL pal	**0.69**(0)	**0.94**(1)	4.9(9)	18(26)	15(18)	15/15
OQNLP pal	**0.72**(0)	4.1(12)	12(11)	44(77)	34(47)	9/15
P-DCN tra	4.7(2)	3.9(3)	5.3(5)	22(38)	77(86)	15/15
P-zero tra	**1.6**(2)	**1.5**(1)	**1.7**(1)	11(13)	43(14)	15/15
SMAC hut	**0.56**(0.4)	**0.54**(0.6)	**1.8**(3)	14(13)	∞ *500*	0/15
U-DCN tra	**1.8**(2)	**1.7**(2)	**2.7**(1)	**2.7**(1)	**1.2**(0.6)	15/15
U-zero tra	**1.7**(2)	**1.3**(1)	**1.5**(0.6)	**1.8**(0.8)	**0.84**(0.4)	15/15
fmincon pa	**0.69**(0)	**0.94**(1)	4.9(9)	12(20)	13(18)	15/15
fminunc pa	**0.69**(0)	**1.6**(2)	4.6(4)	13(14)	19(20)	15/15
ga100 hol	**2.5**(3)	**2.9**(2)	6.3(5)	12(3)	3.5(0.9)	15/15
grid100 ho	4.1(5)	**2.7**(3)	8.6(8)	28(16)	10(4)	15/15
grid16 hol	**2.6**(2)	**2.9**(4)	5.6(5)	6.7(4)	**2.1**(1.0)	15/15
hill hol	7.9(8)	3.9(2)	**2.7**(2)	**1.5**(0.7)	**0.61**(0.3)	15/15
lmmCMA aug	**0.51**(0.4)	**0.79**(1)	**0.93**(1)	**2.2**(0.9)	**1.3**(1)	15/15
memPSODE v	**2.9**(2)	3.2(3)	19(16)	14(10)	4.9(3)	15/15
prcga saw	**1.6**(2)	**0.77**(1.0)	**1.6**(2)	5.2(2)	**2.0**(1)	15/15
ring100 ho	3.1(3)	**1.9**(2)	5.7(6)	20(8)	7.0(2)	15/15
ring16 hol	**1.7**(2)	**2.8**(4)	5.2(4)	5.2(2)	**1.6**(0.5)	15/15
simplex pa	**1.4**(0)	19(52)	41(32)	43(44)	29(26)	15/15

Table 54: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*6.3e+1*:4.0	*4.0e+1*:10	*1.0e-8*:10	*1.0e-8*:10	*1.0e-8*:10	15/15
BIPOP-aCMA	**1.4**(1)	**1.0**(0.3)	**1.2**(0)	**1.2**(0)	**1.2**(0)	15/15
BIPOP-saAC	3.9(4)	**2.4**(2)	6.4(2)	6.4(2)	6.4(2)	15/15
CMAES hut	3.2(2)	**1.9**(2)	5.6(1)	5.6(1)	5.6(1)	15/15
DE pal	**1.6**(2)	3.3(3)	859(45)	859(45)	859(45)	15/15
HCMA los	**2.4**(0.9)	**1.2**(0.1)	**1.5**(0.3)	**1.5**(0.3)	**1.5**(0.3)	15/15
HMLSL pal	**1.8**(0)	**0.71**(0)	503(698)	503(698)	503(698)	15/15
IPOP-10DDr	**1.7**(1)	**2.1**(1)	46(43)	46(43)	46(43)	15/15
IPOP-500 l	**1.7**(1)	**2.1**(1)	46(43)	46(43)	46(43)	15/15
IPOP-tany	**2.6**(3)	**2.3**(1)	67(60)	67(60)	67(60)	15/15
IPOP-texp	7.3(2)	4.2(1)	89(71)	89(71)	89(71)	15/15
IPOP lia	**1.7**(1)	**2.1**(1)	46(43)	46(43)	46(43)	15/15
MLSL pal	**1.8**(0)	**0.71**(0)	527(461)	527(461)	527(461)	14/15
OQNLP pal	5.0(0)	**2.1**(0)	**2.4**(0)	**2.4**(0)	**2.4**(0)	15/15
P-DCN tra	**1.5**(2)	3.2(4)	326(66)	326(66)	326(66)	15/15
P-zero tra	**1.2**(1)	4.0(9)	171(79)	171(79)	171(79)	15/15
SMAC hut	**1.3**(0.2)	**0.63**(0.2)	**0.95**$(0.1)^{\star 3}$	**0.95**$(0.1)^{\star 3}$	**0.95**$(0.1)^{\star 3}$	15/15
U-DCN tra	**1.4**(2)	**2.1**(2)	3.3e6(4e6)	3.3e6(4e6)	3.3e6(4e6)	2/15
U-zero tra	**1.3**(1)	**2.0**(3)	∞	∞	∞ *5e6*	0/15
fmincon pa	**1.8**(0)	**0.71**(0)	1250(2807)	1250(2794)	1250(2794)	13/15
fminunc pa	3.2(0)	**1.3**(0)	**3.1**(0)	**3.1**(0)	**3.1**(0)	15/15
ga100 hol	**2.3**(2)	5.0(5)	124(27)	124(27)	124(27)	15/15
grid100 ho	**2.2**(2)	4.5(4)	264(76)	264(76)	264(76)	15/15
grid16 hol	3.8(7)	10(6)	51(14)	51(14)	51(14)	15/15
hill hol	6.8(6)	4.1(2)	11(4)	11(4)	11(4)	15/15
lmmCMA aug	3.1(2)	**1.9**(0.8)	5.0(1)	5.0(1)	5.0(1)	15/15
memPSODE v	**1.8**(2)	**2.5**(1.0)	14(6)	14(6)	14(6)	15/15
prcga saw	3.5(4)	11(6)	∞	∞	∞ *3e5*	0/15
ring100 ho	**1.8**(2)	6.1(8)	201(42)	201(42)	201(42)	15/15
ring16 hol	4.6(10)	6.3(6)	48(12)	48(12)	48(12)	15/15
simplex pa	19(0.4)	12(13)	90(97)	90(97)	90(97)	15/15

Table 55: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*1.0e+5*:3.0	*2.5e+4*:8.4	*1.0e+2*:16	*2.5e+1*:54	*2.5e-1*:254	15/15
BIPOP-aCMA	3.8(6)	**2.4**(4)	5.1(4)	3.4(3)	**2.2**(0.5)	15/15
BIPOP-saAC	5.4(7)	**2.7**(2)	3.5(4)	3.1(2)	**2.5**(1.0)	15/15
CMAES hut	**2.9**(4)	**1.6**(2)	3.2(4)	**2.7**(2)	**2.4**(1)	11/15
DE pal	**2.3**(3)	**1.8**(2)	5.8(7)	3.2(2)	6.8(2)	15/15
HCMA los	3.2(1)	**1.4**(0.7)	**1.5**(1)	**2.7**(3)	**2.4**(1.0)	15/15
HMLSL pal	**2.8**(4)	**2.3**(2)	3.4(2)	**1.7**(1)	**1.2**(0.6)	15/15
IPOP-10DDr	**2.4**(2)	**2.0**(2)	3.1(3)	**2.0**(0.9)	**2.0**(0.3)	15/15
IPOP-500 l	**2.4**(2)	**2.0**(2)	3.1(3)	**2.0**(0.9)	**2.0**(0.3)	15/15
IPOP-tany	**2.6**(3)	**2.3**(3)	**2.8**(2)	**1.8**(0.9)	**2.1**(0.4)	15/15
IPOP-texp	4.1(6)	3.2(4)	3.6(2)	**1.7**(1.0)	**2.1**(0.6)	15/15
IPOP lia	**2.4**(2)	**2.0**(2)	3.1(3)	**2.0**(0.9)	**2.0**(0.3)	15/15
MLSL pal	**2.8**(4)	**2.3**(2)	3.4(2)	**1.7**(1)	**1.2**(0.6)	15/15
OQNLP pal	3.6(3)	**2.3**(2)	**2.2**(0.8)	**1.1**(0.6)	**0.98**(0.4)	15/15
P-DCN tra	**2.4**(4)	**1.9**(2)	7.7(7)	8.8(8)	8.0(4)	15/15
P-zero tra	**2.2**(3)	**2.4**(3)	10(13)	8.2(8)	7.2(7)	15/15
SMAC hut	**1.4**(1)	**1.1**(1)	**1.5**(2)	**1.9**(2)	∞ *500*	0/15
U-DCN tra	3.2(3)	**2.5**(4)	7.7(4)	6.9(10)	272(433)	15/15
U-zero tra	**2.1**(2)	**1.3**(1)	6.1(4)	3.8(3)	1830(1556)	14/15
fmincon pa	**2.8**(4)	**2.3**(2)	3.2(2)	**1.6**(0.8)	**1.2**(0.6)	15/15
fminunc pa	**2.5**(3)	**1.8**(1)	**2.4**(1)	**1.5**(1)	**2.5**(1)	15/15
ga100 hol	3.6(2)	4.1(5)	13(14)	11(7)	60(34)	15/15
grid100 ho	**2.8**(3)	**2.1**(2)	24(33)	22(18)	657(586)	12/15
grid16 hol	4.7(10)	4.4(8)	9.1(6)	8.2(8)	207(165)	14/15
hill hol	4.7(7)	**2.5**(3)	4.1(5)	3.5(2)	31(29)	15/15
lmmCMA aug	**1.6**(2)	**1.4**(1)	4.7(5)	3.8(4)	4.5(3)	15/15
memPSODE v	**2.0**(1)	**1.5**(2)	7.8(8)	5.4(4)	**2.8**(2)	15/15
prcga saw	**1.5**(2)	3.5(8)	8.3(8)	6.3(5)	218(297)	15/15
ring100 ho	**1.9**(3)	3.6(7)	10(12)	10(7)	96(50)	15/15
ring16 hol	**1.9**(2)	**2.6**(3)	7.0(8)	5.0(4)	23(14)	15/15
simplex pa	21(30)	13(13)	34(55)	22(14)	14(8)	15/15

Table 56: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*1.6e+2*:4.2	*1.0e+2*:6.2	*2.5e+1*:20	*4.0e+0*:54	*1.0e+0*:324	15/15
BIPOP-aCMA	**2.0**(2)	**2.8**(3)	4.7(3)	4.0(2)	**1.5**(1)	15/15
BIPOP-saAC	3.3(3)	3.6(3)	3.0(2)	**2.6**(0.6)	**1.2**(1)	15/15
CMAES hut	**2.5**(3)	**2.8**(3)	**2.7**(2)	3.4(2)	**1.6**(2)	10/15
DE pal	**2.0**(2)	**1.6**(2)	3.7(3)	8.3(6)	**2.8**(1)	15/15
HCMA los	**2.8**(1)	**2.2**(0.6)	**2.3**(2)	3.6(3)	**1.0**(0.3)	15/15
HMLSL pal	**1.9**(2)	**2.0**(2)	5.5(7)	10(4)	3.8(2)	15/15
IPOP-10DDr	**1.2**(1)	**1.2**(1)	**2.5**(2)	**3.3**(1)	**1.1**(0.4)	15/15
IPOP-500 l	**1.2**(1)	**1.2**(1)	**2.5**(2)	**3.3**(1)	**1.1**(0.4)	15/15
IPOP-tany	**1.2**(2)	**1.5**(2)	**1.9**(2)	**2.6**(2)	**1.7**(2)	15/15
IPOP-texp	**1.3**(1)	**1.8**(2)	**1.7**(1)	4.8(10)	**2.1**(2)	15/15
IPOP lia	**1.2**(1)	**1.2**(1)	**2.5**(2)	**3.3**(1)	**1.1**(0.4)	15/15
MLSL pal	**1.8**(2)	**2.1**(3)	14(22)	219(203)	1097(1236)	2/15
OQNLP pal	4.0(4)	7.1(12)	11(13)	29(28)	48(57)	2/15
P-DCN tra	6.0(5)	7.6(4)	46(58)	6812(560)	1695(2334)	14/15
P-zero tra	21(11)	74(40)	61(61)	6831(378)	2798(7771)	13/15
SMAC hut	**1.3**(1)	**1.1**(0.9)	**1.5**(1)	**1.6**(0.8)	**0.88**(0.9)	13/15
U-DCN tra	3.0(5)	**2.8**(3)	4.6(4)	31(28)	1132(41)	14/15
U-zero tra	3.2(3)	**3.0**(2)	3.9(3)	48(37)	1488(2964)	15/15
fmincon pa	**2.7**(3)	3.4(3)	8.8(8)	164(139)	1086(1244)	2/15
fminunc pa	**1.5**(1)	**2.6**(4)	8.1(10)	184(193)	∞ *5e4*	0/15
ga100 hol	**1.8**(2)	3.2(4)	6.9(7)	24(17)	11(10)	15/15
grid100 ho	**2.8**(4)	**2.4**(3)	9.3(10)	44(52)	74(83)	15/15
grid16 hol	**0.73**(0.6)	**2.8**(6)	7.6(6)	26(32)	97(110)	14/15
hill hol	8.6(6)	7.5(6)	5.4(3)	141(132)	117(200)	15/15
lmmCMA aug	**1.2**(1)	**1.3**(1)	**1.5**(1)	**2.3**(4)	**0.92**(1.0)	15/15
memPSODE v	3.7(4)	3.5(3)	10(14)	18(20)	7.5(6)	15/15
prcga saw	**1.4**(1.0)	**1.8**(2)	4.1(4)	9.1(5)	17(17)	15/15
ring100 ho	**1.6**(1)	**2.8**(2)	13(17)	30(19)	19(11)	15/15
ring16 hol	**2.5**(3)	3.3(4)	7.3(6)	10(8)	104(276)	15/15
simplex pa	**1.6**(2)	**2.9**(3)	11(11)	93(69)	155(137)	10/15

Table 57: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*1.0e+4*:4.6	*6.3e+3*:6.8	*1.0e+3*:18	*6.3e+1*:54	*1.6e+0*:258	15/15
BIPOP-aCMA	4.8(4)	3.8(3)	4.5(2)	4.3(2)	4.0(4)	15/15
BIPOP-saAC	**2.7**(4)	**2.4**(3)	**2.6**(2)	**2.3**(0.8)	**2.2**(2)	15/15
CMAES hut	3.7(3)	**2.8**(3)	**2.9**(2)	**2.6**(1)	3.2(2)	8/15
DE pal	3.6(3)	**2.9**(2)	4.7(2)	5.4(2)	5.7(2)	15/15
HCMA los	**1.8**(1)	**1.4**(0.9)	**0.85**(0.3)	**1.2**(2)	**2.3**(3)	15/15
HMLSL pal	**1.2**(2)	**1.1**(1)	**1.2**(1)	**0.92**(0.5)	**1.3**(2)	15/15
IPOP-10DDr	**2.9**(3)	**2.5**(2)	**2.6**(1)	**2.6**(0.9)	4.0(1)	15/15
IPOP-500 l	**2.9**(3)	**2.5**(2)	**2.6**(1)	**2.6**(0.9)	4.0(1)	15/15
IPOP-tany	**2.6**(3)	**2.5**(2)	**2.2**(1)	**2.1**(0.6)	3.3(1)	15/15
IPOP-texp	**2.9**(3)	**2.4**(2)	**2.1**(1)	**1.7**(0.5)	4.3(3)	15/15
IPOP lia	**2.9**(3)	**2.5**(2)	**2.6**(1)	**2.6**(0.9)	4.0(1)	15/15
MLSL pal	**1.2**(2)	**1.1**(1)	**1.2**(1)	**0.92**(0.5)	**1.0**(1)	15/15
OQNLP pal	**1.9**(2)	**1.6**(1)	**1.2**(0.3)	**0.84**(0.5)	**0.68**(0.3)	15/15
P-DCN tra	5.5(4)	5.5(6)	8.2(11)	27(30)	7096(9725)	11/15
P-zero tra	3.0(3)	3.9(7)	6.7(7)	22(24)	3003(9688)	13/15
SMAC hut	**0.99**(1.0)	**0.91**(1)	**1.2**(1)	3.3(2)	∞ *500*	0/15
U-DCN tra	3.7(5)	3.3(5)	3.5(3)	10(9)	279(545)	15/15
U-zero tra	**2.2**(2)	**1.9**(2)	**2.7**(2)	7.3(5)	3004(7911)	14/15
fmincon pa	**1.2**(2)	**1.1**(1)	**1.2**(1)	**0.92**(0.5)	**1.0**(1)	15/15
fminunc pa	**0.83**(0.7)	**0.79**(0.9)	**0.84**(0.5)	**1.1**(0.8)	**0.88**(0.4)	15/15
ga100 hol	3.1(3)	3.3(3)	9.4(9)	16(7)	295(493)	12/15
grid100 ho	**1.7**(2)	3.1(2)	12(13)	53(36)	426(525)	11/15
grid16 hol	4.0(6)	4.7(6)	11(8)	15(12)	504(969)	10/15
hill hol	4.4(5)	3.4(4)	**2.7**(2)	5.7(5)	250(442)	14/15
lmmCMA aug	**1.0**(1)	**0.96**(1)	**1.6**(1)	**1.5**(0.6)	**1.7**(2)	15/15
memPSODE v	3.8(5)	4.7(4)	4.8(3)	3.5(2)	3.5(5)	15/15
prcga saw	**2.1**(2)	**1.5**(2)	4.4(4)	7.5(3)	267(652)	15/15
ring100 ho	**2.8**(3)	3.2(3)	7.0(6)	28(16)	54(24)	15/15
ring16 hol	3.0(2)	3.8(4)	6.1(5)	9.1(6)	272(484)	13/15
simplex pa	7.9(7)	7.5(10)	7.6(5)	10(7)	5.1(3)	15/15

Table 58: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*2.5e+1*:20	*1.6e+1*:26	*1.0e+1*:35	*4.0e+0*:62	*1.6e-2*:256	15/15
BIPOP-aCMA	10(3)	8.4(2)	7.0(2)	7.0(2)	5.9(1)	15/15
BIPOP-saAC	7.1(2)	5.8(1)	4.6(0.9)	3.7(2)	**2.7**(0.6)	15/15
CMAES hut	8.4(3)	7.3(3)	6.1(3)	6.0(4)	∞ *506*	0/15
DE pal	31(13)	27(9)	24(10)	22(13)	33(8)	15/15
HCMA los	7.0(6)	6.4(6)	5.7(5)	5.6(3)	3.6(3)	15/15
HMLSL pal	**0.66**(0)	**1.1**(0.2)	**0.94**(0)	**0.80**(0.1)	**0.60**(0.0)	15/15
IPOP-10DDr	8.8(4)	7.5(3)	6.1(2)	7.3(5)	8.1(5)	15/15
IPOP-500 l	8.8(4)	7.5(3)	6.1(2)	7.3(5)	8.1(5)	15/15
IPOP-tany	6.9(3)	5.9(2)	5.2(2)	7.3(8)	8.2(7)	15/15
IPOP-texp	3.6(2)	3.3(1)	3.0(2)	4.6(4)	7.0(2)	15/15
IPOP lia	8.8(4)	7.5(3)	6.1(2)	7.3(5)	8.1(5)	15/15
MLSL pal	**0.66**(0)	**1.1**(0.2)	**0.94**(0)	**0.80**(0.1)	**0.60**(0.0)	15/15
OQNLP pal	**0.71**(0)	**0.62**(0)	**0.71**(0.0)	**0.43**(8e-3)	**0.54**(0.0)	15/15
P-DCN tra	776(1712)	597(1314)	446(980)	2.1e4(4e4)	1.7e4(2e4)	9/15
P-zero tra	1194(3320)	918(2547)	685(1900)	482(1068)	1.2e4(7875)	14/15
SMAC hut	14(6)	12(4)	12(8)	120(130)	∞ *500*	0/15
U-DCN tra	64(43)	64(49)	65(59)	9769(8356)	2.5e4(3e4)	8/15
U-zero tra	648(98)	501(74)	378(55)	2.1e4(4e4)	∞ *5e6*	0/15
fmincon pa	**0.66**(0)	**1.1**(0.2)	**0.94**(0)	**0.80**(0.1)	**0.60**(0.0)	15/15
fminunc pa	**0.66**(0)	**0.50**(0)$^{\star 4}$	**0.55**(0)$^{\star 4}$	**0.41**(0)$^{\star 4}$	**0.51**(0.0)$^{\star 2}$	15/15
ga100 hol	72(30)	68(26)	58(23)	159(57)	∞ *2e5*	0/15
grid100 ho	268(214)	380(315)	315(218)	1823(2190)	∞ *2e5*	0/15
grid16 hol	71(36)	62(41)	57(42)	1802(2245)	∞ *2e5*	0/15
hill hol	14(9)	14(12)	13(11)	1159(2050)	∞ *2e5*	0/15
lmmCMA aug	3.7(2)	3.3(1)	**2.7**(0.9)	**2.7**(2)	**2.4**(1)	15/15
memPSODE v	10(4)	7.7(3)	5.9(2)	6.2(2)	4.2(6)	15/15
prcga saw	8.8(3)	11(6)	11(5)	11(4)	∞ *5e5*	0/15
ring100 ho	136(41)	133(38)	138(47)	166(61)	∞ *2e5*	0/15
ring16 hol	32(15)	30(11)	30(11)	327(16)	∞ *2e5*	0/15
simplex pa	**1.7**(0.1)	4.0(3)	5.1(3)	4.1(2)	3.2(0.8)	15/15

Table 59: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*2.5e+6*:2.9	*6.3e+5*:7.0	*2.5e+5*:17	*6.3e+3*:54	*2.5e+1*:297	15/15
BIPOP-aCMA	**1.6**(2)	**1.7**(2)	**1.5**(1)	3.5(2)	**2.9**(0.8)	15/15
BIPOP-saAC	**2.2**(2)	**2.1**(3)	**1.4**(1)	**2.4**(1)	**0.79**(0.1)	15/15
CMAES hut	**2.7**(3)	**2.4**(3)	**1.5**(1)	3.8(2)	∞ *506*	0/15
DE pal	**1.3**(1)	**1.3**(1)	**0.94**(0.8)	6.2(4)	20(9)	15/15
HCMA los	**1.1**(0.7)	**1.1**(0.9)	**1.00**(0.6)	**2.1**(2)	**1.2**(0.1)	15/15
HMLSL pal	**2.9**(2)	**1.9**(3)	**1.1**(1)	**0.88**(0.3)	**0.31**(0.1)	15/15
IPOP-10DDr	**1.1**(0.9)	**1.5**(2)	**1.2**(0.8)	5.3(3)	3.4(0.9)	15/15
IPOP-500 l	**1.1**(0.9)	**1.5**(2)	**1.2**(0.8)	5.3(3)	3.4(0.9)	15/15
IPOP-tany	**1.1**(0.9)	**1.2**(1)	**0.76**(0.7)	3.7(2)	3.4(1)	15/15
IPOP-texp	**2.6**(4)	**2.6**(3)	**1.9**(2)	3.9(3)	3.5(1)	15/15
IPOP lia	**1.1**(0.9)	**1.5**(2)	**1.2**(0.8)	5.3(3)	3.4(0.9)	15/15
MLSL pal	**2.9**(2)	**1.9**(3)	**1.1**(1)	**0.88**(0.3)	**0.31**(0.1)	15/15
OQNLP pal	4.3(3)	**2.0**(1)	**1.2**(0.9)	**0.93**(0.5)	**0.43**(0.3)	15/15
P-DCN tra	**1.5**(1)	**2.4**(3)	3.4(6)	23(16)	4834(8682)	12/15
P-zero tra	**1.5**(1)	4.3(2)	4.7(6)	27(26)	1.1e4(1e4)	11/15
SMAC hut	**1.3**(0.9)	**0.80**(0.6)	**0.58**(0.6)	**2.5**(2)	∞ *500*	0/15
U-DCN tra	**1.3**(1)	**1.2**(0.9)	**2.2**(1)	20(8)	1.2e4(2e4)	11/15
U-zero tra	**1.3**(1)	**1.7**(2)	**1.2**(0.9)	75(69)	7.3e4(8e4)	3/15
fmincon pa	**2.9**(2)	**1.9**(3)	**1.1**(1)	**0.88**(0.3)	**0.30**(0.1)	15/15
fminunc pa	**2.4**(2)	**1.6**(2)	**1.1**(0.9)	**1.6**(1)	**0.97**(0.5)	15/15
ga100 hol	**1.4**(1)	**1.8**(3)	**1.2**(1)	21(19)	1562(1903)	6/15
grid100 ho	**1.7**(1)	**1.2**(0.8)	**1.6**(2)	49(80)	∞ *2e5*	0/15
grid16 hol	**1.7**(2)	**2.9**(2)	**2.3**(2)	32(33)	1.2e4(1e4)	1/15
hill hol	4.7(5)	4.0(5)	**2.3**(3)	42(65)	1.2e4(1e4)	1/15
lmmCMA aug	**2.3**(3)	**1.5**(1)	**1.1**(0.9)	**1.5**(0.4)	**0.83**(0.4)	15/15
memPSODE v	**1.8**(1)	**2.0**(2)	**1.8**(1)	3.2(1)	4.1(8)	15/15
prcga saw	**1.1**(0.9)	**0.86**(0.9)	**0.92**(0.8)	272(136)	3384(4085)	5/15
ring100 ho	**1**(2)	**0.71**(0.7)	**1.1**(2)	27(18)	2047(2172)	5/15
ring16 hol	**1.6**(1)	**1.8**(2)	**2.4**(2)	10(9)	3927(4278)	3/15
simplex pa	15(13)	8.2(5)	5.0(6)	7.0(6)	5.8(2)	15/15

Table 60: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*1.0e+6*:3.0	*6.3e+4*:6.2	*6.3e+2*:16	*6.3e+1*:74	*6.3e-1*:298	15/15
BIPOP-aCMA	**2.0**(4)	3.0(3)	3.8(4)	7.0(5)	3.4(0.5)	15/15
BIPOP-saAC	3.5(3)	**2.8**(2)	5.0(7)	3.4(0.6)	**1.1**(0.1)	15/15
CMAES hut	**2.9**(2)	**2.6**(3)	5.5(5)	5.3(5)	∞ *506*	0/15
DE pal	**1.6**(2)	**2.9**(3)	9.0(8)	5.4(6)	28(8)	15/15
HCMA los	**2.5**(2)	**1.8**(1.0)	**1.4**(0.6)	3.1(2)	**1.4**(0.2)	15/15
HMLSL pal	3.2(2)	**2.5**(2)	**1.4**(0.3)	**0.36**(0.1)	**0.15**(0.0)	15/15
IPOP-10DDr	**2.0**(2)	3.2(4)	6.2(3)	4.8(6)	4.9(0.4)	15/15
IPOP-500 l	**2.0**(2)	3.2(4)	6.2(3)	4.8(6)	4.9(0.4)	15/15
IPOP-tany	**1.9**(2)	**2.4**(2)	5.3(4)	6.0(6)	4.9(0.5)	15/15
IPOP-texp	5.7(6)	4.3(3)	3.7(2)	4.0(6)	4.7(0.8)	15/15
IPOP lia	**2.0**(2)	3.2(4)	6.2(3)	4.8(6)	4.9(0.4)	15/15
MLSL pal	3.2(2)	**2.5**(2)	**1.4**(0.3)	**0.36**(0.1)	**0.15**(0.0)	15/15
OQNLP pal	4.4(3)	**2.8**(2)	**2.1**(1)	**0.56**(0.4)	**0.65**(1.0)	15/15
P-DCN tra	**2.3**(2)	4.4(4)	4.5(5)	171(238)	646(402)	15/15
P-zero tra	**2.1**(2)	3.4(6)	3.8(3)	112(216)	967(578)	15/15
SMAC hut	**0.73**(0.5)	**0.94**(0.9)	**1.9**(2)	**0.94**(0.8)	∞ *500*	0/15
U-DCN tra	**1.8**(2)	**2.6**(2)	4.6(4)	12(8)	5350(4218)	14/15
U-zero tra	**2.5**(1)	**2.5**(3)	5.9(3)	27(34)	4759(4840)	14/15
fmincon pa	3.2(2)	**2.5**(2)	**1.4**(0.3)	**0.36**(0.1)	**0.16**(0.0)	15/15
fminunc pa	3.5(3)	**2.4**(1)	**1.7**(0.8)	**0.46**(0.1)	**1.7**(2)	15/15
ga100 hol	**1.7**(2)	**3.0**(3)	14(14)	9.5(12)	2161(2359)	5/15
grid100 ho	**2.4**(3)	3.4(3)	11(9)	210(299)	∞ *2e5*	0/15
grid16 hol	**2.6**(2)	3.5(4)	7.0(5)	148(354)	5991(6296)	2/15
hill hol	3.1(4)	3.2(4)	4.9(5)	45(83)	1433(1428)	7/15
lmmCMA aug	**1.4**(2)	**2.1**(2)	**2.6**(1.0)	**1.9**(1)	**1.3**(0.3)	15/15
memPSODE v	**1.5**(1)	**3.0**(3)	5.9(2)	**2.0**(0.7)	5.9(7)	15/15
prcga saw	**2.3**(1)	**2.8**(3)	6.7(5)	3.8(3)	∞ *3e5*	0/15
ring100 ho	**1.6**(2)	5.3(4)	8.4(10)	16(14)	2746(2938)	4/15
ring16 hol	**1.9**(2)	**2.4**(3)	8.8(8)	12(8)	2695(2938)	4/15
simplex pa	16(12)	10(6)	5.4(2)	**1.4**(0.6)	8.5(2)	15/15

Table 61: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*4.0e+7*:3.6	*1.6e+7*:7.6	*4.0e+6*:19	*1.6e+4*:52	*1.0e+0*:268	15/15
BIPOP-aCMA	3.3(5)	5.1(4)	3.7(2)	5.4(0.8)	4.7(3)	15/15
BIPOP-saAC	**3.0**(3)	3.5(3)	**2.9**(2)	**2.5**(0.3)	**1.9**(2)	15/15
CMAES hut	**2.0**(3)	**1.7**(2)	**2.1**(2)	4.2(1)	28(30)	1/15
DE pal	4.0(5)	3.1(3)	3.8(3)	16(4)	50(20)	15/15
HCMA los	**2.7**(2)	**2.0**(1)	**1.2**(0.4)	3.3(2)	4.4(8)	15/15
HMLSL pal	**1.4**(1.0)	**1.6**(2)	**1.5**(0.8)	**1.5**(0.4)	**0.94**(0.6)	15/15
IPOP-10DDr	**2.3**(2)	**2.9**(2)	**2.6**(1)	4.1(1)	5.9(3)	15/15
IPOP-500 l	**2.3**(2)	**2.9**(2)	**2.6**(1)	4.1(1)	5.9(3)	15/15
IPOP-tany	**1.7**(2)	**2.4**(2)	**2.4**(1)	4.8(1.0)	7.1(5)	15/15
IPOP-texp	**2.1**(2)	3.4(2)	**2.6**(1)	4.2(0.6)	8.7(9)	15/15
IPOP lia	**2.3**(2)	**2.9**(2)	**2.6**(1)	4.1(1)	5.9(3)	15/15
MLSL pal	**1.4**(1.0)	**1.6**(2)	**1.5**(0.8)	**1.5**(0.4)	**0.94**(0.6)	15/15
OQNLP pal	3.1(2)	**2.3**(1)	**1.3**(0.4)	**1.5**(0.9)	**0.95**(0.8)	15/15
P-DCN tra	**2.0**(2)	**2.8**(3)	7.2(7)	10(4)	2.8e4(4e4)	6/15
P-zero tra	**1.2**(1)	5.3(9)	9.4(11)	10(4)	1.2e5(1e5)	2/15
SMAC hut	**0.57**(0.4)	**1.3**(2)	3.6(5)	34(34)	∞ *500*	0/15
U-DCN tra	**1.3**(2)	**2.8**(3)	4.4(4)	33(10)	3.7e4(5e4)	5/15
U-zero tra	**1.3**(2)	**2.3**(2)	3.0(1)	21(16)	3.8e4(5e4)	5/15
fmincon pa	**1.4**(1.0)	**1.6**(2)	**1.5**(0.8)	**1.5**(0.4)	**0.95**(0.5)	15/15
fminunc pa	**2.1**(2)	**1.9**(2)	**1.3**(0.9)	**1.0**(0.9)	**1.1**(1.0)	15/15
ga100 hol	**1.6**(1)	**2.9**(3)	7.6(8)	57(27)	2353(2457)	5/15
grid100 ho	**1.4**(1.0)	**2.0**(2)	9.3(14)	159(67)	∞ *2e5*	0/15
grid16 hol	**1.4**(2)	6.3(11)	8.1(9)	31(10)	6623(7909)	2/15
hill hol	6.1(8)	4.2(5)	**2.7**(2)	15(8)	6174(7001)	2/15
lmmCMA aug	**0.80**(0.6)	**1.6**(2)	**1.6**(0.8)	**1.7**(0.6)	**1.4**(1)	15/15
memPSODE v	**2.1**(4)	**2.8**(3)	6.1(5)	3.9(3)	4.8(5)	15/15
prcga saw	**0.98**(1)	**1.7**(2)	3.9(4)	12(4)	296(609)	14/15
ring100 ho	**1.6**(2)	**2.7**(3)	8.2(9)	109(40)	1999(1867)	6/15
ring16 hol	**1.2**(1.0)	4.0(4)	8.1(4)	29(9)	1172(1372)	8/15
simplex pa	16(10)	18(27)	15(14)	12(3)	6.7(3)	15/15

Table 62: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*1.0e+3*:2.8	*6.3e+2*:8.4	*4.0e+2*:17	*6.3e+1*:52	*6.3e-2*:264	15/15
BIPOP-aCMA	**1.1**(1)	**2.4**(3)	3.4(2)	4.8(2)	4.1(0.8)	15/15
BIPOP-saAC	**2.7**(2)	**2.0**(2)	**2.0**(2)	**2.3**(0.5)	**1.3**(0.3)	15/15
CMAES hut	4.0(4)	**2.8**(2)	3.0(2)	3.3(1.0)	∞ *506*	0/15
DE pal	**1.5**(1)	**1.6**(2)	3.2(3)	10(3)	46(20)	15/15
HCMA los	**2.5**(2)	**1.5**(1)	**1.1**(0.3)	**1.4**(2)	**1.6**(0.6)	15/15
HMLSL pal	**1.7**(1)	**1.0**(0.8)	**1.2**(0.6)	**1.2**(0.2)	**0.79**(0.1)	15/15
IPOP-10DDr	**2.5**(2)	**2.4**(2)	**2.6**(0.7)	3.5(1)	5.7(3)	15/15
IPOP-500 l	**2.5**(2)	**2.4**(2)	**2.6**(0.7)	3.5(1)	5.7(3)	15/15
IPOP-tany	3.0(4)	**2.4**(3)	**2.5**(2)	3.5(2)	6.2(2)	15/15
IPOP-texp	4.4(5)	3.0(3)	**2.5**(2)	3.1(1)	6.4(2)	15/15
IPOP lia	**2.5**(2)	**2.4**(2)	**2.6**(0.7)	3.5(1)	5.7(3)	15/15
MLSL pal	**1.7**(1)	**1.0**(0.8)	**1.2**(0.6)	**1.2**(0.2)	**0.79**(0.1)	15/15
OQNLP pal	3.7(3)	**2.0**(1)	**1.4**(0.4)	**1.5**(0.2)	**0.98**(0.2)	15/15
P-DCN tra	**2.5**(4)	4.8(5)	10(10)	847(1396)	2.6e5(3e5)	1/15
P-zero tra	**2.9**(3)	5.2(7)	7.8(10)	1.2e4(4e4)	2.7e5(3e5)	1/15
SMAC hut	**1**(1)	**1.1**(1)	**0.96**(0.5)	**1.1**(0.5)	∞ *500*	0/15
U-DCN tra	**1.8**(2)	**2.6**(2)	3.5(3)	20(18)	∞ *5e6*	0/15
U-zero tra	**2.0**(2)	**2.5**(3)	**2.6**(2)	6891(21)	2.7e5(3e5)	1/15
fmincon pa	**1.7**(1)	**1.0**(0.8)	**1.2**(0.6)	**1.2**(0.2)	**0.79**(0.1)	15/15
fminunc pa	**2.4**(3)	**1.5**(1)	**1.1**(0.4)	**1.0**(0.2)	**0.98**(0.1)	15/15
ga100 hol	**2.7**(4)	**2.4**(4)	7.1(10)	36(19)	∞ *2e5*	0/15
grid100 ho	**1.6**(2)	**2.9**(5)	9.2(10)	557(388)	∞ *2e5*	0/15
grid16 hol	3.1(2)	5.0(7)	5.9(5)	20(16)	∞ *2e5*	0/15
hill hol	7.3(8)	3.5(5)	**2.4**(3)	1218(2409)	∞ *2e5*	0/15
lmmCMA aug	**1.4**(2)	**1.6**(2)	**1.7**(1.0)	**1.8**(0.5)	**1.6**(0.4)	15/15
memPSODE v	**2.9**(2)	3.4(3)	4.7(3)	3.0(3)	**2.4**(6)	15/15
prcga saw	**1.4**(1)	4.0(6)	5.0(7)	10(4)	2241(2765)	6/15
ring100 ho	**2.2**(2)	**2.8**(3)	12(15)	59(17)	∞ *2e5*	0/15
ring16 hol	**1.7**(2)	**2.9**(5)	4.9(4)	16(8)	∞ *2e5*	0/15
simplex pa	13(13)	14(13)	18(15)	20(12)	16(13)	15/15

Table 63: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*1.6e+1*:3.0	*1.0e+1*:10	*6.3e+0*:15	*2.5e-1*:53	*1.0e-5*:251	15/15
BIPOP-aCMA	**1.9**(2)	**2.9**(4)	3.6(4)	4.0(1)	4.3(0.8)	15/15
BIPOP-saAC	3.2(3)	**1.5**(1)	**2.1**(1)	**2.9**(1.0)	**1.8**(0.3)	15/15
CMAES hut	3.6(6)	**1.7**(2)	**1.7**(2)	3.2(1)	∞ *506*	0/15
DE pal	**2.4**(3)	**2.2**(2)	**2.6**(3)	9.0(3)	36(12)	15/15
HCMA los	3.7(3)	**1.6**(0.6)	**1.2**(0.6)	**2.1**(2)	**2.2**(0.3)	15/15
HMLSL pal	**1.2**(1)	**0.68**(0.4)	**0.59**(0.4)	**0.60**(0.1)	**0.72**(0.1)	15/15
IPOP-10DDr	**2.0**(2)	**1.2**(1)	**2.0**(2)	3.1(1)	5.7(0.4)	15/15
IPOP-500 l	**2.0**(2)	**1.2**(1)	**2.0**(2)	3.1(1)	5.7(0.4)	15/15
IPOP-tany	**1.6**(2)	**0.94**(1)	**1.3**(0.9)	3.1(1)	5.5(0.7)	15/15
IPOP-texp	**1.5**(2)	**0.93**(1)	**1.2**(0.9)	**2.2**(0.7)	4.9(0.7)	15/15
IPOP lia	**2.0**(2)	**1.2**(1)	**2.0**(2)	3.1(1)	5.7(0.4)	15/15
MLSL pal	**1.2**(1)	**0.68**(0.4)	**0.59**(0.4)	**0.60**(0.1)	**0.72**(0.1)	15/15
OQNLP pal	**2.2**(3)	**1.4**(0.9)	**1.2**(1.0)	**0.99**(0.3)	7.0(9)	15/15
P-DCN tra	3.2(4)	**2.0**(2)	3.6(4)	10(3)	5.4e4(5e4)	5/15
P-zero tra	4.0(5)	3.1(4)	5.5(6)	11(6)	∞ *5e6*	0/15
SMAC hut	**1.2**(2)	**0.62**(0.6)	**0.76**(1)	4.9(2)	∞ *500*	0/15
U-DCN tra	**2.7**(2)	**1.2**(0.7)	**1.9**(2)	14(8)	∞ *5e6*	0/15
U-zero tra	3.0(3)	**1.5**(2)	**1.7**(2)	6.4(4)	∞ *5e6*	0/15
fmincon pa	**1.2**(1)	**0.68**(0.4)	**0.59**(0.4)	**0.60**(0.1)	**0.72**(0.1)	15/15
fminunc pa	**1**(1)	**0.71**(0.6)	**0.71**(0.6)	**1**(0.5)	**0.84**(0.2)	15/15
ga100 hol	**2.4**(3)	**1.6**(1)	**1.9**(2)	27(8)	∞ *2e5*	0/15
grid100 ho	**2.5**(4)	**1.9**(2)	3.3(2)	84(42)	∞ *2e5*	0/15
grid16 hol	**1.2**(1)	**0.81**(0.7)	**2.3**(2)	18(7)	∞ *2e5*	0/15
hill hol	4.1(4)	**1.9**(2)	**2.0**(2)	4.0(2)	∞ *2e5*	0/15
lmmCMA aug	**1.1**(1)	**0.62**(0.6)	**0.81**(0.7)	**1.6**(0.5)	**1.8**(0.2)	15/15
memPSODE v	5.4(5)	**2.6**(2)	3.3(2)	**2.5**(0.3)	**2.2**(0.1)	15/15
prcga saw	**2.7**(3)	**1.1**(1)	**1.7**(2)	10(3)	6773(7089)	3/15
ring100 ho	**2.6**(2)	**1.7**(1)	4.3(5)	53(14)	∞ *2e5*	0/15
ring16 hol	3.0(4)	**1.8**(3)	3.8(3)	12(4)	∞ *2e5*	0/15
simplex pa	7.4(12)	6.4(4)	7.0(9)	17(7)	5.6(1)	15/15

Table 64: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*1.6e+2*:3.0	*1.0e+2*:13	*6.3e+1*:24	*4.0e+1*:55	*1.6e+1*:289	5/5
BIPOP-aCMA	5.8(6)	**2.8**(2)	3.0(2)	**2.5**(1)	**1.7**(1)	15/15
BIPOP-saAC	4.7(4)	**1.9**(2)	**2.1**(2)	**2.1**(1)	**1.5**(0.9)	15/15
CMAES hut	4.1(4)	**1.9**(2)	**2.0**(0.9)	**1.7**(0.9)	**1.7**(1)	11/15
DE pal	**2.6**(2)	**1.9**(1)	**2.9**(3)	3.9(2)	3.8(3)	15/15
HCMA los	5.3(2)	**2.3**(2)	**2.1**(3)	**1.9**(2)	**2.0**(0.8)	15/15
HMLSL pal	16(31)	6.8(7)	10(9)	9.1(4)	3.3(0.6)	15/15
IPOP-10DDr	4.2(4)	**1.9**(2)	**2.0**(1)	**1.5**(0.7)	**1.2**(0.6)	15/15
IPOP-500 l	4.2(4)	**1.9**(2)	**2.0**(1)	**1.5**(0.7)	**1.2**(0.6)	15/15
IPOP-tany	3.6(4)	**1.6**(2)	**2.0**(1)	**1.8**(0.7)	**2.2**(0.8)	15/15
IPOP-texp	6.8(8)	**2.8**(2)	**2.4**(1)	**2.1**(2)	**2.1**(3)	15/15
IPOP lia	4.2(4)	**1.9**(2)	**2.0**(1)	**1.5**(0.7)	**1.2**(0.6)	15/15
MLSL pal	15(30)	6.3(9)	10(8)	10(3)	5.5(4)	15/15
OQNLP pal	30(43)	14(17)	20(14)	16(19)	11(11)	15/15
P-DCN tra	3.1(2)	3.4(3)	242(14)	1.3e4(4e4)	7.0e4(8e4)	3/15
P-zero tra	3.2(2)	1275(2705)	3676(5912)	2.8e4(4e4)	4.1e4(4e4)	5/15
SMAC hut	**1.1**(2)	**0.83**(0.6)	**1.6**(1)	**2.2**(2)	8.1(8)	3/15
U-DCN tra	**3.1**(3)	**2.2**(2)	**2.9**(2)	4.9(4)	10(12)	15/15
U-zero tra	3.8(4)	**2.0**(1)	**2.4**(2)	7.0(5)	713(218)	15/15
fmincon pa	16(30)	7.2(10)	10(8)	7.2(3)	5.5(5)	15/15
fminunc pa	15(26)	8.0(9)	11(8)	7.4(3)	10(10)	15/15
ga100 hol	3.3(4)	**3.0**(2)	7.9(5)	10(5)	7.9(4)	15/15
grid100 ho	4.0(4)	4.9(4)	13(15)	25(26)	71(144)	15/15
grid16 hol	5.7(8)	4.7(6)	8.2(10)	19(10)	49(38)	15/15
hill hol	4.3(6)	**1.9**(2)	3.7(5)	3.1(2)	65(107)	15/15
lmmCMA aug	**1.3**(2)	**1.3**(1)	**1.5**(0.9)	**1.6**(1)	**1.4**(2)	15/15
memPSODE v	15(10)	11(18)	16(10)	12(6)	15(17)	15/15
prcga saw	**2.5**(2)	**1.8**(2)	3.5(3)	4.1(3)	**3.0**(2)	15/15
ring100 ho	4.8(5)	3.3(3)	11(8)	12(10)	18(13)	15/15
ring16 hol	3.7(7)	3.4(3)	6.0(4)	6.2(2)	25(9)	15/15
simplex pa	153(191)	51(40)	41(14)	21(5)	20(20)	15/15

Table 65: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*4.0e+1*:4.8	*2.5e+1*:16	*1.6e+1*:46	*1.0e+1*:120	*4.0e+0*:334	15/15
BIPOP-aCMA	**1.8**(1)	**1.8**(3)	3.2(4)	4.6(10)	3.8(5)	15/15
BIPOP-saAC	**1.8**(2)	**2.1**(2)	**1.9**(2)	**2.1**(2)	**2.7**(4)	15/15
CMAES hut	**1.9**(2)	**2.3**(4)	**2.8**(2)	**2.5**(3)	**2.6**(2)	7/15
DE pal	**1.8**(2)	**1.1**(1.0)	**2.1**(2)	3.3(3)	6.4(5)	15/15
HCMA los	4.7(5)	**2.2**(2)	**1.6**(1)	**2.9**(2)	3.0(4)	15/15
HMLSL pal	14(37)	10(12)	6.5(5)	4.4(2)	7.2(5)	15/15
IPOP-10DDr	**1.4**(1)	**1.3**(1)	**1.4**(1)	**2.0**(2)	**2.3**(1)	15/15
IPOP-500 l	**1.4**(1)	**1.3**(1)	**1.4**(1)	**2.0**(2)	**2.3**(1)	15/15
IPOP-tany	**1.7**(2)	**1.7**(2)	**1.9**(2)	**1.9**(1)	**1.6**(1)	15/15
IPOP-texp	**2.1**(2)	**2.0**(2)	**1.3**(1)	**1.1**(1)	**0.96**(1.0)	15/15
IPOP lia	**1.4**(1)	**1.3**(1)	**1.4**(1)	**2.0**(2)	**2.3**(1)	15/15
MLSL pal	14(38)	10(11)	5.9(5)	4.7(3)	9.4(8)	15/15
OQNLP pal	48(52)	18(17)	10(4)	12(19)	16(16)	15/15
P-DCN tra	**2.2**(2)	**1.6**(1)	**1.2**(1)	**1.1**(0.7)	73(9)	15/15
P-zero tra	**1.7**(1)	**1.7**(2)	5.1(4)	5.5(16)	5592(7745)	11/15
SMAC hut	**1.7**(2)	**0.77**(0.5)	**0.53**(0.5)	**0.42**(0.3)	**0.45**(0.6)	15/15
U-DCN tra	**1.8**(1)	**1.9**(2)	**2.3**(2)	**1.7**(1.0)	3.6(4)	15/15
U-zero tra	**1.9**(2)	**1.7**(2)	**1.4**(2)	**1.3**(0.9)	16(21)	15/15
fmincon pa	16(43)	11(14)	6.5(5)	4.1(2)	8.2(11)	15/15
fminunc pa	51(42)	20(15)	10(4)	12(12)	39(36)	15/15
ga100 hol	**1.2**(1)	**1.1**(1)	**1.5**(2)	3.2(3)	6.3(7)	15/15
grid100 ho	**1.8**(2)	**1.1**(1)	**1.9**(3)	**2.6**(2)	5.6(6)	15/15
grid16 hol	**1.5**(1)	**2.1**(3)	**1.6**(2)	**2.1**(3)	5.5(8)	15/15
hill hol	3.4(5)	3.1(2)	**2.0**(2)	**2.9**(2)	14(30)	15/15
lmmCMA aug	**1.7**(2)	**1.8**(2)	**2.7**(3)	**2.0**(2)	**1.3**(0.8)	15/15
memPSODE v	**1.4**(1)	**1.7**(1)	3.6(3)	3.0(2)	5.6(12)	15/15
prcga saw	**2.2**(3)	**2.2**(3)	**2.0**(4)	3.0(2)	7.2(3)	15/15
ring100 ho	**1.5**(2)	**1.8**(3)	**0.94**(1)	3.1(4)	8.4(8)	15/15
ring16 hol	**1.3**(1)	**1.5**(1)	**2.0**(2)	**1.5**(1.0)	**2.9**(2)	15/15
simplex pa	114(45)	38(12)	14(4)	6.3(1)	3.3(2)	15/15

Table 66: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*1.0e+1*:5.2	*6.3e+0*:26	*4.0e+0*:57	*2.5e+0*:110	*6.3e-1*:412	15/15
BIPOP-aCMA	5.5(6)	**2.1**(1)	**1.6**(0.7)	**1.2**(0.5)	**0.63**(0.3)	15/15
BIPOP-saAC	4.9(3)	**2.8**(2)	5.3(3)	3.1(1)	**1.4**(1)	15/15
CMAES hut	4.1(6)	**1.3**(1)	**1.3**(1.0)	**0.93**(0.4)	**0.62**(0.3)	14/15
DE pal	5.4(5)	**2.3**(2)	**2.1**(1.0)	**2.1**(0.9)	**1.8**(0.6)	15/15
HCMA los	**2.2**(2)	**1.6**(1)	**1.7**(1)	**1.5**(1.0)	**0.90**(0.2)	15/15
HMLSL pal	26(34)	7.3(7)	20(34)	12(17)	6.3(5)	15/15
IPOP-10DDr	3.2(3)	**1.5**(1)	**1.0**(0.5)	**0.84**(0.3)	**0.57**(0.2)	15/15
IPOP-500 l	3.2(3)	**1.5**(1)	**1.0**(0.5)	**0.84**(0.3)	**0.57**(0.2)	15/15
IPOP-tany	3.6(6)	**2.1**(2)	**1.6**(1)	**0.98**(0.5)	**0.67**(0.3)	15/15
IPOP-texp	47(7)	11(2)	5.9(2)	3.6(3)	**1.9**(4)	15/15
IPOP lia	3.2(3)	**1.5**(1)	**1.0**(0.5)	**0.84**(0.3)	**0.57**(0.2)	15/15
MLSL pal	24(35)	7.5(9)	22(34)	16(33)	173(163)	12/15
OQNLP pal	15(19)	15(11)	27(54)	34(51)	108(117)	6/15
P-DCN tra	4.3(4)	3.1(4)	6637(1051)	1.7e4(2e4)	4.9e4(5e4)	3/15
P-zero tra	5.6(8)	5339(1863)	1.6e4(4e4)	2.7e4(5e4)	2.7e4(4e4)	5/15
SMAC hut	**2.5**(4)	**1.6**(2)	**1.9**(2)	**2.1**(2)	**2.5**(3)	6/15
U-DCN tra	4.1(4)	**1.9**(2)	**2.0**(1)	**2.0**(1)	32(19)	15/15
U-zero tra	**2.6**(2)	**1.5**(1)	**2.5**(3)	**2.5**(4)	158(66)	15/15
fmincon pa	20(25)	6.4(7)	9.0(10)	25(66)	161(92)	14/15
fminunc pa	11(16)	6.4(6)	5.4(4)	10(9)	47(67)	14/15
ga100 hol	3.5(6)	**2.7**(3)	4.7(4)	5.0(3)	5.2(1)	15/15
grid100 ho	3.7(3)	3.3(4)	7.7(9)	15(6)	54(33)	15/15
grid16 hol	4.2(6)	**2.7**(2)	4.3(5)	18(9)	58(41)	14/15
hill hol	39(19)	11(10)	8.0(12)	8.2(11)	219(312)	12/15
lmmCMA aug	**1.7**(2)	**0.91**(0.8)	**0.70**(0.5)	**0.55**(0.2)	**0.62**(0.3)	15/15
memPSODE v	6.9(4)	12(11)	10(12)	12(6)	10(14)	15/15
prcga saw	**1.9**(2)	**1.5**(1)	**2.0**(2)	**2.5**(2)	6.3(1)	15/15
ring100 ho	3.8(6)	3.9(4)	7.8(5)	10(5)	13(5)	15/15
ring16 hol	5.9(8)	**2.9**(4)	**3.0**(2)	**2.6**(2)	3.6(2)	15/15
simplex pa	63(71)	28(25)	16(10)	20(22)	293(273)	8/15

Table 67: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*6.3e+1*:3.4	*4.0e+1*:7.2	*2.5e+1*:20	*1.6e+1*:58	*1.6e+0*:318	15/15
BIPOP-aCMA	**2.4**(4)	3.5(2)	**2.9**(3)	**1.8**(1)	**1.0**(0.4)	15/15
BIPOP-saAC	4.4(4)	4.7(4)	3.0(2)	**1.5**(0.9)	3.5(6)	15/15
CMAES hut	**1.6**(2)	**2.7**(3)	**1.9**(1)	**1.2**(0.7)	**0.92**(0.3)	14/15
DE pal	3.5(4)	3.8(5)	**2.6**(3)	**1.6**(1)	4.2(1)	15/15
HCMA los	**3.0**(2)	3.0(2)	**1.9**(2)	**1.5**(1)	**2.2**(0.8)	15/15
HMLSL pal	**2.6**(3)	17(16)	11(10)	11(13)	10(7)	15/15
IPOP-10DDr	**2.2**(2)	**2.2**(2)	**1.9**(2)	**1.1**(0.6)	**1.9**(0.4)	15/15
IPOP-500 l	**2.2**(2)	**2.2**(2)	**1.9**(2)	**1.1**(0.6)	**1.9**(0.4)	15/15
IPOP-tany	**1.7**(2)	**1.8**(2)	**1.4**(0.8)	**0.94**(0.7)	**1.0**(0.5)	15/15
IPOP-texp	4.2(5)	5.4(5)	**3.0**(2)	**1.4**(0.8)	**1.8**(0.7)	15/15
IPOP lia	**2.2**(2)	**2.2**(2)	**1.9**(2)	**1.1**(0.6)	**1.9**(0.4)	15/15
MLSL pal	**2.6**(3)	17(19)	10(8)	10(12)	781(851)	5/15
OQNLP pal	6.5(2)	13(24)	12(10)	12(1)	136(157)	6/15
P-DCN tra	**1.6**(1)	**1.9**(2)	**1.8**(1)	27(52)	2.6e4(3e4)	6/15
P-zero tra	**1.8**(2)	**2.5**(3)	452(1)	533(36)	3.5e4(4e4)	5/15
SMAC hut	**1.1**(1)	**0.85**(0.6)	**0.97**(1.0)	**1.1**(1)	11(12)	2/15
U-DCN tra	**1.2**(1)	**1.7**(2)	3.0(2)	**1.7**(1)	3684(7109)	14/15
U-zero tra	**1.2**(1)	**1.6**(1)	**2.8**(3)	**1.8**(2)	4474(8009)	12/15
fmincon pa	**2.6**(3)	15(15)	11(11)	11(12)	400(342)	9/15
fminunc pa	**2.2**(3)	12(17)	7.7(7)	5.0(4)	242(322)	8/15
ga100 hol	**1.0**(0.7)	**2.6**(3)	3.2(3)	3.3(4)	11(7)	15/15
grid100 ho	**1.3**(1)	3.0(4)	5.3(7)	7.0(7)	504(786)	10/15
grid16 hol	**2.4**(3)	3.9(5)	4.8(5)	3.9(3)	251(395)	13/15
hill hol	10(20)	17(23)	12(26)	4.8(9)	269(403)	12/15
lmmCMA aug	**1.3**(1)	**1.6**(2)	**0.92**(0.8)	**0.73**(0.4)	**0.52**(0.2)$^{\star 2}$	15/15
memPSODE v	3.2(3)	5.1(3)	19(17)	13(10)	17(17)	15/15
prcga saw	**1.3**(2)	**1.6**(2)	**2.8**(4)	**1.9**(3)	**2.8**(1)	15/15
ring100 ho	**1.4**(2)	**1.7**(0.8)	4.7(4)	6.6(5)	27(15)	15/15
ring16 hol	**1.8**(2)	3.1(3)	4.3(3)	3.8(2)	144(394)	13/15
simplex pa	21(13)	38(45)	28(20)	14(3)	374(357)	8/15

Table 68: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:172	*1.0e-1*:242	*6.3e-2*:675	*4.0e-2*:3078	*2.5e-2*:4946	15/15
BIPOP-aCMA	159(150)	139(107)	55(38)	18(19)	18(20)	15/15
BIPOP-saAC	51(40)	76(97)	61(78)	15(19)	18(20)	15/15
CMAES hut	∞	∞	∞	∞	∞ *506*	0/15
DE pal	571(475)	1087(1107)	1053(1111)	238(241)	148(170)	2/15
HCMA los	95(112)	99(104)	41(60)	14(21)	13(12)	15/15
HMLSL pal	**0.11**(0)$_{\downarrow 4}$	**0.17**(0.0)$_{\downarrow 4}$	**0.07**(0.0)$_{\downarrow}$	**0.02**(3e-3)$_{\downarrow 4}$	**0.01**(4e-3)$_{\downarrow 4}$	15/15
IPOP-10DDr	614(657)	519(658)	263(299)	72(77)	46(48)	15/15
IPOP-500 l	563(657)	483(576)	251(256)	57(60)	37(37)	15/15
IPOP-tany	493(546)	391(388)	192(136)	57(102)	36(66)	15/15
IPOP-texp	895(958)	746(669)	284(240)	68(52)	51(44)	15/15
IPOP lia	563(657)	483(576)	251(256)	57(60)	37(37)	15/15
MLSL pal	**0.11**(0)$_{\downarrow 4}$	**0.17**(0.0)$_{\downarrow 4}$	**0.07**(0.0)$_{\downarrow}$	**0.02**(3e-3)$_{\downarrow 4}$	**0.01**(4e-3)$_{\downarrow 4}$	15/15
OQNLP pal	**0.10**(3e-3)$^{\star 4}_{\downarrow 4}$	**0.09**(0)$^{\star 4}_{\downarrow 4}$	**0.03**(0)$^{\star 4}_{\downarrow}$	**7.5e-3**(0)$^{\star 4}_{\downarrow 4}$	**4.7e-3**(0)$^{\star 4}_{\downarrow 4}$	15/15
P-DCN tra	5.2e4(6e4)	6.5e4(7e4)	1.1e5(1e5)	2.3e4(3e4)	1.4e4(2e4)	1/15
P-zero tra	4.3e5(5e5)	3.1e5(3e5)	∞	∞	∞ *5e6*	0/15
SMAC hut	∞	∞	∞	∞	∞ *500*	0/15
U-DCN tra	2.6e4(3e4)	4.9e4(5e4)	5.1e4(6e4)	2.4e4(3e4)	1.5e4(2e4)	1/15
U-zero tra	1.7e4(2e4)	3.2e4(4e4)	4.8e4(6e4)	∞	∞ *5e6*	0/15
fmincon pa	**0.11**(0)$_{\downarrow 4}$	**0.17**(0.0)$_{\downarrow 4}$	**0.07**(0.0)$_{\downarrow}$	**0.02**(3e-3)$_{\downarrow 4}$	**0.01**(4e-3)$_{\downarrow 4}$	15/15
fminunc pa	**0.16**(0.0)$_{\downarrow 4}$	**0.13**(0.0)$_{\downarrow 4}$	**0.05**(0.0)$_{\downarrow}$	**0.01**(3e-3)$_{\downarrow 4}$	**7.8e-3**(2e-3)$_{\downarrow 4}$	15/15
ga100 hol	807(922)	1121(1120)	724(813)	1156(1381)	∞ *2e5*	0/15
grid100 ho	1.0e4(1e4)	1.5e4(2e4)	5534(5924)	∞	∞ *2e5*	0/15
grid16 hol	2686(3001)	4684(5161)	5264(5739)	∞	∞ *2e5*	0/15
hill hol	3635(3925)	6883(7742)	2472(2777)	1159(1178)	738(809)	1/15
lmmCMA aug	55(57)	56(58)	30(33)	14(14)	∞ *2805*	0/15
memPSODE v	157(105)	154(80)	96(106)	41(33)	33(23)	15/15
prcga saw	56(7)	55(5)	20(2)	4.8(3)	3.2(2)	15/15
ring100 ho	1435(1554)	3410(4030)	2468(2962)	541(609)	341(404)	2/15
ring16 hol	2015(2001)	3361(3613)	1635(1837)	1149(1340)	715(834)	1/15
simplex pa	**0.17**(0.1)$_{\downarrow 4}$	**0.18**(0.0)$_{\downarrow 4}$	**0.08**(0.0)$_{\downarrow}$	**0.02**(4e-3)$_{\downarrow 4}$	**0.01**(3e-3)$_{\downarrow 4}$	15/15

Table 69: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*6.3e+3*:5.1	*4.0e+3*:8.4	*4.0e+1*:15	*2.5e+0*:69	*1.0e+0*:851	15/15
BIPOP-aCMA	**2.3**(4)	**2.2**(2)	4.0(2)	**2.9**(2)	7.6(9)	15/15
BIPOP-saAC	3.5(4)	**2.5**(2)	3.5(3)	**2.5**(2)	5.5(7)	15/15
CMAES hut	3.4(3)	**2.2**(2)	3.7(2)	3.1(1)	∞ *506*	0/15
DE pal	**1.8**(2)	**1.6**(2)	7.7(4)	5.7(2)	**2.3**(2)	15/15
HCMA los	**1.7**(1)	**1.3**(0.8)	**0.90**(0.2)	**1.2**(2)	5.2(7)	15/15
HMLSL pal	**1.6**(0)	**0.95**(0)	**1.5**(0)	**1.2**(0)	**2.3**(1)	15/15
IPOP-10DDr	**1.9**(2)	**1.4**(2)	3.4(1)	**2.9**(2)	12(11)	15/15
IPOP-500 l	**1.9**(2)	**1.4**(2)	3.4(1)	**2.9**(2)	12(11)	15/15
IPOP-tany	**1.6**(2)	**1.1**(1.0)	**2.4**(1)	**2.9**(2)	12(10)	15/15
IPOP-texp	**1.1**(1)	**0.72**(0.8)	**1.6**(0.6)	**1.7**(1)	17(19)	15/15
IPOP lia	**1.9**(2)	**1.4**(2)	3.4(1)	**2.9**(2)	12(11)	15/15
MLSL pal	**1.6**(0)	**0.95**(0)	**1.5**(0)	**1.2**(0)	7.2(10)	15/15
OQNLP pal	**2.7**(0)	**2.0**(0)	**1.2**(0)	**0.51**(0)	5.8(7)	12/15
P-DCN tra	**2.4**(2)	**2.9**(1)	8.2(8)	3.6(2)	336(965)	15/15
P-zero tra	7.9(14)	6.4(10)	14(9)	4.9(2)	371(909)	15/15
SMAC hut	**0.57**(0.2)	**0.44**(0.2)	**0.73**(0.3)	4.3(3)	∞ *500*	0/15
U-DCN tra	**1.6**(1)	**1.7**(2)	3.6(3)	4.6(5)	5.6(8)	15/15
U-zero tra	**2.4**(2)	**2.3**(2)	3.7(2)	3.4(2)	17(29)	15/15
fmincon pa	**1.6**(0)	**0.95**(0)	**1.5**(0)	**1.2**(0)	6.4(9)	15/15
fminunc pa	**1.4**(0)	**0.83**(0)	**0.46**(0)*	**1.8**(0)	4.6(4)	15/15
ga100 hol	**1.9**(2)	**2.3**(2)	17(13)	13(7)	**4.1**(1)	15/15
grid100 ho	**2.4**(3)	**1.6**(2)	28(37)	30(14)	14(7)	15/15
grid16 hol	**2.9**(2)	**2.6**(6)	11(9)	7.4(4)	8.1(3)	15/15
hill hol	7.1(8)	4.7(5)	5.9(5)	**2.2**(1)	4.4(8)	15/15
lmmCMA aug	**1.2**(0.9)	**0.83**(0.5)	**1.8**(1)	4.0(6)	15(15)	3/15
memPSODE v	3.1(3)	3.5(3)	5.3(2)	**2.5**(0.9)	**3.6**(5)	15/15
prcga saw	**1.2**(2)	**0.91**(1)	4.7(3)	5.5(3)	25(44)	15/15
ring100 ho	**2.1**(2)	**2.3**(2)	31(20)	24(7)	7.4(2)	15/15
ring16 hol	**1.5**(1)	**2.3**(2)	8.0(6)	5.6(2)	**3.3**(0.5)	15/15
simplex pa	7.8(0.3)	6.9(0.2)	8.4(4)	10(9)	5.4(3)	15/15

Table 70: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*4.0e+1*:3.9	*2.5e+1*:11	*1.6e+1*:31	*6.3e+0*:73	*1.6e+0*:347	5/5
BIPOP-aCMA	**1.3**(2)	**1.5**(2)	**2.0**(2)	**2.2**(1.0)	10(13)	15/15
BIPOP-saAC	**2.4**(3)	**1.5**(2)	**1.2**(1)	3.2(5)	3.1(5)	15/15
CMAES hut	**2.3**(3)	**1.3**(1)	**1.3**(2)	**2.0**(1)	3.4(4)	5/15
DE pal	**1.7**(2)	**1.8**(2)	**2.1**(2)	4.7(4)	4.4(4)	15/15
HCMA los	3.3(2)	**2.0**(0.9)	**0.89**(0.7)	**2.5**(6)	4.6(5)	15/15
HMLSL pal	3.6(5)	3.5(5)	**1.8**(2)	4.5(5)	**2.6**(2)	15/15
IPOP-10DDr	3.0(3)	**2.4**(3)	**1.2**(1)	6.1(11)	15(11)	15/15
IPOP-500 l	3.0(3)	**2.4**(3)	**1.2**(1)	6.1(11)	14(11)	15/15
IPOP-tany	**2.4**(2)	**1.7**(2)	**1.1**(1)	3.8(9)	6.6(9)	15/15
IPOP-texp	**1.4**(1)	**1.6**(2)	**1.0**(0.9)	**2.0**(1)	23(43)	15/15
IPOP lia	3.0(3)	**2.4**(3)	**1.2**(1)	6.1(11)	14(11)	15/15
MLSL pal	3.6(5)	3.8(6)	**2.0**(3)	3.4(3)	**2.1**(2)	15/15
OQNLP pal	4.9(3)	3.6(5)	**1.8**(2)	**1.9**(2)	3.0(6)	13/15
P-DCN tra	**2.1**(2)	**1.8**(2)	1.2e4(3)	2.5e4(3e4)	2.2e4(3e4)	6/15
P-zero tra	**2.3**(2)	**2.4**(5)	**2.9**(3)	1.7e4(3e4)	4.0e4(5e4)	4/15
SMAC hut	**1.8**(2)	**1.8**(2)	**1.0**(0.9)	**1.0**(0.9)	**1.0**(1)	11/15
U-DCN tra	**2.1**(3)	**1.8**(2)	**2.2**(2)	3.0(2)	358(645)	15/15
U-zero tra	**1.8**(2)	**1.2**(0.9)	**0.91**(0.9)	3.7(7)	697(1323)	15/15
fmincon pa	3.6(5)	3.6(5)	**2.2**(2)	3.6(3)	**1.5**(1)	15/15
fminunc pa	4.1(2)	3.6(6)	**1.8**(3)	**2.6**(3)	**2.1**(2)	15/15
ga100 hol	**1.7**(2)	**2.6**(3)	**2.1**(2)	7.0(3)	58(6)	14/15
grid100 ho	**1.9**(2)	**1.9**(2)	**1.8**(2)	12(14)	379(718)	11/15
grid16 hol	**1.4**(1)	**1.2**(1)	**2.0**(2)	6.8(8)	558(729)	9/15
hill hol	**2.7**(3)	**2.9**(4)	**2.7**(4)	13(27)	883(1083)	7/15
lmmCMA aug	**1.9**(2)	**1.4**(2)	**0.93**(0.7)	**1.6**(0.8)	**2.7**(4)	13/15
memPSODE v	**2.3**(2)	**2.2**(2)	4.3(7)	6.0(4)	12(13)	15/15
prcga saw	**1.3**(1)	**2.2**(2)	**2.3**(2)	4.3(4)	44(68)	15/15
ring100 ho	**1.8**(2)	**1.4**(1)	**2.3**(3)	10(8)	7.5(3)	15/15
ring16 hol	**2.1**(4)	**2.4**(3)	**2.2**(2)	4.0(2)	116(361)	13/15
simplex pa	47(63)	35(57)	18(19)	14(8)	5.1(4)	15/15

Table 71: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*6.3e+1*:3.6	*4.0e+1*:15	*2.5e+1*:32	*1.0e+1*:71	*1.6e+0*:341	5/5
BIPOP-aCMA	**2.6**(2)	**2.4**(2)	**1.9**(1)	8.1(11)	22(40)	15/15
BIPOP-saAC	3.8(5)	4.4(3)	3.8(8)	9.1(13)	7.2(10)	15/15
CMAES hut	**2.5**(3)	**1.8**(2)	**1.3**(2)	**1.9**(1)	4.6(5)	4/15
DE pal	**2.0**(2)	**2.2**(2)	**1.8**(2)	3.5(2)	77(149)	12/15
HCMA los	**2.9**(2)	**2.4**(2)	**1.5**(1)	3.3(6)	6.1(6)	15/15
HMLSL pal	**2.4**(2)	3.2(5)	**1.9**(3)	3.6(3)	**2.3**(2)	15/15
IPOP-10DDr	**2.7**(2)	**2.2**(2)	**1.8**(1)	7.4(11)	47(60)	15/15
IPOP-500 l	**2.7**(2)	**2.2**(2)	**1.8**(1)	7.4(11)	104(31)	15/15
IPOP-tany	**1.9**(2)	**1.6**(1)	**1.4**(1)	12(9)	32(57)	15/15
IPOP-texp	**2.1**(2)	**1.5**(1)	**1.0**(1)	22(9)	14(27)	15/15
IPOP lia	**2.7**(2)	**2.2**(2)	**1.8**(1)	7.4(11)	37(31)	15/15
MLSL pal	**2.4**(2)	3.3(6)	**2.0**(4)	**2.7**(3)	**2.0**(3)	15/15
OQNLP pal	4.5(3)	3.0(3)	**2.7**(3)	**2.8**(2)	**2.8**(4)	14/15
P-DCN tra	4.5(6)	4.0(4)	2.4e4(8e4)	2.6e4(4e4)	2.2e4(3e4)	6/15
P-zero tra	3.3(4)	4.0(5)	2.4e4(8e4)	2.6e4(4e4)	4.0e4(5e4)	4/15
SMAC hut	**1.8**(3)	**1.5**(1)	**1.0**(0.8)	**0.90**(0.8)	**1.0**(1)	11/15
U-DCN tra	**2.9**(2)	**2.3**(2)	**1.6**(0.8)	**1.9**(1)	368(186)	15/15
U-zero tra	**2.8**(2)	**1.7**(1)	**2.5**(2)	4.8(6)	1248(519)	14/15
fmincon pa	**2.4**(2)	3.4(6)	**1.9**(3)	**2.2**(3)	**1.4**(1)	15/15
fminunc pa	**2.8**(2)	**2.5**(4)	**2.4**(3)	3.3(3)	**1.4**(1)	15/15
ga100 hol	3.2(5)	**2.2**(3)	**2.1**(2)	5.9(5)	272(369)	11/15
grid100 ho	3.0(2)	**2.0**(1)	**2.5**(3)	5.5(6)	139(368)	13/15
grid16 hol	**1.9**(2)	**1.3**(2)	**1.00**(1.0)	5.1(7)	771(1103)	8/15
hill hol	4.7(5)	**2.0**(2)	7.5(11)	6.7(10)	516(735)	9/15
lmmCMA aug	**1.6**(2)	**1.4**(1)	**1.3**(1)	**2.5**(3)	4.2(5)	12/15
memPSODE v	4.0(3)	4.4(3)	4.3(6)	4.6(3)	8.7(12)	15/15
prcga saw	**1.3**(2)	**2.4**(4)	**2.1**(3)	3.3(3)	123(275)	15/15
ring100 ho	**2.1**(2)	**1.4**(2)	3.4(4)	5.5(3)	8.7(5)	15/15
ring16 hol	**2.0**(2)	**1.3**(1)	**2.0**(2)	**2.5**(2)	104(347)	14/15
simplex pa	22(25)	25(37)	16(21)	11(10)	5.7(3)	15/15

Table 72: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*1.0e+1*:3.0	*6.3e+0*:9.0	*4.0e+0*:33	*2.5e+0*:84	*1.0e+0*:518	15/15
BIPOP-aCMA	**1.8**(2)	**2.0**(3)	3.6(7)	6.8(7)	8.6(6)	15/15
BIPOP-saAC	**2.0**(2)	**2.3**(3)	4.2(4)	7.3(12)	12(14)	15/15
CMAES hut	**1.6**(1)	**2.9**(3)	5.4(5)	6.7(7)	∞ *506*	0/15
DE pal	**1.9**(2)	**2.5**(4)	3.2(2)	7.0(8)	31(27)	15/15
HCMA los	8.1(8)	4.6(5)	3.0(2)	6.8(7)	13(10)	15/15
HMLSL pal	9.2(11)	5.1(5)	**2.9**(2)	**2.4**(1)	**2.4**(2)	15/15
IPOP-10DDr	**2.1**(2)	**1.9**(2)	**2.3**(2)	3.4(3)	7.2(5)	15/15
IPOP-500 l	**2.1**(2)	**1.9**(2)	**2.3**(2)	3.4(3)	7.2(5)	15/15
IPOP-tany	**1.7**(1)	**2.3**(2)	3.3(4)	6.7(6)	7.5(6)	15/15
IPOP-texp	**3.0**(3)	**2.7**(4)	3.1(3)	3.7(4)	7.0(7)	15/15
IPOP lia	**2.1**(2)	**1.9**(2)	**2.3**(2)	3.4(3)	7.2(5)	15/15
MLSL pal	9.2(11)	5.1(5)	**2.9**(2)	**2.2**(1)	**1.9**(2)	15/15
OQNLP pal	29(47)	14(18)	6.5(7)	5.8(4)	5.6(4)	15/15
P-DCN tra	3.6(3)	**2.9**(3)	**2.1**(2)	**2.6**(3)	**3.2**(4)	15/15
P-zero tra	3.6(3)	**2.1**(2)	**2.7**(3)	**2.6**(3)	29(62)	15/15
SMAC hut	**1.6**(2)	**2.9**(3)	**2.6**(3)	3.3(3)	∞ *500*	0/15
U-DCN tra	3.4(2)	**2.9**(3)	**2.2**(2)	3.2(4)	10(17)	15/15
U-zero tra	3.2(2)	**2.2**(3)	**2.0**(1)	6.4(8)	43(50)	15/15
fmincon pa	7.2(6)	5.6(4)	3.4(6)	**2.4**(3)	**1.6**(2)	15/15
fminunc pa	9.1(16)	10(12)	6.4(7)	5.5(5)	10(10)	15/15
ga100 hol	**2.3**(2)	**2.7**(4)	**2.3**(3)	5.2(5)	45(46)	15/15
grid100 ho	**3.0**(2)	**2.1**(2)	4.7(3)	8.9(13)	60(74)	15/15
grid16 hol	**2.2**(3)	**1.8**(2)	**3.0**(4)	6.5(5)	40(30)	15/15
hill hol	**2.5**(3)	**1.7**(2)	4.1(4)	11(9)	49(45)	15/15
lmmCMA aug	**1.9**(2)	**2.6**(2)	**2.6**(3)	7.1(6)	10(11)	6/15
memPSODE v	3.4(3)	4.1(2)	5.4(5)	4.0(3)	3.4(3)	15/15
prcga saw	**1.9**(2)	3.0(2)	3.0(4)	6.2(7)	39(50)	15/15
ring100 ho	**1.8**(2)	**2.3**(2)	**2.8**(2)	4.6(4)	23(27)	15/15
ring16 hol	**3.0**(2)	**2.5**(3)	4.1(4)	7.3(10)	26(29)	15/15
simplex pa	63(104)	47(51)	19(16)	11(3)	**3.0**(1)	15/15

Table 73: 05-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*6.3e+1*:15	*4.0e+1*:37	*4.0e+1*:37	*2.5e+1*:118	*1.6e+1*:692	15/15
BIPOP-aCMA	**2.6**(1)	3.3(2)	3.3(2)	**2.2**(1)	**1.1**(0.7)	15/15
BIPOP-saAC	**1.9**(2)	**2.6**(1)	**2.6**(1)	**2.6**(2)	**0.98**(1.0)	15/15
CMAES hut	**1.6**(2)	**1.9**(2)	**1.9**(2)	**2.2**(2)	**1.4**(2)	6/15
DE pal	3.6(3)	6.2(3)	6.2(3)	5.3(3)	4.4(3)	15/15
HCMA los	**1.0**(0.3)	**1.4**(1)	**1.4**(1)	**2.0**(2)	**1.3**(1)	15/15
HMLSL pal	**2.1**(0.9)	**2.9**(4)	**2.9**(4)	6.0(4)	**1.9**(0.9)	15/15
IPOP-10DDr	**2.1**(2)	**2.1**(0.7)	**2.1**(0.7)	**1.6**(1)	**0.99**(0.6)	15/15
IPOP-500 l	**2.1**(2)	**2.1**(0.7)	**2.1**(0.7)	**1.6**(1)	**0.99**(0.6)	15/15
IPOP-tany	**1.3**(1)	**2.1**(1)	**2.1**(1)	**1.4**(0.6)	**1.2**(0.9)	15/15
IPOP-texp	**0.49**(0.4)	**1.3**(1)	**1.3**(1)	**1.2**(1.0)	**1.2**(1)	15/15
IPOP lia	**2.1**(2)	**2.1**(0.7)	**2.1**(0.7)	**1.6**(1)	**0.99**(0.6)	15/15
MLSL pal	**1.9**(0.9)	**2.7**(5)	**2.7**(5)	3.5(3)	**2.0**(2)	15/15
OQNLP pal	**1.1**(0.7)	**1.6**(0.6)	**1.6**(0.6)	4.4(1)	**1.2**(0.8)	15/15
P-DCN tra	**1.9**(1)	4.7(4)	4.7(4)	422(1096)	534(553)	15/15
P-zero tra	**2.1**(2)	1691(1763)	1691(1763)	6787(2e4)	1.2e4(1e4)	7/15
SMAC hut	**0.51**(0.5)	**2.6**(3)	**2.6**(3)	7.4(7)	∞ *500*	0/15
U-DCN tra	**2.4**(3)	5.1(5)	5.1(5)	5.8(3)	7.2(8)	15/15
U-zero tra	**1.5**(0.8)	3.3(5)	3.3(5)	7.5(9)	10(9)	15/15
fmincon pa	**1.7**(0.9)	**2.3**(2)	**2.3**(2)	3.4(2)	**2.2**(2)	15/15
fminunc pa	**1.9**(1)	**1.9**(0.7)	**1.9**(0.7)	6.0(1)	**2.5**(2)	15/15
ga100 hol	**2.1**(3)	10(6)	10(6)	10(6)	6.2(6)	15/15
grid100 ho	4.2(4)	18(18)	18(18)	23(16)	38(55)	15/15
grid16 hol	3.3(4)	6.4(4)	6.4(4)	6.0(4)	6.1(7)	15/15
hill hol	5.2(6)	6.6(7)	6.6(7)	17(35)	12(8)	15/15
lmmCMA aug	**0.77**(1.0)	**2.0**(2)	**2.0**(2)	**1.7**(1)	**0.91**(0.6)	15/15
memPSODE v	13(16)	18(7)	18(7)	11(9)	8.9(8)	15/15
prcga saw	**1.2**(1)	**2.5**(2)	**2.5**(2)	**2.8**(2)	**2.0**(1)	15/15
ring100 ho	4.6(5)	14(11)	14(11)	20(13)	8.7(7)	15/15
ring16 hol	**2.6**(2)	5.1(6)	5.1(6)	7.7(6)	3.7(2)	15/15
simplex pa	**2.9**(4)	6.9(4)	6.9(4)	20(19)	6.2(6)	15/15

Table 74: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*4.0e+1*:8.0	*2.5e+1*:16	*1.0e-8*:23	*1.0e-8*:23	*1.0e-8*:23	15/15
BIPOP-aCMA	6.4(0.9)	3.7(0.6)	16(0)	16(0)	16(0)	15/15
BIPOP-saAC	6.0(4)	4.3(2)	18(1)	18(1)	18(1)	15/15
CMAES hut	4.2(4)	3.7(3)	∞	∞	∞ *1002*	0/15
DE pal	9.0(7)	8.5(5)	339(12)	339(12)	339(12)	15/15
HCMA los	**2.6**(0)	**1.4**(0)	**0.99**(0.0)	**0.99**(0.0)	**0.99**(0.0)	15/15
HMLSL pal	**1.3**(0.7)	**0.70**(0)	**4.7**(0.5)	**4.7**(0.5)	**4.7**(0.5)	15/15
IPOP-10DDr	4.2(2)	3.6(1)	63(4)	63(4)	63(4)	15/15
IPOP-500 l	4.2(2)	3.6(1)	63(4)	63(4)	63(4)	15/15
IPOP-tany	3.5(2)	3.1(2)	70(5)	70(5)	70(5)	15/15
IPOP-texp	**2.4**(2)	**2.5**(1)	69(4)	69(4)	69(4)	15/15
IPOP lia	4.2(2)	3.6(1)	63(4)	63(4)	63(4)	15/15
MLSL pal	**1.3**(0.7)	**0.70**(0)	**4.7**(0.5)	**4.7**(0.5)	**4.7**(0.5)	15/15
OQNLP pal	3.1(2)	**1.7**(0.1)	**2.0**(0.0)	**2.0**(0.0)	**2.0**(0.0)	15/15
P-DCN tra	7.0(6)	13(10)	1999(957)	1999(957)	1999(957)	15/15
P-zero tra	12(12)	14(13)	4241(1514)	4241(1514)	4241(1514)	15/15
SMAC hut	**0.99**(0.9)	**0.80**(0.4)	∞	∞	∞ *1000*	0/15
U-DCN tra	5.0(5)	4.7(3)	8551(4389)	8551(4389)	8551(4389)	15/15
U-zero tra	4.3(3)	3.4(1)	2.4e5(8e4)	2.4e5(8e4)	2.4e5(8e4)	15/15
fmincon pa	**1.3**(0.7)	**0.70**(0)	**4.7**(0.5)	**4.7**(0.5)	**4.7**(0.5)	15/15
fminunc pa	**1.6**(1)	**1.2**(0.3)	**1**(0)	**1**(0)	**1**(0)	15/15
ga100 hol	10(9)	14(13)	∞	∞	∞ *5e5*	0/15
grid100 ho	11(15)	33(38)	∞	∞	∞ *5e5*	0/15
grid16 hol	17(15)	16(8)	∞	∞	∞ *5e5*	0/15
hill hol	7.5(4)	5.2(3)	∞	∞	∞ *5e5*	0/15
lmmCMA aug	**2.6**(3)	**2.4**(2)	9.1(0.5)	9.1(0.5)	9.1(0.5)	15/15
memPSODE v	8.7(3)	5.0(1)	**4.5**(0.2)	**4.5**(0.2)	**4.5**(0.2)	15/15
prcga saw	5.2(6)	7.6(8)	1959(1719)	1959(1719)	1959(1719)	15/15
ring100 ho	16(30)	25(24)	∞	∞	∞ *5e5*	0/15
ring16 hol	10(8)	11(6)	∞	∞	∞ *5e5*	0/15
simplex pa	19(12)	27(30)	3497(3137)	3497(3137)	3497(3137)	14/15

Table 75: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*2.5e+6*:5.6	*1.0e+6*:17	*1.0e+5*:33	*2.5e+3*:118	*1.0e-8*:196	15/15
BIPOP-aCMA	**1.8**(2)	**2.2**(3)	**3.2**(0.3)	**1.4**(0.1)	**6.2**(0.2)	15/15
BIPOP-saAC	3.2(2)	**2.0**(1)	5.8(2)	3.2(0.4)	**4.6**(0.3)	15/15
CMAES hut	**1.6**(2)	**1.2**(1)	9.3(5)	14(10)	∞ *1002*	0/15
DE pal	**1.8**(1)	**1.4**(1)	9.3(4)	11(2)	54(2)	15/15
HCMA los	3.7(0)	**1.3**(0)	**0.90**(0.1)$^{\star 2}$	**1.5**(0.5)	**2.9**(0.2)	15/15
HMLSL pal	10(11)	5.1(5)	6.2(4)	3.4(1)	25(38)	15/15
IPOP-10DDr	**2.0**(2)	**2.1**(2)	5.7(3)	8.7(3)	34(2)	15/15
IPOP-500 l	**2.0**(2)	**2.1**(2)	5.7(3)	8.7(3)	34(2)	15/15
IPOP-tany	**2.0**(2)	**2.0**(1)	7.6(4)	12(3)	34(2)	15/15
IPOP-texp	**2.6**(3)	**1.6**(1)	4.5(3)	9.2(3)	32(2)	15/15
IPOP lia	**2.0**(2)	**2.1**(2)	5.7(3)	8.7(3)	34(2)	15/15
MLSL pal	10(11)	5.1(5)	6.2(4)	3.4(1)	15(19)	15/15
OQNLP pal	4.8(0.3)	**2.1**(0.6)	**2.7**(1)	**1.7**(0.4)	∞ *6e4*	0/15
P-DCN tra	**2.8**(4)	**2.8**(4)	13(6)	11(5)	9168(2e4)	14/15
P-zero tra	**1.3**(0.9)	3.0(6)	11(7)	12(6)	3.7e5(4e5)	2/15
SMAC hut	**1.2**(1)	**0.74**(1)	4.4(4)	22(22)	∞ *1000*	0/15
U-DCN tra	**2.3**(2)	**1.9**(2)	4.7(2)	15(11)	6.9e4(8e4)	7/15
U-zero tra	**1.4**(2)	**1.2**(0.9)	4.5(3)	22(20)	∞ *1e7*	0/15
fmincon pa	10(12)	5.5(6)	7.1(6)	3.4(2)	26(41)	15/15
fminunc pa	4.1(3)	**1.9**(1.0)	**3.5**(3)	4.7(2)	15(2)	15/15
ga100 hol	**1.5**(2)	**1.9**(2)	20(11)	28(8)	∞ *5e5*	0/15
grid100 ho	**1.4**(2)	**2.4**(2)	59(51)	92(36)	∞ *5e5*	0/15
grid16 hol	4.2(7)	7.3(7)	17(9)	20(5)	∞ *5e5*	0/15
hill hol	7.1(6)	3.3(3)	6.1(4)	6.7(8)	∞ *5e5*	0/15
lmmCMA aug	**1.0**(1)	**0.80**(0.6)	**3.7**(1)	**2.7**(0.6)	**7.7**(0.9)	15/15
memPSODE v	**1.4**(2)	**3.0**(3)	3.8(1)	**1.9**(0.4)	**2.4**(0.4)$^{\star 2}$	15/15
prcga saw	**1.7**(2)	**1.0**(0.9)	10(5)	11(2)	4696(4913)	10/15
ring100 ho	**0.86**(0.7)	3.7(4)	39(22)	50(10)	∞ *5e5*	0/15
ring16 hol	**0.95**(1.0)	**2.8**(4)	12(3)	16(6)	∞ *5e5*	0/15
simplex pa	27(5)	17(9)	32(23)	35(21)	∞ *2e5*	0/15

Table 76: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*4.0e+2*:8.2	*1.6e+2*:37	*1.0e+2*:69	*6.3e+1*:147	*2.5e+1*:1129	15/15
BIPOP-aCMA	3.3(3)	**1.9**(0.3)	**1.3**(0.3)	**0.86**(0.2)	**0.22**(0.1)	15/15
BIPOP-saAC	**2.2**(3)	**2.5**(1)	**2.5**(0.7)	3.2(2)	**1.5**(1)	15/15
CMAES hut	**2.2**(2)	**2.5**(1)	**2.7**(0.7)	**2.9**(0.9)	**1.5**(1)	8/15
DE pal	**1.7**(2)	6.3(3)	8.8(3)	8.1(2)	4.8(1)	15/15
HCMA los	**2.2**(2)	**2.4**(1)	**2.0**(0.5)	**1.2**(0.1)	**0.23**(0.1)	15/15
HMLSL pal	**0.82**(0.9)	15(16)	17(11)	13(3)	3.1(1)	15/15
IPOP-10DDr	**0.66**(0.8)	**2.6**(1)	**2.5**(1)	3.1(1)	**1.1**(0.4)	15/15
IPOP-500 l	**0.66**(0.8)	**2.6**(1)	**2.5**(1)	3.1(1)	**1.1**(0.4)	15/15
IPOP-tany	**0.57**(0.9)	**2.2**(0.9)	**2.8**(1.0)	**2.6**(0.8)	**0.89**(0.2)	15/15
IPOP-texp	**0.39**(0.2)	**1.4**(0.7)	**2.5**(1)	**2.9**(1)	**1.3**(0.3)	15/15
IPOP lia	**0.66**(0.8)	**2.6**(1)	**2.5**(1)	3.1(1)	**1.1**(0.4)	15/15
MLSL pal	**0.82**(0.9)	14(15)	20(19)	64(90)	240(200)	8/15
OQNLP pal	**1.4**(2)	20(11)	71(108)	135(218)	82(96)	8/15
P-DCN tra	4.0(2)	10(14)	20(29)	30(40)	57(121)	15/15
P-zero tra	**1.8**(2)	10(15)	16(22)	46(53)	142(331)	15/15
SMAC hut	**0.46**(0.5)	**2.2**(4)	8.3(9)	18(17)	∞ *1000*	0/15
U-DCN tra	**2.1**(2)	3.1(2)	3.5(2)	**2.7**(1)	**0.99**(0.4)	15/15
U-zero tra	**1.6**(1)	**1.9**(2)	**2.2**(1)	**1.6**(0.6)	**0.62**(0.3)	15/15
fmincon pa	**0.82**(0.9)	12(14)	38(60)	78(97)	100(86)	13/15
fminunc pa	**0.75**(0.7)	14(14)	53(83)	140(148)	379(383)	5/15
ga100 hol	**2.0**(2)	13(4)	15(4)	11(2)	**2.6**(0.6)	15/15
grid100 ho	**1.8**(2)	38(31)	40(12)	34(13)	10(4)	15/15
grid16 hol	**2.6**(4)	7.3(5)	8.1(3)	6.0(2)	**1.7**(0.4)	15/15
hill hol	4.7(5)	**2.4**(1)	**1.9**(0.9)	**1.4**(0.7)	**0.45**(0.1)	15/15
lmmCMA aug	**0.54**(0.6)	**1.3**(1)	**2.1**(0.4)	**2.3**(0.8)	**0.85**(1)	15/15
memPSODE v	3.4(3)	**2.6**(0.6)	8.1(7)	6.9(11)	3.2(3)	15/15
prcga saw	**0.41**(0.2)	5.8(3)	8.7(2)	8.5(2)	**2.7**(0.8)	15/15
ring100 ho	**1.7**(2)	17(13)	25(10)	20(4)	5.8(0.8)	15/15
ring16 hol	**2.1**(2)	5.9(2)	5.8(2)	4.3(0.8)	**1.1**(0.3)	15/15
simplex pa	47(87)	47(8)	230(331)	575(657)	∞ *2e5*	0/15

Table 77: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*2.5e+2*:21	*1.6e+2*:59	*1.6e+2*:59	*6.3e+1*:139	*4.0e+1*:854	15/15
BIPOP-aCMA	3.0(1)	**2.0**(0.7)	**2.0**(0.7)	**1.5**(0.4)	**0.33**(0.1)	15/15
BIPOP-saAC	3.4(2)	**2.4**(1)	**2.4**(1)	5.3(2)	**1.2**(0.4)	15/15
CMAES hut	3.7(2)	**2.7**(2)	**2.7**(2)	4.7(1)	**1.4**(0.8)	11/15
DE pal	7.8(6)	7.0(2)	7.0(2)	13(4)	4.0(1)	15/15
HCMA los	4.2(2)	**2.6**(1)	**2.6**(1)	**1.6**(0.3)	**0.33**(0.1)	15/15
HMLSL pal	**2.4**(3)	12(10)	12(10)	19(3)	3.6(0.2)	15/15
IPOP-10DDr	3.5(3)	3.3(0.8)	3.3(0.8)	4.7(1)	**1.2**(0.2)	15/15
IPOP-500 l	3.5(3)	3.3(0.8)	3.3(0.8)	4.7(1)	**1.2**(0.2)	15/15
IPOP-tany	**2.6**(2)	**2.8**(1)	**2.8**(1)	4.5(2)	**1.1**(0.2)	15/15
IPOP-texp	**1.0**(1)	**1.2**(0.8)	**1.2**(0.8)	4.2(2)	**1.0**(0.4)	15/15
IPOP lia	3.5(3)	3.3(0.8)	3.3(0.8)	4.7(1)	**1.2**(0.2)	15/15
MLSL pal	**2.4**(3)	15(12)	15(12)	222(193)	347(400)	7/15
OQNLP pal	20(21)	56(67)	56(67)	290(360)	100(111)	8/15
P-DCN tra	3.2(2)	5.3(5)	5.3(5)	25(24)	15(21)	15/15
P-zero tra	12(3)	21(22)	21(22)	70(55)	25(17)	15/15
SMAC hut	7.5(10)	31(30)	31(29)	∞	∞ *1000*	0/15
U-DCN tra	3.6(1)	**2.5**(0.6)	**2.5**(0.6)	**3.4**(1)	**0.94**(0.4)	15/15
U-zero tra	**2.7**(1)	**1.8**(0.6)	**1.8**(0.6)	**2.4**(1)	**0.68**(0.3)	15/15
fmincon pa	**2.4**(3)	19(21)	19(21)	293(248)	227(265)	10/15
fminunc pa	9.2(19)	23(16)	23(16)	605(632)	1568(1847)	2/15
ga100 hol	14(7)	13(5)	13(5)	14(3)	3.3(0.5)	15/15
grid100 ho	42(42)	44(21)	44(21)	52(14)	12(4)	15/15
grid16 hol	8.9(8)	7.5(3)	7.5(3)	8.9(2)	**2.2**(0.6)	15/15
hill hol	4.0(2)	**1.9**(0.9)	**1.9**(0.9)	**1.7**(0.5)	**0.46**(0.1)	15/15
lmmCMA aug	**1.3**(1)	**1.7**(0.9)	**1.7**(0.9)	3.6(1.0)	**0.92**(0.2)	15/15
memPSODE v	4.3(0.5)	**2.4**(2)	**2.4**(2)	9.0(0.9)	3.5(4)	15/15
prcga saw	4.8(5)	7.2(3)	7.2(3)	14(4)	3.1(0.8)	15/15
ring100 ho	26(18)	24(10)	24(10)	27(6)	6.6(0.9)	15/15
ring16 hol	8.5(3)	5.7(2)	5.7(2)	6.2(1)	**1.5**(0.3)	15/15
simplex pa	30(44)	220(501)	220(501)	3148(3084)	3517(3411)	1/15

Table 78: 10-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*1.0e+2*:16	*6.3e+1*:19	*1.0e-8*:20	*1.0e-8*:20	*1.0e-8*:20	15/15
BIPOP-aCMA	**1.2**(0.4)	**1.2**(0)	**1.1**(0)	**1.1**(0)	**1.1**(0)	15/15
BIPOP-saAC	**1.9**(0.9)	**2.4**(0.8)	6.0(1)	6.0(1)	6.0(1)	15/15
CMAES hut	**1.8**(0.5)	**2.3**(0.5)	5.8(1)	5.8(1)	5.8(1)	15/15
DE pal	4.4(4)	16(10)	2174(71)	2174(71)	2174(71)	15/15
HCMA los	**1.3**(0)	**1.2**(0.0)	**1.6**(0.5)	**1.6**(0.5)	**1.6**(0.5)	15/15
HMLSL pal	**0.73**$(0)_{\downarrow 4}$	**1.8**(0)	2202(1149)	2202(1149)	2202(1149)	15/15
IPOP-10DDr	**1.1**(0.7)	**2.0**(0.8)	196(81)	196(81)	196(81)	15/15
IPOP-500 l	**1.1**(0.7)	**2.0**(0.8)	196(81)	196(81)	196(81)	15/15
IPOP-tany	**1.6**(0.6)	**2.2**(0.8)	168(52)	168(67)	168(67)	15/15
IPOP-texp	3.8(0.8)	4.7(2)	236(142)	236(142)	236(142)	15/15
IPOP lia	**1.1**(0.7)	**2.0**(0.8)	196(81)	196(81)	196(81)	15/15
MLSL pal	**0.73**$(0)_{\downarrow 4}$	**1.8**(0)	4536(6380)	4536(6386)	4536(6407)	11/15
OQNLP pal	**1.9**(0)	**1.6**(0)	**1.7**(0)	**1.7**(0)	**1.7**(0)	15/15
P-DCN tra	3.5(4)	17(19)	393(70)	393(70)	393(70)	15/15
P-zero tra	**2.8**(4)	15(13)	187(66)	187(66)	187(66)	15/15
SMAC hut	**0.39**$(0.2)^{\star}_{\downarrow 4}$	**0.48**$(0.2)^{\star 4}_{\downarrow 4}$	**0.63**$(0.2)^{\star 4}_{\downarrow 4}$	**0.63**$(0.2)^{\star 4}_{\downarrow 4}$	**0.63**$(0.2)^{\star 4}_{\downarrow 4}$	15/15
U-DCN tra	**2.0**(2)	5.0(3)	∞	∞	∞ *1e7*	0/15
U-zero tra	**1.4**(1)	3.3(1)	∞	∞	∞ *1e7*	0/15
fmincon pa	**0.73**$(0)_{\downarrow 4}$	**1.8**(0)	3146(4090)	3146(4191)	3146(3932)	11/15
fminunc pa	**1.4**(0)	**1.2**(0)	**2.8**(0)	**2.8**(0)	**2.8**(0)	15/15
ga100 hol	5.2(6)	26(10)	132(17)	132(17)	132(17)	15/15
grid100 ho	14(14)	51(22)	385(106)	385(106)	385(106)	15/15
grid16 hol	6.7(6)	15(8)	70(13)	70(13)	70(13)	15/15
hill hol	**2.6**(2)	3.6(2)	12(5)	12(5)	12(5)	15/15
lmmCMA aug	**2.1**(1)	**2.6**(0.7)	6.4(2)	6.4(2)	6.4(2)	15/15
memPSODE v	**1.7**(0.9)	3.6(3)	6.5(2)	6.5(2)	6.5(2)	15/15
prcga saw	14(7)	22(8)	∞	∞	∞ *5e5*	0/15
ring100 ho	10(16)	36(21)	246(26)	246(26)	246(26)	15/15
ring16 hol	5.6(5)	11(5)	45(10)	45(10)	45(10)	15/15
simplex pa	14(6)	26(23)	142(112)	142(112)	142(112)	15/15

Table 79: 10-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*1.6e+5*:7.0	*6.3e+4*:16	*4.0e+2*:36	*1.0e+2*:102	*4.0e+0*:504	15/15
BIPOP-aCMA	**2.0**(2)	**2.9**(3)	3.8(2)	3.7(0.9)	**1.8**(0.4)	15/15
BIPOP-saAC	3.3(2)	**2.2**(2)	3.5(4)	3.9(2)	**2.0**(0.3)	15/15
CMAES hut	**2.2**(3)	**1.7**(2)	**2.3**(1)	**2.6**(1)	**2.0**(1)	12/15
DE pal	**2.4**(4)	3.8(4)	8.0(5)	5.4(3)	12(3)	15/15
HCMA los	**2.3**(1)	**1.2**(0.7)	**1.1**(0.6)	**2.6**(3)	**2.3**(0.9)	15/15
HMLSL pal	**1.7**(2)	**1.7**(1)	3.7(3)	**2.2**(1)	**1.2**(0.5)	15/15
IPOP-10DDr	**1.5**(2)	**1.6**(1)	**2.0**(2)	**1.6**(1)	**1.5**(0.2)	15/15
IPOP-500 l	**1.5**(2)	**1.6**(1)	**2.0**(2)	**1.6**(1)	**1.5**(0.2)	15/15
IPOP-tany	**1.5**(2)	**1.9**(2)	**2.8**(2)	**1.9**(0.7)	**1.6**(0.3)	15/15
IPOP-texp	**2.6**(2)	**2.2**(2)	3.0(2)	**1.7**(0.9)	**1.7**(0.3)	15/15
IPOP lia	**1.5**(2)	**1.6**(1)	**2.0**(2)	**1.6**(1)	**1.5**(0.2)	15/15
MLSL pal	**1.7**(2)	**1.7**(1)	3.7(3)	**2.2**(1)	**1.2**(0.5)	15/15
OQNLP pal	**2.7**(2)	**1.8**(0.1)	**1.7**(0.3)	**0.71**(0.2)	**1.2**(0.6)	15/15
P-DCN tra	4.6(4)	5.9(5)	14(12)	13(6)	9.1(5)	15/15
P-zero tra	6.4(2)	5.6(5)	12(11)	10(6)	86(24)	15/15
SMAC hut	**1.0**(0.9)	**0.96**(0.8)	**2.1**(2)	**2.0**(2)	∞ *1000*	0/15
U-DCN tra	**2.1**(2)	**2.6**(3)	5.9(10)	7.1(8)	61(60)	15/15
U-zero tra	**2.2**(2)	**1.6**(2)	4.2(5)	4.2(4)	4527(9929)	13/15
fmincon pa	**1.7**(2)	**1.7**(1)	3.7(2)	**2.2**(2)	**1.2**(0.5)	15/15
fminunc pa	**1.8**(2)	**1.3**(0.7)	**1.3**(0.6)	**0.70**(0.4)	**2.6**(1)	15/15
ga100 hol	**2.3**(3)	6.8(10)	15(14)	11(6)	23(7)	15/15
grid100 ho	7.0(14)	6.4(10)	48(40)	43(34)	229(219)	15/15
grid16 hol	3.2(5)	5.0(8)	11(11)	10(8)	114(80)	14/15
hill hol	5.0(5)	3.3(2)	3.7(4)	4.1(3)	32(72)	15/15
lmmCMA aug	**1.8**(2)	**1.4**(1)	3.2(1)	5.2(3)	6.3(3)	14/15
memPSODE v	**2.4**(3)	**2.5**(2)	**3.0**(1)	4.0(2)	**2.5**(1)	15/15
prcga saw	**2.7**(4)	5.1(4)	17(15)	9.2(5)	149(21)	15/15
ring100 ho	3.0(4)	6.1(11)	25(32)	17(9)	50(10)	15/15
ring16 hol	4.1(5)	3.9(5)	6.1(6)	5.9(3)	10(3)	15/15
simplex pa	17(13)	18(13)	40(22)	19(8)	1357(1262)	4/15

Table 80: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*2.5e+2*:9.2	*1.6e+2*:18	*1.0e+2*:33	*1.0e+1*:172	*4.0e+0*:678	15/15
BIPOP-aCMA	5.5(6)	4.7(3)	3.9(2)	**2.2**(0.9)	**0.76**(0.2)	15/15
BIPOP-saAC	**2.9**(3)	**2.9**(2)	**2.6**(1)	**1.4**(0.5)	**0.44**(0.1)	15/15
CMAES hut	**2.1**(2)	3.2(2)	**2.8**(2)	**2.1**(0.5)	**1.1**(0.8)	12/15
DE pal	3.8(4)	4.2(6)	5.1(3)	12(5)	5.5(2)	15/15
HCMA los	**2.5**(1)	**1.6**(0.5)	**1.0**(0.3)	**2.2**(0.7)	**0.82**(0.2)	15/15
HMLSL pal	5.9(6)	8.5(7)	13(9)	17(8)	7.9(2)	15/15
IPOP-10DDr	**2.4**(3)	**2.3**(2)	**2.8**(1)	**2.2**(0.9)	**1.6**(2)	15/15
IPOP-500 l	**2.4**(3)	**2.3**(2)	**2.8**(1)	**2.2**(0.9)	**1.6**(2)	15/15
IPOP-tany	**1.6**(2)	**1.6**(1)	**1.9**(1)	**2.1**(0.7)	**1.0**(0.3)	15/15
IPOP-texp	**2.2**(2)	**1.8**(2)	**1.5**(0.9)	**2.1**(0.5)	**2.1**(2)	15/15
IPOP lia	**2.4**(3)	**2.3**(2)	**2.8**(1)	**2.2**(0.9)	**1.6**(2)	15/15
MLSL pal	5.1(6)	11(10)	44(47)	∞	∞ *1e5*	0/15
OQNLP pal	12(11)	17(13)	17(25)	160(160)	∞ *5509*	0/15
P-DCN tra	4.5(4)	10(13)	18(18)	337(314)	2376(6057)	14/15
P-zero tra	3.2(3)	24(35)	41(57)	916(1230)	1305(2876)	15/15
SMAC hut	**1.0**(1)	**0.82**(0.6)	**0.84**(0.7)	**1.2**(0.7)	**0.53**(0.3)	15/15
U-DCN tra	3.5(3)	4.3(3)	4.0(3)	2097(132)	2370(7386)	13/15
U-zero tra	**2.8**(2)	3.8(2)	3.5(4)	284(185)	1443(1438)	14/15
fmincon pa	4.4(5)	11(11)	41(35)	∞	∞ *1e5*	0/15
fminunc pa	5.1(6)	13(29)	25(26)	∞	∞ *1e5*	0/15
ga100 hol	4.1(4)	6.0(8)	9.0(7)	14(6)	13(17)	15/15
grid100 ho	10(3)	11(13)	23(25)	350(222)	395(410)	12/15
grid16 hol	4.4(8)	5.8(6)	8.9(9)	87(72)	218(373)	13/15
hill hol	3.9(4)	3.0(3)	**2.8**(2)	70(102)	320(495)	11/15
lmmCMA aug	**1.8**(2)	**1.6**(2)	**2.1**(1)	**1.1**(0.4)	**0.65**(1)	15/15
memPSODE v	4.2(4)	13(18)	42(44)	48(22)	18(13)	15/15
prcga saw	3.3(5)	3.7(3)	6.0(4)	12(7)	181(382)	12/15
ring100 ho	3.6(3)	8.7(11)	14(14)	36(13)	25(17)	15/15
ring16 hol	4.6(6)	5.9(5)	6.0(5)	14(12)	57(85)	15/15
simplex pa	4.5(5)	7.6(5)	20(8)	2927(3478)	∞ *1e5*	0/15

Table 81: 10-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*1.6e+4*:15	*1.0e+4*:22	*1.6e+3*:34	*2.5e+2*:103	*4.0e+0*:727	15/15
BIPOP-aCMA	3.4(2)	**2.8**(2)	5.3(2)	3.1(0.9)	3.2(0.7)	15/15
BIPOP-saAC	4.1(2)	3.4(2)	4.0(0.7)	**1.8**(0.4)	**1.3**(0.3)	15/15
CMAES hut	**2.8**(2)	**2.5**(2)	4.3(3)	**2.4**(1)	∞ *1002*	0/15
DE pal	6.7(4)	6.0(3)	14(3)	11(3)	30(1)	14/15
HCMA los	**1.5**(0.1)	**1.0**(0.0)	**0.82**(0.2)	**1.2**(2)	**1.8**(0.4)	15/15
HMLSL pal	**0.95**(0.8)	**0.89**(0.5)	**1.6**(0.9)	**1.1**(0.5)	**1.6**(2)	15/15
IPOP-10DDr	3.4(2)	**2.8**(2)	4.4(1)	**2.9**(1)	4.5(2)	15/15
IPOP-500 l	3.4(2)	**2.8**(2)	4.4(1)	**2.9**(1)	4.5(2)	15/15
IPOP-tany	**2.9**(1)	**2.4**(1)	4.0(1)	**2.5**(0.6)	4.0(2)	15/15
IPOP-texp	**1.6**(2)	**1.6**(2)	**2.8**(2)	**2.1**(0.9)	3.9(1)	15/15
IPOP lia	3.4(2)	**2.8**(2)	4.4(1)	**2.9**(1)	4.5(2)	15/15
MLSL pal	**0.95**(0.8)	**0.89**(0.5)	**1.6**(0.9)	**1.1**(0.5)	**0.97**(0.9)	15/15
OQNLP pal	**1.4**(1.0)	**1.1**(0.6)	**1.1**(0.2)	**0.61**(0.2)	**0.82**(0.7)	15/15
P-DCN tra	12(13)	12(10)	19(9)	10(4)	7035(1e4)	10/15
P-zero tra	10(11)	11(9)	16(11)	9.0(5)	2208(6900)	13/15
SMAC hut	**0.98**(0.8)	**0.95**(0.4)	**1.6**(0.8)	**1.7**(0.8)	∞ *1000*	0/15
U-DCN tra	5.7(2)	5.1(3)	10(4)	9.3(4)	246(325)	15/15
U-zero tra	4.8(2)	3.9(1)	6.1(3)	4.9(2)	1924(3420)	15/15
fmincon pa	**0.95**(0.8)	**0.89**(0.5)	**1.6**(0.9)	**1.1**(0.5)	**0.97**(1.0)	15/15
fminunc pa	**0.72**(0.8)	**0.65**(0.5)	**1.0**(0.3)	**0.72**(0.3)	**1.3**(0.3)	15/15
ga100 hol	14(18)	14(14)	29(12)	20(7)	4528(5492)	2/15
grid100 ho	20(20)	39(40)	83(46)	66(32)	606(725)	10/15
grid16 hol	8.4(5)	8.0(5)	17(7)	13(5)	675(770)	8/15
hill hol	5.5(2)	4.1(2)	4.9(2)	3.3(2)	60(11)	14/15
lmmCMA aug	**1.4**(1)	**1.4**(1)	**2.8**(1)	**1.7**(0.4)	**1.3**(0.4)	15/15
memPSODE v	5.3(0.9)	3.6(0.6)	**3.0**(0.5)	**1.6**(0.7)	**1.4**(2)	15/15
prcga saw	3.4(4)	5.6(6)	15(9)	11(3)	1411(1731)	8/15
ring100 ho	12(12)	20(15)	51(11)	41(5)	123(54)	14/15
ring16 hol	10(7)	8.8(5)	13(5)	8.3(2)	1633(1994)	5/15
simplex pa	10(11)	13(12)	43(24)	23(5)	96(79)	14/15

Table 82: 10-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*4.0e+1*:125	*2.5e+1*:148	*1.6e+1*:180	*1.0e+1*:200	*1.6e+0*:563	15/15
BIPOP-aCMA	4.0(2)	3.6(1)	3.3(1)	3.5(1)	6.2(2)	15/15
BIPOP-saAC	**2.5**(0.7)	**2.4**(0.6)	**2.1**(0.5)	**2.1**(0.7)	**2.3**(0.4)	15/15
CMAES hut	**2.8**(0.4)	**2.6**(0.5)	**2.5**(0.3)	**2.7**(0.5)	∞ *1002*	0/15
DE pal	20(6)	20(7)	18(9)	21(9)	201(90)	14/15
HCMA los	**2.8**(2)	**2.5**(2)	**2.3**(1)	**2.4**(0.7)	**2.4**(0.5)	15/15
HMLSL pal	**0.26**$(0)_{\downarrow 4}$	**0.41**$(0)_{\downarrow 4}$	**0.43**$(0.0)_{\downarrow 4}$	**0.49**(0.1)	**0.48**(0.1)	15/15
IPOP-10DDr	3.6(1)	3.3(0.9)	3.0(0.6)	3.4(0.8)	6.9(2)	15/15
IPOP-500 l	3.6(1)	3.3(0.9)	3.0(0.6)	3.4(0.8)	6.9(2)	15/15
IPOP-tany	**2.9**(0.9)	**2.8**(0.7)	**2.7**(0.7)	3.1(0.7)	6.7(1.0)	15/15
IPOP-texp	**1.9**(0.5)	**1.9**(0.3)	**1.9**(0.5)	**2.5**(0.6)	6.8(2)	15/15
IPOP lia	3.6(1)	3.3(0.9)	3.0(0.6)	3.4(0.8)	6.9(2)	15/15
MLSL pal	**0.26**$(0)_{\downarrow 4}$	**0.41**$(0)_{\downarrow 4}$	**0.43**$(0.0)_{\downarrow 4}$	**0.49**(0.1)	**0.48**(0.1)	15/15
OQNLP pal	**0.32**$(4e\text{-}3)_{\downarrow 4}$	**0.47**$(3e\text{-}3)_{\downarrow 4}$	**0.71**(0.0)	**0.86**(2e-3)	**0.38**(2e-3)	15/15
P-DCN tra	660(114)	556(96)	458(79)	413(72)	3745(9003)	13/15
P-zero tra	1766(14)	1487(12)	1224(10)	1102(9)	9819(2e4)	10/15
SMAC hut	4.9(2)	18(18)	41(44)	∞	∞ *1000*	0/15
U-DCN tra	7658(4496)	6471(3799)	5343(3131)	4836(2817)	9768(1e4)	11/15
U-zero tra	6588(5780)	5553(4875)	4571(4013)	4129(3619)	2.4e4(2e4)	9/15
fmincon pa	**0.26**$(0)_{\downarrow 4}$	**0.41**$(0)_{\downarrow 4}$	**0.43**$(0.0)_{\downarrow 4}$	**0.49**(0.1)	**0.48**(0.1)	15/15
fminunc pa	**0.27**$(0)_{\downarrow 4}$	**0.38**$(0)^{\star}_{\downarrow 4}$	**0.38**$(0)^{\star 2}_{\downarrow 4}$	**0.40**$(0.0)^{\star}_{\downarrow 4}$	**0.38**(0.0)	15/15
ga100 hol	58(35)	59(31)	60(35)	72(28)	∞ *5e5*	0/15
grid100 ho	217(201)	275(292)	316(264)	539(206)	∞ *5e5*	0/15
grid16 hol	1213(2013)	1028(1691)	852(1396)	788(1260)	∞ *5e5*	0/15
hill hol	330(155)	280(131)	232(108)	215(95)	5799(7107)	2/15
lmmCMA aug	**1.8**(0.5)	**1.8**(0.4)	**1.6**(0.4)	**1.6**(0.3)	**2.2**(0.8)	15/15
memPSODE v	**2.5**(0.6)	**2.2**(0.5)	**1.9**(0.5)	**1.8**(0.4)	4.7(6)	15/15
prcga saw	10(4)	14(4)	17(7)	20(8)	2367(2649)	8/15
ring100 ho	78(21)	83(20)	89(18)	133(25)	5969(6219)	2/15
ring16 hol	309(26)	265(24)	222(22)	210(17)	∞ *5e5*	0/15
simplex pa	5.4(4)	20(22)	31(33)	79(102)	463(458)	8/15

Table 83: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*2.5e+6*:6.0	*1.0e+6*:21	*4.0e+5*:38	*2.5e+4*:104	*6.3e+2*:512	15/15
BIPOP-aCMA	**2.6**(3)	**2.5**(2)	3.4(4)	5.5(2)	**2.8**(0.5)	15/15
BIPOP-saAC	3.4(3)	**1.8**(2)	**1.9**(1)	**2.9**(0.6)	**0.85**(0.1)	15/15
CMAES hut	3.5(3)	**1.9**(1)	**1.9**(3)	4.5(2)	∞ *1002*	0/15
DE pal	**1.8**(2)	**2.2**(2)	3.8(3)	20(14)	200(123)	15/15
HCMA los	**1.6**(2)	**0.84**(0.6)	**0.81**(0.3)	**2.3**(2)	**1.1**(0.1)	15/15
HMLSL pal	3.6(3)	**1.7**(1)	**1.7**(0.9)	**1.7**(0.6)	**0.60**(0.4)	15/15
IPOP-10DDr	**2.1**(3)	**1.7**(2)	**2.0**(0.8)	4.3(2)	3.3(0.9)	15/15
IPOP-500 l	**2.1**(3)	**1.7**(2)	**2.0**(0.8)	4.3(2)	3.3(0.9)	15/15
IPOP-tany	**1.2**(0.8)	**0.81**(0.6)	**1.2**(1.0)	4.6(2)	3.4(1)	15/15
IPOP-texp	3.4(3)	**1.6**(1)	**1.8**(2)	4.0(1)	3.4(0.9)	15/15
IPOP lia	**2.1**(3)	**1.7**(2)	**2.0**(0.8)	4.3(2)	3.3(0.9)	15/15
MLSL pal	3.6(3)	**1.7**(1)	**1.7**(0.9)	**1.7**(0.6)	**0.60**(0.4)	15/15
OQNLP pal	4.2(2)	**1.7**(0.4)	**1.2**(0.4)	**1.3**(0.7)	**0.65**(0.4)	15/15
P-DCN tra	**2.4**(2)	**1.3**(1)	**2.3**(3)	16(19)	1419(1337)	15/15
P-zero tra	**2.7**(4)	**2.6**(5)	5.3(9)	15(16)	1550(2460)	15/15
SMAC hut	**1.5**(2)	**1.1**(1.0)	**1.3**(1)	4.6(5)	∞ *1000*	0/15
U-DCN tra	**3.0**(3)	**1.5**(1)	**2.0**(2)	79(197)	3048(3590)	15/15
U-zero tra	**2.0**(2)	**1.1**(1)	**1.3**(1)	76(76)	6.0e4(7e4)	4/15
fmincon pa	3.6(3)	**1.7**(1)	**1.7**(0.9)	**1.6**(0.6)	**0.61**(0.3)	15/15
fminunc pa	3.3(3)	**1.4**(0.8)	**1.4**(0.9)	**1.8**(1)	**1.4**(0.5)	15/15
ga100 hol	**2.3**(3)	**2.7**(2)	4.0(4)	26(12)	3025(3420)	4/15
grid100 ho	**2.3**(2)	4.2(6)	7.5(6)	341(341)	1.4e4(2e4)	1/15
grid16 hol	3.9(5)	**2.2**(3)	5.8(9)	152(211)	∞ *5e5*	0/15
hill hol	4.3(5)	**2.0**(2)	3.3(5)	172(344)	1.5e4(2e4)	1/15
lmmCMA aug	**1.9**(2)	**0.79**(0.6)	**1.0**(0.7)	**1.8**(0.5)	**0.84**(0.2)	15/15
memPSODE v	3.4(3)	**2.3**(1)	**2.2**(0.9)	**2.9**(2)	4.5(7)	15/15
prcga saw	3.5(9)	3.7(7)	5.6(7)	14(10)	3188(3538)	7/15
ring100 ho	**2.2**(3)	**2.1**(1)	5.6(10)	38(14)	1931(2147)	6/15
ring16 hol	3.9(5)	**2.3**(3)	3.1(3)	20(18)	6450(7269)	2/15
simplex pa	29(34)	14(7)	12(6)	17(5)	7.9(3)	15/15

Table 84: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*4.0e+4*:6.4	*2.5e+3*:15	*6.3e+1*:217	*4.0e+1*:244	*2.5e+0*:675	15/15
BIPOP-aCMA	3.4(4)	4.0(2)	7.2(1.0)	6.9(0.6)	3.2(0.3)	15/15
BIPOP-saAC	3.1(3)	**3.0**(3)	**2.6**(0.3)	**2.4**(0.2)	**0.96**(0.1)	15/15
CMAES hut	**2.3**(2)	3.2(3)	66(77)	∞	∞ *1002*	0/15
DE pal	3.2(2)	3.5(4)	12(9)	30(23)	341(193)	11/15
HCMA los	**2.1**(2)	**1.8**(1.0)	3.3(0.4)	**3.0**(0.3)	**1.2**(0.1)	15/15
HMLSL pal	4.2(2)	**2.7**(0.8)	**0.24**(0.1)	**0.23**(0.0)	**0.13**(0.0)	15/15
IPOP-10DDr	**2.6**(3)	5.3(6)	10(5)	12(2)	5.8(0.7)	15/15
IPOP-500 l	**2.6**(3)	5.3(6)	10(5)	12(2)	5.8(0.7)	15/15
IPOP-tany	**2.6**(3)	4.5(4)	10(4)	11(3)	5.9(0.6)	15/15
IPOP-texp	3.4(4)	**2.7**(3)	8.9(6)	10(2)	4.9(0.6)	15/15
IPOP lia	**2.6**(3)	5.3(6)	10(5)	12(2)	5.8(0.7)	15/15
MLSL pal	4.2(2)	**2.7**(0.8)	**0.24**(0.1)	**0.23**(0.0)	**0.13**(0.0)	15/15
OQNLP pal	4.7(0.4)	**2.6**(2)	**0.52**(0.6)	**0.49**(0.5)	**0.53**(0.6)	15/15
P-DCN tra	4.2(4)	3.6(2)	298(265)	468(455)	716(679)	15/15
P-zero tra	3.1(3)	**2.5**(2)	345(404)	542(610)	1016(858)	15/15
SMAC hut	**1.8**(2)	**1.4**(1)	3.1(3)	28(31)	∞ *1000*	0/15
U-DCN tra	3.6(3)	3.4(2)	50(72)	142(201)	1482(1012)	15/15
U-zero tra	3.6(3)	3.6(2)	86(113)	189(214)	1801(1335)	15/15
fmincon pa	4.2(2)	**2.7**(0.8)	**0.24**(0.1)	**0.23**(0.0)	**0.13**(0.0)	15/15
fminunc pa	4.4(3)	**2.7**(1)	**0.35**(0.2)	**0.89**(0.5)	**0.97**(1)	15/15
ga100 hol	3.8(3)	6.8(8)	30(21)	64(68)	662(573)	11/15
grid100 ho	3.8(6)	8.1(8)	239(371)	2783(2827)	∞ *5e5*	0/15
grid16 hol	5.8(8)	6.0(4)	277(251)	488(262)	∞ *5e5*	0/15
hill hol	**3.0**(2)	**2.3**(1)	114(90)	168(126)	721(532)	11/15
lmmCMA aug	3.0(4)	**2.5**(2)	**2.9**(0.8)	**2.7**(0.6)	**1.2**(0.2)	15/15
memPSODE v	4.3(4)	3.2(2)	**0.53**(0.0)	**0.48**(0.0)	**0.21**(0.0)	15/15
prcga saw	**2.7**(2)	5.0(5)	23(4)	907(2050)	∞ *9e5*	0/15
ring100 ho	5.0(5)	7.1(6)	25(34)	124(138)	1383(1137)	7/15
ring16 hol	4.3(4)	5.4(4)	40(51)	106(106)	1500(1530)	6/15
simplex pa	23(4)	11(2)	3.1(5)	14(17)	2027(2141)	2/15

Table 85: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*4.0e+7*:15	*2.5e+7*:24	*1.6e+7*:34	*1.0e+6*:103	*1.0e+1*:515	15/15
BIPOP-aCMA	6.9(5)	5.8(3)	4.9(2)	3.4(0.6)	3.5(2)	15/15
BIPOP-saAC	4.1(2)	3.6(2)	3.2(1)	**1.9**(0.7)	**1.0**(0.4)	15/15
CMAES hut	3.4(2)	**2.8**(1)	3.1(1)	**2.7**(0.3)	5.7(5)	5/15
DE pal	4.8(4)	5.9(4)	8.9(4)	12(3)	116(67)	14/15
HCMA los	**2.9**(1)	**2.1**(0.8)	**1.9**(0.7)	**1.8**(2)	**1.3**(0.3)	15/15
HMLSL pal	**1.6**(1)	**1.4**(1)	**1.3**(1)	**1.3**(0.8)	**0.71**(0.3)	15/15
IPOP-10DDr	3.4(2)	3.5(1)	3.3(0.9)	**2.7**(0.6)	4.6(4)	15/15
IPOP-500 l	3.4(2)	3.5(1)	3.3(0.9)	**2.7**(0.6)	4.6(4)	15/15
IPOP-tany	**2.0**(1.0)	**2.2**(1)	**2.6**(1)	**2.7**(0.3)	3.1(2)	15/15
IPOP-texp	**2.8**(2)	**2.6**(2)	**2.5**(1)	**2.7**(0.6)	**2.5**(0.2)	15/15
IPOP lia	3.4(2)	3.5(1)	3.3(0.9)	**2.7**(0.6)	4.6(4)	15/15
MLSL pal	**1.6**(1)	**1.4**(1)	**1.3**(1)	**1.3**(0.8)	**0.71**(0.3)	15/15
OQNLP pal	**2.2**(0.7)	**1.6**(0.4)	**1.2**(0.3)	**0.61**(0.2)	**0.82**(0.6)	15/15
P-DCN tra	6.3(8)	9.4(9)	12(9)	11(4)	7077(9711)	11/15
P-zero tra	10(12)	12(14)	13(12)	10(4)	4862(9708)	12/15
SMAC hut	**2.5**(2)	6.8(11)	12(17)	141(156)	∞ *1000*	0/15
U-DCN tra	3.7(3)	3.6(3)	4.2(3)	10(5)	7172(9744)	11/15
U-zero tra	**3.0**(1)	**3.0**(1.0)	3.3(2)	4.8(2)	1.7e4(3e4)	8/15
fmincon pa	**1.6**(1)	**1.4**(1)	**1.3**(1)	**1.3**(0.8)	**0.72**(0.3)	15/15
fminunc pa	**1.9**(2)	**1.8**(2)	**1.5**(1)	**0.84**(0.6)	**0.40**(0.2)	15/15
ga100 hol	10(10)	14(8)	17(5)	23(4)	463(500)	13/15
grid100 ho	30(33)	56(50)	61(59)	75(18)	∞ *5e5*	0/15
grid16 hol	12(11)	12(8)	13(8)	15(5)	1078(1166)	9/15
hill hol	4.2(3)	3.1(2)	**2.7**(1)	**2.7**(1)	477(525)	12/15
lmmCMA aug	**1.3**(1)	**1.4**(1)	**2.0**(1)	**1.7**(0.4)	**0.86**(0.2)	15/15
memPSODE v	5.0(2)	4.2(2)	3.4(1)	**2.2**(1.0)	**2.6**(2)	15/15
prcga saw	3.2(4)	6.7(5)	9.3(5)	14(4)	249(512)	14/15
ring100 ho	15(16)	20(16)	28(10)	46(9)	507(142)	15/15
ring16 hol	6.2(5)	7.1(3)	7.2(4)	9.1(2)	331(491)	13/15
simplex pa	32(50)	35(37)	33(23)	23(3)	16(11)	15/15

Table 86: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*1.0e+3*:12	*6.3e+2*:32	*4.0e+2*:40	*6.3e+1*:154	*2.5e+0*:521	15/15
BIPOP-aCMA	6.9(4)	5.2(1)	5.8(2)	3.4(0.4)	3.4(2)	15/15
BIPOP-saAC	5.2(3)	3.4(1)	3.2(0.3)	**1.2**(0.2)	**0.75**(0.3)	15/15
CMAES hut	3.3(2)	3.7(2)	4.5(1)	**3.0**(0.3)	4.6(4)	6/15
DE pal	8.0(7)	11(4)	15(5)	19(4)	46(25)	15/15
HCMA los	**2.2**(0.6)	**0.99**(0.3)	**0.98**(0.3)	**0.95**(0.8)	**0.91**(0.1)	15/15
HMLSL pal	**1.8**(0.9)	**1.2**(1)	**1.9**(1)	**1.2**(0.1)	**0.73**(0.1)	15/15
IPOP-10DDr	4.3(3)	3.4(1)	4.4(0.8)	**2.9**(0.5)	3.8(4)	15/15
IPOP-500 l	4.3(3)	3.4(1)	4.4(0.8)	**2.9**(0.5)	3.8(4)	15/15
IPOP-tany	**3.0**(2)	**2.9**(2)	4.5(1)	3.1(0.3)	5.6(3)	15/15
IPOP-texp	**2.8**(2)	**2.8**(2)	4.0(1)	3.2(0.6)	5.0(4)	15/15
IPOP lia	4.3(3)	3.4(1)	4.4(0.8)	**2.9**(0.5)	3.8(4)	15/15
MLSL pal	**1.8**(0.9)	**1.2**(1)	**1.9**(1)	**1.2**(0.1)	**0.73**(0.1)	15/15
OQNLP pal	**2.3**(0.2)	**1.1**(0.3)	**1.4**(0.2)	**1.3**(0.1)	**0.70**(0.2)	15/15
P-DCN tra	5.1(3)	10(6)	16(5)	4659(3)	3.8e4(6e4)	5/15
P-zero tra	6.3(9)	10(8)	14(6)	4659(9)	5.3e4(8e4)	4/15
SMAC hut	**0.81**(0.7)	**0.68**(0.3)	**0.87**(0.3)	**0.71**(0.2)	∞ *1000*	0/15
U-DCN tra	4.2(3)	4.1(3)	9.2(5)	4714(45)	2.9e4(4e4)	6/15
U-zero tra	3.1(2)	3.2(2)	6.8(3)	4681(65)	7.7e4(9e4)	3/15
fmincon pa	**1.8**(0.9)	**1.2**(1)	**1.9**(1)	**1.2**(0.1)	**0.74**(0.1)	15/15
fminunc pa	**1.8**(0.9)	**1.0**(0)	**1.2**(0.3)	**0.80**(0.1)	**0.98**(0.1)	15/15
ga100 hol	7.7(9)	21(7)	31(7)	42(10)	1572(1920)	6/15
grid100 ho	24(30)	55(40)	92(48)	755(1597)	∞ *5e5*	0/15
grid16 hol	15(9)	14(8)	21(6)	69(57)	4165(4798)	3/15
hill hol	7.0(5)	4.3(2)	4.8(2)	11(7)	2106(2405)	5/15
lmmCMA aug	**1.6**(2)	**2.0**(1.0)	**2.8**(0.6)	**1.7**(0.2)	**1.2**(0.4)	15/15
memPSODE v	6.1(2)	3.1(0.5)	3.1(0.7)	**2.3**(0.1)	**1.6**(0.1)	15/15
prcga saw	6.9(6)	9.5(6)	19(7)	22(10)	2911(3531)	6/15
ring100 ho	20(21)	32(12)	57(24)	98(21)	601(544)	12/15
ring16 hol	10(7)	10(4)	15(6)	24(12)	1554(1921)	6/15
simplex pa	26(33)	37(25)	42(23)	23(14)	40(43)	15/15

Table 87: 10-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*4.0e+1*:7.7	*1.6e+1*:27	*1.0e+1*:37	*6.3e-1*:107	*1.0e-4*:505	15/15
BIPOP-aCMA	**1.2**(1)	**2.9**(1)	3.8(2)	3.5(0.8)	3.8(0.5)	15/15
BIPOP-saAC	**1.7**(2)	**1.4**(0.7)	**2.0**(2)	**2.3**(0.4)	**1.7**(0.3)	15/15
CMAES hut	**1.4**(1)	**1.7**(2)	**2.2**(2)	**2.7**(0.7)	∞ *1002*	0/15
DE pal	**1.2**(1)	3.2(2)	4.7(3)	14(3)	295(213)	13/15
HCMA los	**2.4**(2)	**1.1**(0.3)	**1.1**(0.5)	**2.3**(2)	**2.1**(0.5)	15/15
HMLSL pal	**1.1**(1)	**0.57**(0.2)	**0.60**(0.3)	**0.55**(0.1)	**0.63**(0.1)	15/15
IPOP-10DDr	**1.1**(1)	**1.8**(1)	**2.5**(2)	3.1(0.7)	5.1(0.5)	15/15
IPOP-500 l	**1.1**(1)	**1.8**(1)	**2.5**(2)	3.1(0.7)	5.1(0.5)	15/15
IPOP-tany	**0.88**(1.0)	**1.3**(0.7)	**1.7**(0.9)	**2.9**(0.5)	5.1(0.5)	15/15
IPOP-texp	**0.62**(0.8)	**0.82**(1)	**1.3**(1)	**2.8**(0.6)	4.8(0.6)	15/15
IPOP lia	**1.1**(1)	**1.8**(1)	**2.5**(2)	3.1(0.7)	5.1(0.5)	15/15
MLSL pal	**1.1**(1)	**0.57**(0.2)	**0.60**(0.3)	**0.55**(0.1)	**0.63**(0.1)	15/15
OQNLP pal	**1.7**(2)	**1.1**(0.4)	**1.00**(0.3)	**0.83**(0.1)	**0.89**(0.6)	15/15
P-DCN tra	**1.4**(1)	3.6(3)	6.9(7)	14(5)	5241(1972)	15/15
P-zero tra	**1.4**(2)	3.1(3)	7.5(6)	13(6)	∞ *1e7*	0/15
SMAC hut	**0.41**(0.5)	**0.61**(0.8)	**1.4**(2)	140(158)	∞ *1000*	0/15
U-DCN tra	**1.7**(2)	**2.2**(2)	**2.9**(1)	14(4)	2.4e4(2e4)	9/15
U-zero tra	**1.4**(2)	**1.8**(1)	**2.5**(2)	7.2(2)	∞ *1e7*	0/15
fmincon pa	**1.1**(1)	**0.57**(0.2)	**0.60**(0.3)	**0.55**(0.1)	**0.63**(0.1)	15/15
fminunc pa	**0.79**(0.7)	**0.60**(0.2)	**0.68**(0.4)	**1.1**(0.6)	**0.86**(0.2)	15/15
ga100 hol	**1.0**(1)	**2.6**(3)	9.5(6)	25(3)	∞ *5e5*	0/15
grid100 ho	**1.8**(2)	6.3(7)	23(28)	94(38)	∞ *5e5*	0/15
grid16 hol	**1.3**(0.8)	3.9(3)	5.6(4)	16(6)	∞ *5e5*	0/15
hill hol	3.5(4)	**2.4**(1)	**2.7**(1)	3.8(2)	∞ *5e5*	0/15
lmmCMA aug	**0.77**(2)	**0.62**(0.8)	**0.93**(0.9)	**1.9**(0.3)	**1.9**(0.2)	15/15
memPSODE v	**2.2**(2)	**2.5**(1)	**2.6**(0.7)	**1.4**(0.2)	**0.66**(0.1)	15/15
prcga saw	**0.73**(0.9)	**1.7**(1)	4.4(4)	16(5)	∞ *1e6*	0/15
ring100 ho	**1.0**(0.7)	4.6(7)	13(15)	62(15)	∞ *5e5*	0/15
ring16 hol	**1.6**(2)	3.4(4)	5.3(4)	12(2)	∞ *5e5*	0/15
simplex pa	8.1(10)	11(13)	20(24)	36(27)	∞ *2e5*	0/15

Table 88: 10-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*2.5e+2*:9.0	*1.6e+2*:72	*1.0e+2*:186	*6.3e+1*:450	*4.0e+1*:872	15/15
BIPOP-aCMA	6.3(5)	**2.0**(1)	**1.3**(0.3)	**0.97**(0.3)	**1.3**(0.5)	15/15
BIPOP-saAC	4.6(3)	**1.3**(0.5)	**0.99**(0.4)	**0.88**(0.6)	**1.0**(0.3)	15/15
CMAES hut	5.1(6)	**1.4**(0.5)	**1.2**(0.6)	**1.0**(0.4)	3.2(3)	5/15
DE pal	9.1(9)	3.6(2)	4.1(2)	5.0(2)	17(14)	15/15
HCMA los	**2.7**(0.6)	**0.70**(0.4)	**0.68**(0.8)	**1.1**(1)	**1.3**(0.8)	15/15
HMLSL pal	18(30)	9.2(8)	7.7(2)	5.8(1)	3.7(0.1)	15/15
IPOP-10DDr	4.3(4)	**1.3**(0.6)	**1.0**(0.2)	**0.95**(0.5)	**1.4**(0.6)	15/15
IPOP-500 l	4.3(4)	**1.3**(0.6)	**1.0**(0.2)	**0.95**(0.5)	**1.4**(0.6)	15/15
IPOP-tany	**2.9**(2)	**0.83**(0.6)	**0.96**(0.2)	**0.85**(0.4)	**1.3**(0.6)	15/15
IPOP-texp	**3.2**(3)	**1.00**(0.7)	**0.89**(0.3)	**1.1**(0.4)	**1.2**(0.3)	15/15
IPOP lia	4.3(4)	**1.3**(0.6)	**1.0**(0.2)	**0.95**(0.5)	**1.4**(0.6)	15/15
MLSL pal	17(25)	8.5(7)	9.0(8)	23(27)	52(35)	14/15
OQNLP pal	35(39)	18(31)	43(61)	49(53)	49(55)	12/15
P-DCN tra	6.8(4)	3.5e4(7e4)	1.5e5(2e5)	3.1e5(3e5)	1.6e5(2e5)	1/15
P-zero tra	1.5e5(5e5)	1.6e5(2e5)	1.5e5(2e5)	1.4e5(2e5)	∞ *1e7*	0/15
SMAC hut	**1.2**(1)	**0.57**(0.4)	**1.5**(1)	5.7(6)	∞ *1000*	0/15
U-DCN tra	5.0(3)	**1.9**(0.8)	**2.9**(3)	390(665)	2411(5736)	13/15
U-zero tra	4.7(3)	**1.3**(0.8)	3.8(2)	644(1097)	7624(9873)	10/15
fmincon pa	19(33)	7.8(7)	6.2(3)	18(24)	56(32)	15/15
fminunc pa	30(37)	11(7)	16(29)	29(33)	65(46)	15/15
ga100 hol	11(9)	6.6(5)	6.3(1)	6.7(2)	11(6)	15/15
grid100 ho	14(20)	16(17)	20(11)	103(73)	365(581)	10/15
grid16 hol	14(13)	6.7(5)	7.9(7)	109(129)	553(599)	8/15
hill hol	9.1(5)	**2.8**(2)	30(8)	298(561)	1304(1471)	5/15
lmmCMA aug	**2.0**(2)	**0.76**(0.5)	**0.68**(0.2)	**0.66**(0.4)	**0.65**(0.2)*	15/15
memPSODE v	29(17)	33(50)	28(26)	22(14)	15(8)	15/15
prcga saw	5.9(8)	4.1(2)	4.1(1)	4.0(2)	5.2(1)	15/15
ring100 ho	12(18)	10(6)	11(4)	13(5)	19(9)	15/15
ring16 hol	11(11)	3.7(2)	4.1(3)	5.8(4)	151(290)	12/15
simplex pa	104(85)	23(10)	112(182)	223(121)	327(276)	9/15

Table 89: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*4.0e+1*:12	*2.5e+1*:47	*1.6e+1*:88	*1.0e+1*:425	*4.0e+0*:989	15/15
BIPOP-aCMA	**2.0**(2)	5.0(6)	10(3)	**2.8**(1)	**2.5**(3)	15/15
BIPOP-saAC	**2.9**(3)	4.4(6)	9.5(7)	**2.6**(2)	**2.2**(2)	15/15
CMAES hut	**1.3**(0.9)	7.2(6)	11(9)	3.7(3)	**2.3**(2)	6/15
DE pal	**2.0**(2)	**2.5**(3)	23(24)	33(32)	337(311)	7/15
HCMA los	3.1(4)	**2.1**(3)	6.4(7)	**2.6**(1)	**2.2**(2)	15/15
HMLSL pal	7.1(9)	9.2(12)	29(20)	16(9)	317(363)	7/15
IPOP-10DDr	**1.3**(1)	3.1(4)	7.0(4)	**1.8**(0.7)	**1.0**(0.3)	15/15
IPOP-500 l	**1.3**(1)	3.1(4)	7.0(4)	**1.8**(0.7)	**1.0**(0.3)	15/15
IPOP-tany	**1.4**(1)	**1.5**(1)	6.8(4)	**2.1**(0.7)	**1.2**(0.4)	15/15
IPOP-texp	**1.8**(2)	**1.3**(1)	**3.3**(4)	**1.4**(1)	**0.91**(0.5)	15/15
IPOP lia	**1.3**(1)	3.1(4)	7.0(4)	**1.8**(0.7)	**1.0**(0.3)	15/15
MLSL pal	7.1(9)	10(12)	21(20)	32(33)	368(362)	7/15
OQNLP pal	37(29)	19(5)	47(54)	58(43)	247(266)	4/15
P-DCN tra	**1.8**(2)	**1.3**(0.9)	**2.4**(2)	**1.0**(0.8)	5769(1e4)	10/15
P-zero tra	**1.6**(2)	**1.3**(1)	**2.6**(2)	5896(1e4)	2.9e4(4e4)	4/15
SMAC hut	**1.7**(1)	**1.2**(1)	**1.7**(2)	**1.2**(1)	15(15)	1/15
U-DCN tra	**1.4**(1)	**2.8**(3)	6.4(3)	4.7(3)	1629(3933)	14/15
U-zero tra	**1.4**(2)	**2.3**(1)	5.6(6)	4.9(7)	2487(5065)	13/15
fmincon pa	15(24)	13(11)	15(12)	17(15)	399(432)	6/15
fminunc pa	70(58)	28(8)	144(282)	294(198)	∞ *2e5*	0/15
ga100 hol	**1**(0.9)	3.5(3)	15(13)	14(9)	12(6)	15/15
grid100 ho	**1.2**(1)	**2.9**(4)	12(12)	13(10)	219(291)	12/15
grid16 hol	**2.0**(2)	3.0(2)	8.6(5)	13(11)	262(453)	11/15
hill hol	**2.9**(3)	**2.2**(2)	**3.6**(3)	52(168)	530(760)	8/15
lmmCMA aug	**1.5**(1)	3.9(4)	5.2(4)	**1.3**(0.8)	**2.0**(2)	14/15
memPSODE v	**1.2**(1)	**1.1**(0.9)	11(22)	7.6(12)	18(17)	15/15
prcga saw	**1.2**(2)	3.9(4)	18(15)	10(7)	169(506)	13/15
ring100 ho	**1.7**(2)	3.7(4)	13(12)	8.5(4)	18(10)	15/15
ring16 hol	**1.3**(2)	3.3(2)	7.1(6)	4.0(3)	63(67)	14/15
simplex pa	106(62)	33(4)	22(3)	9.0(5)	80(71)	15/15

Table 90: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*1.0e+1*:26	*6.3e+0*:85	*4.0e+0*:155	*2.5e+0*:238	*6.3e-1*:585	15/15
BIPOP-aCMA	**2.4**(3)	**1.7**(0.5)	**1.4**(0.4)	**1.3**(0.2)	**1.1**(0.4)	15/15
BIPOP-saAC	**2.8**(2)	**1.5**(0.8)	**1.4**(0.5)	**1.4**(0.6)	**1.1**(0.3)	15/15
CMAES hut	**2.2**(2)	**1.3**(0.7)	**1.2**(0.6)	**1.1**(0.5)	**1.0**(0.4)	14/15
DE pal	**2.9**(3)	**2.8**(2)	4.1(3)	5.0(1)	7.2(2)	15/15
HCMA los	**2.2**(2)	**1.7**(2)	**2.0**(1)	**1.9**(0.6)	**1.3**(0.6)	15/15
HMLSL pal	18(17)	12(12)	10(9)	12(6)	11(5)	15/15
IPOP-10DDr	**1.5**(1.0)	**1.3**(0.5)	**1.1**(0.3)	**1.0**(0.4)	**0.99**(0.3)	15/15
IPOP-500 l	**1.5**(1.0)	**1.3**(0.5)	**1.1**(0.3)	**1.0**(0.4)	**0.99**(0.3)	15/15
IPOP-tany	**1.6**(1)	**1.1**(0.7)	**1.2**(0.3)	**1.2**(0.4)	**1.0**(0.3)	15/15
IPOP-texp	**1.8**(1)	**1.3**(0.6)	**1.1**(0.7)	**1.1**(0.3)	**1.1**(0.4)	15/15
IPOP lia	**1.5**(1.0)	**1.3**(0.5)	**1.1**(0.3)	**1.0**(0.4)	**0.99**(0.3)	15/15
MLSL pal	17(19)	12(11)	28(52)	267(241)	∞ *2e5*	0/15
OQNLP pal	10(14)	32(42)	82(131)	351(370)	∞ *1e5*	0/15
P-DCN tra	**1.6**(1)	**1.6**(1)	2.4e4(3e4)	2.9e5(3e5)	∞ *1e7*	0/15
P-zero tra	**1.7**(0.9)	8657(1162)	1.3e5(2e5)	2.7e5(3e5)	∞ *1e7*	0/15
SMAC hut	**0.79**(1)	**2.6**(2)	4.6(4)	5.2(5)	∞ *1000*	0/15
U-DCN tra	**1.9**(1)	**1.9**(1)	18(5)	3044(208)	2.0e4(3e4)	7/15
U-zero tra	**1.5**(0.8)	**2.2**(1)	76(41)	2158(2563)	7.1e4(8e4)	3/15
fmincon pa	19(21)	15(14)	87(125)	294(266)	∞ *2e5*	0/15
fminunc pa	14(21)	13(10)	39(72)	239(295)	∞ *2e5*	0/15
ga100 hol	4.4(4)	6.3(5)	7.4(3)	7.0(2)	11(6)	15/15
grid100 ho	4.0(5)	11(7)	192(527)	556(773)	1.3e4(1e4)	1/15
grid16 hol	3.2(3)	9.4(7)	136(200)	448(1050)	1543(1846)	6/15
hill hol	31(21)	171(473)	210(553)	689(1056)	∞ *5e5*	0/15
lmmCMA aug	**0.63**(0.7)	**0.61**(0.6)	**0.76**(0.5)	**0.78**(0.3)	**1.0**(0.3)	15/15
memPSODE v	24(50)	60(52)	69(31)	79(52)	116(101)	15/15
prcga saw	**2.2**(2)	3.0(2)	4.2(3)	4.6(2)	11(4)	15/15
ring100 ho	6.2(7)	8.9(6)	12(6)	17(8)	57(23)	15/15
ring16 hol	3.1(3)	3.4(2)	5.5(4)	6.9(4)	771(894)	8/15
simplex pa	33(29)	20(8)	204(447)	1283(1137)	∞ *2e5*	0/15

Table 91: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*4.0e+1*:11	*2.5e+1*:56	*1.6e+1*:172	*1.6e+1*:172	*2.5e+0*:561	15/15
BIPOP-aCMA	5.9(5)	**2.6**(0.8)	**1.3**(0.4)	**1.3**(0.4)	**1.1**(0.2)	15/15
BIPOP-saAC	4.1(4)	**1.6**(1.0)	**0.99**(0.4)	**0.99**(0.4)	**2.6**(6)	15/15
CMAES hut	4.2(3)	**1.8**(2)	**1.1**(1.0)	**1.1**(1.0)	**1.2**(0.4)	14/15
DE pal	10(8)	4.4(2)	3.4(2)	3.4(2)	9.2(4)	15/15
HCMA los	3.8(3)	**2.5**(2)	**1.6**(1)	**1.6**(1)	**2.6**(0.5)	15/15
HMLSL pal	20(41)	16(16)	10(7)	10(7)	18(9)	15/15
IPOP-10DDr	3.7(2)	**1.6**(0.7)	**1.0**(0.2)	**1.0**(0.2)	**0.89**(0.2)	15/15
IPOP-500 l	3.7(2)	**1.6**(0.7)	**1.0**(0.2)	**1.0**(0.2)	**0.89**(0.2)	15/15
IPOP-tany	**2.7**(1)	**1.5**(0.5)	**0.99**(0.4)	**0.99**(0.4)	**1.7**(0.3)	15/15
IPOP-texp	3.9(3)	**1.8**(1.0)	**0.96**(0.6)	**0.96**(0.6)	**2.5**(1)	15/15
IPOP lia	3.7(2)	**1.6**(0.7)	**1.0**(0.2)	**1.0**(0.2)	**0.89**(0.2)	15/15
MLSL pal	16(35)	35(31)	37(46)	37(46)	∞ *2e5*	0/15
OQNLP pal	27(31)	31(44)	80(77)	80(77)	1430(1463)	2/15
P-DCN tra	**2.3**(2)	**2.4**(2)	3.0e4(3e4)	3.0e4(6e4)	2.5e5(3e5)	1/15
P-zero tra	3.9(3)	3.9e4(9e4)	7.2e4(9e4)	7.2e4(1e5)	∞ *1e7*	0/15
SMAC hut	**1.5**(2)	**1.2**(1)	**2.5**(3)	**2.5**(3)	∞ *1000*	0/15
U-DCN tra	**2.3**(2)	**2.2**(2)	3.9(5)	3.9(5)	5.1e4(6e4)	4/15
U-zero tra	3.4(3)	**2.1**(1)	57(170)	57(170)	2.2e4(3e4)	7/15
fmincon pa	18(38)	14(14)	18(6)	18(6)	∞ *2e5*	0/15
fminunc pa	36(59)	18(20)	46(87)	46(87)	∞ *2e5*	0/15
ga100 hol	7.5(7)	5.5(4)	4.9(2)	4.9(2)	19(8)	15/15
grid100 ho	12(18)	17(10)	21(14)	21(14)	2953(3124)	4/15
grid16 hol	8.8(8)	7.4(7)	100(29)	100(29)	2678(3117)	4/15
hill hol	121(54)	348(756)	196(269)	196(269)	2656(3117)	4/15
lmmCMA aug	**1.5**(2)	**0.75**(0.7)	**0.63**(0.3)	**0.63**(0.3)	**0.65**(0.2)*	15/15
memPSODE v	92(212)	88(84)	64(33)	64(33)	260(80)	15/15
prcga saw	3.1(3)	3.2(3)	3.2(2)	3.2(2)	26(5)	15/15
ring100 ho	9.1(11)	12(9)	10(4)	10(4)	58(49)	15/15
ring16 hol	5.8(7)	4.7(3)	**2.9**(2)	**2.9**(2)	389(575)	11/15
simplex pa	84(86)	32(31)	196(274)	196(274)	∞ *2e5*	0/15

Table 92: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:618	*1.0e-1*:10609	*6.3e-2*:10623	*4.0e-2*:10625	*2.5e-2*:10644	15/15
BIPOP-aCMA	64(71)	7.5(7)	19(13)	31(43)	54(62)	15/15
BIPOP-saAC	87(80)	8.2(7)	13(8)	21(18)	43(41)	15/15
CMAES hut	∞	∞	∞	∞	∞ *1002*	0/15
DE pal	∞	∞	∞	∞	∞ *2e5*	0/15
HCMA los	51(27)	7.9(6)	12(9)	25(22)	47(32)	15/15
HMLSL pal	**0.09**(0.0)↓	**7.7e-3**(5e-5)↓4	**7.6e-3**(5e-5)↓4	**9.8e-3**(8e-4)↓4	**0.01**(2e-3)↓4	15/15
IPOP-10DDr	974(1315)	67(86)	71(82)	84(79)	152(122)	15/15
IPOP-500 l	974(1315)	67(86)	71(82)	83(79)	135(71)	15/15
IPOP-tany	549(681)	34(39)	51(52)	78(60)	97(59)	15/15
IPOP-texp	196(303)	19(19)	26(20)	70(90)	91(114)	15/15
IPOP lia	974(1315)	67(86)	71(82)	82(79)	110(71)	15/15
MLSL pal	**0.09**(0.0)↓	**7.7e-3**(5e-5)↓4	**7.6e-3**(5e-5)↓4	**9.8e-3**(8e-4)↓4	**0.01**(2e-3)↓4	15/15
OQNLP pal	**0.06**(8e-4)$^{\star 4}_{\downarrow}$	**4.8e-3**(5e-5)$^{\star 4}_{\downarrow 4}$	**6.0e-3**(5e-5)$^{\star 4}_{\downarrow 4}$	**7.5e-3**(5e-5)$^{\star 4}_{\downarrow 4}$	**7.4e-3**(5e-5)$^{\star 4}_{\downarrow 4}$	15/15
P-DCN tra	∞	∞	∞	∞	∞ *1e7*	0/15
P-zero tra	∞	∞	∞	∞	∞ *1e7*	0/15
SMAC hut	∞	∞	∞	∞	∞ *1000*	0/15
U-DCN tra	∞	∞	∞	∞	∞ *1e7*	0/15
U-zero tra	∞	∞	∞	∞	∞ *1e7*	0/15
fmincon pa	**0.09**(0.0)↓	**7.7e-3**(5e-5)↓4	**7.6e-3**(5e-5)↓4	**9.8e-3**(8e-4)↓4	**0.01**(2e-3)↓4	15/15
fminunc pa	**0.12**(0.0)↓	**8.0e-3**(1e-3)↓4	**9.1e-3**(1e-3)↓4	**9.1e-3**(1e-3)↓4	**0.01**(1e-3)↓4	15/15
ga100 hol	∞	∞	∞	∞	∞ *5e5*	0/15
grid100 ho	∞	∞	∞	∞	∞ *5e5*	0/15
grid16 hol	∞	∞	∞	∞	∞ *5e5*	0/15
hill hol	∞	∞	∞	∞	∞ *5e5*	0/15
lmmCMA aug	∞	∞	∞	∞	∞ *4805*	0/15
memPSODE v	386(295)	36(24)	79(56)	220(237)	482(490)	9/15
prcga saw	7.9(2)	**0.61**(0.2)	**0.99**(0.5)	**1.9**(2)	5.0(5)	15/15
ring100 ho	∞	∞	∞	∞	∞ *5e5*	0/15
ring16 hol	∞	∞	∞	∞	∞ *5e5*	0/15
simplex pa	**0.18**(0.1)↓	**0.02**(6e-3)↓4	**0.02**(0.0)↓4	**0.03**(0.0)↓4	**0.04**(0.0)↓4	15/15

Table 93: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*1.0e+4*:17	*6.3e+3*:21	*6.3e+1*:30	*2.5e+0*:122	*1.0e+0*:15426	13/15
BIPOP-aCMA	4.4(2)	3.8(1)	7.7(2)	6.3(2)	**3.0**(2)	15/15
BIPOP-saAC	**2.3**(2)	**2.3**(1)	4.1(0.8)	4.8(2)	**1.0**(0.9)	15/15
CMAES hut	**2.0**(2)	**2.5**(2)	4.9(2)	6.1(4)	**0.97**(1)	1/15
DE pal	3.2(4)	5.3(3)	16(7)	15(3)	**0.75**(0.4)	15/15
HCMA los	**1.3**(0)	**1.1**(0)	**0.90**(0.2)	**2.5**(3)	**0.87**(0.4)	15/15
HMLSL pal	**0.77**(0)$_\downarrow$	**0.63**(0)$_\downarrow$	**1.7**(0)	**1.1**(0)	**0.57**(0.4)	15/15
IPOP-10DDr	**2.7**(0.6)	3.4(1)	5.9(1)	5.7(2)	3.0(2)	15/15
IPOP-500 l	**2.7**(0.6)	3.4(1)	5.9(1)	5.7(2)	3.0(2)	15/15
IPOP-tany	**1.7**(0.9)	**2.1**(0.5)	5.3(2)	8.6(3)	3.6(2)	15/15
IPOP-texp	**0.36**(0.2)$_\downarrow$	**0.45**(0.3)$_\downarrow$	**1.8**(2)	12(18)	4.9(4)	15/15
IPOP lia	**2.7**(0.6)	3.4(1)	5.9(1)	5.7(2)	3.0(2)	15/15
MLSL pal	**0.77**(0)$_\downarrow$	**0.63**(0)$_\downarrow$	**1.7**(0)	**1.1**(0)	**1.3**(1)	15/15
OQNLP pal	**1.4**(0)	**1.3**(0)	**0.95**(0)	**1.4**(0)	8.7(9)	4/15
P-DCN tra	5.6(7)	7.0(8)	18(11)	6.4(3)	15(21)	15/15
P-zero tra	7.1(11)	9.0(11)	21(9)	6.7(3)	25(43)	15/15
SMAC hut	**0.27**(0.1)$_\downarrow$	**0.33**(0.1)$_{\downarrow 2}$	**1.1**(0.5)	∞	∞ *1000*	0/15
U-DCN tra	3.1(3)	3.4(2)	12(11)	8.0(5)	**1.4**(2)	15/15
U-zero tra	**2.9**(2)	3.4(2)	9.2(6)	5.0(2)	**1.1**(2)	15/15
fmincon pa	**0.77**(0)$_\downarrow$	**0.63**(0)$_\downarrow$	**1.7**(0)	**1.1**(0)	**1.1**(1)	15/15
fminunc pa	**0.71**(0)$_\downarrow$	**0.58**(0)$_{\downarrow 2}$	**0.75**(0)	6.2(0.1)	**0.87**(0.9)	15/15
ga100 hol	4.5(6)	8.5(10)	34(9)	19(4)	**0.55**(0.2)	15/15
grid100 ho	10(9)	24(24)	106(58)	62(22)	3.9(4)	15/15
grid16 hol	5.1(5)	6.7(7)	23(12)	13(5)	**0.50**(0.5)	15/15
hill hol	4.3(5)	4.3(5)	5.1(3)	**2.7**(1)	**0.22**(0.1)	15/15
lmmCMA aug	**0.80**(0.6)	**1.0**(0.9)	3.1(0.6)	6.5(2)	∞ *4817*	0/15
memPSODE v	4.8(2)	4.7(0.6)	3.8(0.4)	3.9(0.8)	**1.1**(0.8)	15/15
prcga saw	**1.1**(1)	**2.5**(3)	11(4)	17(7)	14(27)	14/15
ring100 ho	4.8(7)	15(11)	58(15)	40(9)	**0.92**(0.3)	15/15
ring16 hol	5.1(4)	5.9(4)	16(5)	7.5(2)	**0.25**(0.1)	15/15
simplex pa	5.3(0.3)	6.7(0.2)	15(5)	20(6)	4.1(5)	14/15

Table 94: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*4.0e+1*:30	*2.5e+1*:46	*1.6e+1*:56	*1.0e+1*:130	*6.3e+0*:639	15/15
BIPOP-aCMA	3.6(2)	3.8(2)	11(25)	11(12)	**2.7**(5)	15/15
BIPOP-saAC	**2.5**(1)	**2.2**(1)	4.2(3)	**2.6**(4)	**0.89**(1)	15/15
CMAES hut	3.8(2)	6.9(11)	6.2(9)	3.7(4)	**1.2**(1)	10/15
DE pal	6.8(5)	11(8)	27(16)	16(10)	7.2(7)	15/15
HCMA los	**1.1**(0.2)	**1.3**(0.8)	**3.1**(2)	**1.8**(1)	**0.55**(1)	15/15
HMLSL pal	**2.9**(1)	3.6(10)	7.6(17)	6.8(11)	**2.0**(2)	15/15
IPOP-10DDr	5.2(1)	4.6(0.8)	4.3(1)	3.5(0.9)	**1.4**(2)	15/15
IPOP-500 l	5.2(1)	4.6(0.8)	4.3(1)	3.5(0.9)	**1.4**(2)	15/15
IPOP-tany	3.1(2)	**2.8**(2)	**3.4**(1)	7.5(11)	**1.6**(2)	15/15
IPOP-texp	**2.4**(2)	5.4(2)	5.3(3)	4.0(11)	**2.7**(2)	15/15
IPOP lia	5.2(1)	4.6(0.8)	4.3(1)	3.5(0.9)	**1.4**(2)	15/15
MLSL pal	3.0(1)	3.3(8)	3.8(7)	**2.7**(4)	**0.72**(0.8)	15/15
OQNLP pal	**3.0**(7)	**2.9**(5)	**3.5**(4)	3.3(6)	**0.78**(1)	15/15
P-DCN tra	6.9(7)	3.4e4(1e5)	4.4e4(9e4)	2.8e4(4e4)	2.3e4(3e4)	6/15
P-zero tra	2.4e4(12)	5.5e4(1e5)	6.5e4(9e4)	5.1e4(8e4)	2.3e4(3e4)	6/15
SMAC hut	**1.7**(0.8)	**2.0**(2)	**3.2**(2)	**2.8**(4)	**0.99**(2)	10/15
U-DCN tra	5.8(4)	6.7(4)	10(4)	10(3)	323(346)	15/15
U-zero tra	3.1(1.0)	323(2)	265(3)	5612(843)	5900(7991)	11/15
fmincon pa	**1.7**(1)	**3.0**(8)	3.6(7)	**2.4**(3)	**0.87**(1)	15/15
fminunc pa	4.2(8)	4.8(9)	6.4(8)	3.7(4)	**0.97**(1.0)	15/15
ga100 hol	7.7(8)	17(8)	24(9)	17(5)	59(3)	14/15
grid100 ho	12(11)	28(22)	713(195)	333(108)	212(393)	12/15
grid16 hol	6.4(5)	10(7)	652(18)	301(72)	291(400)	11/15
hill hol	871(4)	573(13)	2989(4445)	1762(1933)	1206(1564)	6/15
lmmCMA aug	**2.1**(1)	**2.1**(1)	**2.5**(0.9)	3.2(3)	**1.5**(2)	15/15
memPSODE v	3.1(0.6)	**2.6**(0.6)	16(21)	27(26)	13(28)	15/15
prcga saw	6.0(6)	10(7)	18(13)	635(545)	260(782)	13/15
ring100 ho	15(18)	22(15)	33(12)	20(5)	5.9(1)	15/15
ring16 hol	6.4(4)	7.7(4)	10(3)	5.4(2)	**1.9**(0.8)	15/15
simplex pa	32(29)	26(20)	28(15)	14(7)	3.8(2)	15/15

Table 95: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*6.3e+1*:18	*4.0e+1*:30	*4.0e+1*:30	*6.3e+0*:155	*4.0e+0*:631	14/15
BIPOP-aCMA	6.2(4)	12(4)	12(4)	36(49)	14(16)	15/15
BIPOP-saAC	7.3(2)	6.7(2)	6.7(2)	15(17)	4.7(6)	15/15
CMAES hut	3.5(3)	**3.4**(3)	**3.4**(3)	7.3(10)	**2.2**(3)	7/15
DE pal	8.2(6)	12(8)	12(8)	223(648)	123(163)	11/15
HCMA los	**1.9**(0.3)	**4.1**(1.0)	**4.1**(1.0)	18(14)	5.5(4)	15/15
HMLSL pal	**1.1**(0.7)	5.5(17)	5.5(17)	13(12)	3.7(3)	15/15
IPOP-10DDr	4.6(5)	10(3)	10(3)	313(347)	78(85)	15/15
IPOP-500 l	4.6(5)	10(3)	10(3)	350(917)	101(225)	15/15
IPOP-tany	3.5(2)	4.8(4)	4.8(4)	213(536)	89(166)	15/15
IPOP-texp	3.2(3)	9.0(3)	9.0(3)	75(234)	19(58)	15/15
IPOP lia	4.6(5)	10(3)	10(3)	2723(2177)	1231(562)	14/15
MLSL pal	**1.1**(0.7)	**3.8**(8)	**3.8**(8)	**4.3**(5)	**1.2**(1)	15/15
OQNLP pal	**1.8**(0.4)	**3.3**(5)	**3.3**(5)	**3.0**(4)	**1.5**(2)	15/15
P-DCN tra	10(12)	2.4e4(13)	2.4e4(13)	9.7e4(1e5)	3.2e4(4e4)	5/15
P-zero tra	9.4(9)	13(18)	13(18)	4.3e4(6e4)	1.8e4(2e4)	7/15
SMAC hut	**2.6**(2)	4.6(2)	4.6(2)	8.1(10)	4.5(6)	4/15
U-DCN tra	4.6(4)	6.9(6)	6.9(6)	2.4e4(3e4)	8145(2e4)	10/15
U-zero tra	4.1(3)	6.8(6)	6.8(6)	2.4e4(3e4)	9704(1e4)	11/15
fmincon pa	**1.1**(0.7)	4.5(13)	4.5(13)	**4.0**(4)	**1.1**(1.0)	15/15
fminunc pa	**1.5**(0.6)	4.2(10)	4.2(10)	**4.1**(3)	**1.3**(1)	15/15
ga100 hol	11(9)	18(9)	18(9)	250(10)	401(397)	10/15
grid100 ho	15(15)	27(37)	27(37)	1949(3234)	744(1188)	8/15
grid16 hol	10(9)	272(17)	272(17)	2892(3342)	928(1216)	7/15
hill hol	8.8(8)	10(21)	10(21)	1622(3234)	695(794)	8/15
lmmCMA aug	**1.8**(2)	**2.3**(1)	**2.3**(1)	6.7(16)	**2.4**(4)	12/15
memPSODE v	4.7(1)	17(41)	17(41)	92(108)	66(98)	15/15
prcga saw	5.0(4)	11(8)	11(8)	938(2804)	402(792)	12/15
ring100 ho	14(13)	27(12)	27(12)	23(11)	7.1(4)	15/15
ring16 hol	6.6(6)	7.1(4)	7.1(4)	**6.5**(3)	58(3)	14/15
simplex pa	34(41)	47(25)	47(25)	23(15)	7.1(7)	15/15

Table 96: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*6.3e+0*:10	*4.0e+0*:62	*2.5e+0*:162	*2.5e+0*:162	*1.0e+0*:915	15/15
BIPOP-aCMA	**2.2**(2)	**2.8**(4)	11(9)	11(9)	20(12)	15/15
BIPOP-saAC	5.2(5)	5.3(5)	7.5(7)	7.5(7)	16(14)	15/15
CMAES hut	**2.8**(4)	**2.7**(3)	9.4(12)	9.4(10)	∞ *1002*	0/15
DE pal	**1.9**(2)	**1.9**(2)	12(11)	12(11)	256(267)	9/15
HCMA los	5.1(3)	**2.7**(3)	6.6(8)	6.6(8)	14(12)	15/15
HMLSL pal	4.5(3)	**2.3**(2)	5.8(9)	5.8(9)	**4.0**(4)	15/15
IPOP-10DDr	**2.2**(3)	**2.5**(4)	7.9(7)	7.9(7)	16(24)	15/15
IPOP-500 l	**2.2**(3)	**2.5**(4)	7.9(7)	7.9(7)	16(24)	15/15
IPOP-tany	**2.0**(3)	**1.9**(2)	5.6(5)	5.6(5)	24(29)	15/15
IPOP-texp	**1.9**(2)	**1.9**(2)	9.1(10)	9.1(10)	18(29)	15/15
IPOP lia	**2.2**(3)	**2.5**(4)	7.9(7)	7.9(7)	16(24)	15/15
MLSL pal	4.5(3)	**2.4**(2)	**3.3**(4)	**3.3**(4)	**2.0**(2)	15/15
OQNLP pal	12(18)	5.0(6)	**3.8**(4)	**3.8**(4)	**3.4**(4)	15/15
P-DCN tra	**1.6**(2)	3.3(3)	**2.9**(2)	**2.9**(2)	11(15)	15/15
P-zero tra	**2.1**(2)	**1.6**(1)	**1.6**(1)	**1.6**(1)	427(12)	15/15
SMAC hut	**1.7**(2)	**1.9**(2)	8.1(9)	8.1(9)	∞ *1000*	0/15
U-DCN tra	**2.8**(3)	**2.2**(2)	5.0(5)	5.0(5)	116(18)	15/15
U-zero tra	**1.5**(1)	**2.8**(4)	8.0(6)	8.0(6)	28(19)	15/15
fmincon pa	4.3(3)	**2.3**(2)	**1.9**(1)	**1.9**(1)	**2.6**(3)	15/15
fminunc pa	13(18)	6.0(6)	11(6)	11(6)	31(36)	15/15
ga100 hol	**2.4**(2)	**1.9**(2)	5.6(8)	5.6(8)	161(193)	14/15
grid100 ho	**1.6**(2)	**1.8**(2)	10(7)	10(7)	207(283)	13/15
grid16 hol	**2.4**(2)	**2.1**(2)	12(12)	12(12)	113(162)	14/15
hill hol	**2.5**(2)	3.3(4)	7.3(5)	7.3(5)	86(109)	15/15
lmmCMA aug	**2.5**(5)	**1.9**(2)	13(16)	13(16)	38(39)	2/15
memPSODE v	**2.9**(4)	7.2(4)	6.4(12)	6.4(12)	11(8)	15/15
prcga saw	**2.2**(3)	**1.8**(1)	10(11)	10(11)	438(425)	12/15
ring100 ho	**1.8**(2)	**2.7**(4)	12(15)	12(15)	56(23)	15/15
ring16 hol	**2.5**(3)	3.3(4)	10(12)	10(12)	73(102)	15/15
simplex pa	102(76)	22(14)	12(2)	12(2)	**2.9**(0.9)	15/15

Table 97: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*1.0e+2*:66	*6.3e+1*:596	*4.0e+1*:3181	*2.5e+1*:7668	*1.6e+1*:14353	15/15
BIPOP-aCMA	3.1(0.8)	**2.1**(2)	**1.3**(0.9)	**1.1**(0.9)	**1.2**(1)	15/15
BIPOP-saAC	**2.2**(1)	**0.89**(0.4)	**1.4**(1)	**0.72**(0.6)	**0.78**(0.4)	15/15
CMAES hut	**2.6**(0.9)	**1.4**(1)	4.5(5)	∞	∞ *1002*	0/15
DE pal	12(6)	6.3(3)	17(13)	183(205)	104(98)	2/15
HCMA los	**1.2**(0.2)	**1.3**(1.0)	**1.6**(1)	**1.1**(1)	**1.1**(0.9)	15/15
HMLSL pal	**2.7**(0.9)	**2.3**(2)	**1.2**(0.5)	**1.6**(0.9)	11(12)	11/15
IPOP-10DDr	**2.9**(1)	**1.5**(1)	**1.2**(0.6)	**1.1**(1)	**2.0**(1)	15/15
IPOP-500 l	**2.9**(1)	**1.5**(1)	**1.2**(0.6)	**1.1**(1)	**2.0**(1)	15/15
IPOP-tany	**2.4**(1)	**1.1**(0.5)	**1.6**(1)	**0.97**(0.5)	**1.2**(1)	15/15
IPOP-texp	**1.1**(1)	**0.73**(0.4)	**0.75**(0.7)	**0.67**(0.5)	**0.78**(0.4)	15/15
IPOP lia	**2.9**(1)	**1.5**(1)	**1.2**(0.6)	**1.1**(1)	**2.0**(1)	15/15
MLSL pal	**2.6**(0.9)	4.8(10)	10(10)	37(37)	∞ *2e5*	0/15
OQNLP pal	**1.4**(1)	**0.36**(0.1)	3.1(5)	3.6(3)	3.7(4)	11/15
P-DCN tra	3.8e4(8e4)	3.4e4(4e4)	∞	∞	∞ *1e7*	0/15
P-zero tra	1.1e4(68)	2.5e4(3e4)	∞	∞	∞ *1e7*	0/15
SMAC hut	**1.6**(1)	7.1(8)	∞	∞	∞ *1000*	0/15
U-DCN tra	7.1(7)	8.8(10)	1369(2755)	8487(9125)	∞ *1e7*	0/15
U-zero tra	11(4)	13(16)	1031(1594)	9172(1e4)	∞ *1e7*	0/15
fmincon pa	**2.0**(0.9)	5.3(8)	13(12)	34(30)	∞ *2e5*	0/15
fminunc pa	**1.6**(0.7)	**2.1**(0.8)	19(11)	57(63)	87(102)	2/15
ga100 hol	13(7)	4.5(2)	8.0(6)	18(23)	242(261)	2/15
grid100 ho	42(19)	73(56)	143(146)	955(1043)	∞ *5e5*	0/15
grid16 hol	10(5)	29(35)	177(239)	294(293)	∞ *5e5*	0/15
hill hol	13(17)	73(24)	98(157)	921(1011)	∞ *5e5*	0/15
lmmCMA aug	**1.9**(1)	**0.99**(1.0)	**1.2**(1)	**1.0**(1)	**1.6**(2)	3/15
memPSODE v	64(67)	16(14)	6.1(4)	5.2(3)	7.1(6)	15/15
prcga saw	5.6(2)	5.3(4)	3.4(3)	4.7(4)	25(37)	12/15
ring100 ho	34(7)	17(8)	16(10)	39(39)	498(540)	1/15
ring16 hol	8.1(6)	5.7(5)	25(37)	52(71)	489(540)	1/15
simplex pa	6.0(3)	88(86)	135(131)	∞	∞ *2e5*	0/15

Table 98: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*6.3e+1*:24	*4.0e+1*:42	*1.0e-8*:43	*1.0e-8*:43	*1.0e-8*:43	15/15
BIPOP-aCMA	4.5(0)	3.2(0.4)	18(0.5)	18(0.5)	18(0.5)	15/15
BIPOP-saAC	4.0(2)	3.4(0.2)	16(0.7)	16(0.7)	16(0.7)	15/15
CMAES hut	4.3(2)	3.6(2)	∞	∞	∞ *2006*	0/15
DE pal	18(8)	22(5)	768(18)	768(18)	768(18)	15/15
HCMA los	**1.7**(0)	**1.0**(0)	**1.0**(0.0)	**1.0**(0.0)	**1.0**(0.0)	15/15
HMLSL pal	**0.91**(0)	**0.53**(0)	**5.1**(0.5)	**5.1**(0.5)	**5.1**(0.5)	15/15
IPOP-10DDr	4.2(2)	3.8(0.7)	63(5)	63(5)	63(5)	15/15
IPOP-500 l	4.2(2)	3.8(0.7)	63(5)	63(5)	63(5)	15/15
IPOP-tany	3.8(1)	3.3(1)	68(4)	68(4)	68(4)	15/15
IPOP-texp	**2.0**(1)	**2.1**(0.8)	66(4)	66(4)	66(4)	15/15
IPOP lia	4.2(2)	3.8(0.7)	63(5)	63(5)	63(5)	15/15
MLSL pal	**0.91**(0)	**0.53**(0)	**5.1**(0.5)	**5.1**(0.5)	**5.1**(0.5)	15/15
OQNLP pal	**2.0**(0.0)	**1.2**(0.0)	**1.8**(0)	**1.8**(0)	**1.8**(0)	15/15
P-DCN tra	17(20)	21(13)	4134(1370)	4134(1370)	4134(1370)	15/15
P-zero tra	29(24)	26(14)	7717(2217)	7717(2217)	7717(2217)	15/15
SMAC hut	**0.80**(0.4)	**0.67**(0.2)	∞	∞	∞ *2000*	0/15
U-DCN tra	5.6(2)	5.7(2)	3.2e4(3e4)	3.2e4(3e4)	3.2e4(3e4)	15/15
U-zero tra	4.0(2)	3.7(2)	4.0e5(2e5)	4.0e5(3e5)	4.0e5(3e5)	13/15
fmincon pa	**0.91**(0)	**0.53**(0)	**5.1**(0.5)	**5.1**(0.5)	**5.1**(0.5)	15/15
fminunc pa	**1.1**(0.4)	**1.00**(0)	**1**(0)	**1**(0)	**1**(0)	15/15
ga100 hol	25(7)	23(6)	∞	∞	∞ *1e6*	0/15
grid100 ho	75(65)	90(37)	∞	∞	∞ *1e6*	0/15
grid16 hol	20(9)	19(8)	∞	∞	∞ *1e6*	0/15
hill hol	5.7(2)	4.4(1)	∞	∞	∞ *1e6*	0/15
lmmCMA aug	**2.5**(1)	**2.5**(1)	10(0.2)	10(0.2)	10(0.2)	15/15
memPSODE v	7.5(0.9)	5.5(2)	25(25)	25(25)	25(25)	15/15
prcga saw	13(9)	15(5)	9668(1e4)	9668(1e4)	9668(1e4)	15/15
ring100 ho	51(24)	55(13)	∞	∞	∞ *1e6*	0/15
ring16 hol	13(5)	12(4)	∞	∞	∞ *1e6*	0/15
simplex pa	62(42)	60(4)	∞	∞	∞ *4e5*	0/15

Table 99: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*4.0e+6*:29	*2.5e+6*:42	*1.0e+5*:65	*1.0e+4*:207	*1.0e-8*:412	15/15
BIPOP-aCMA	**2.3**(2)	**2.1**(2)	**3.6**(0.3)	**1.5**(0.1)	**28**(19)	15/15
BIPOP-saAC	**1.2**(0.8)	**1.4**(0.7)	10(2)	**4.0**(0.7)	**5.9**(0.6)	15/15
CMAES hut	**0.97**(0.9)	**0.94**(0.7)	14(5)	35(35)	∞ *2006*	0/15
DE pal	**1.7**(2)	**2.4**(2)	29(7)	20(2)	106(3)	15/15
HCMA los	**1.3**(0.7)	**0.93**(0)	**1.0**(0.2)$^{\star 4}$	**1.4**(0.6)	**7.7**(4)	15/15
HMLSL pal	**2.4**(4)	**2.5**(5)	10(7)	5.4(3)	38(31)	15/15
IPOP-10DDr	**1.3**(1)	**2.0**(1)	14(3)	12(3)	52(2)	15/15
IPOP-500 l	**1.3**(1)	**2.0**(1)	14(3)	12(3)	52(2)	15/15
IPOP-tany	**1.00**(1)	**1.1**(1)	14(5)	12(3)	52(2)	15/15
IPOP-texp	**0.72**(0.6)	**0.96**(0.5)	10(5)	10(2)	50(2)	15/15
IPOP lia	**1.3**(1)	**2.0**(1)	14(3)	12(3)	52(2)	15/15
MLSL pal	**2.4**(4)	**2.5**(5)	10(7)	5.4(3)	58(89)	15/15
OQNLP pal	**1.6**(0.0)	**1.3**(0.3)	**5.3**(3)	**2.6**(0.8)	∞ *3e5*	0/15
P-DCN tra	**3.0**(2)	5.3(7)	33(10)	17(5)	2.2e4(3e4)	13/15
P-zero tra	7.6(8)	11(10)	34(16)	17(5)	3.6e5(4e5)	2/15
SMAC hut	**0.54**(0.4)	**0.70**(0.6)	23(21)	143(145)	∞ *2000*	0/15
U-DCN tra	**1.8**(1.0)	**1.9**(2)	10(5)	14(5)	2.1e5(2e5)	3/15
U-zero tra	**1.4**(1)	**1.7**(1)	7.4(5)	9.2(5)	∞ *2e7*	0/15
fmincon pa	**2.6**(4)	**2.3**(4)	10(8)	6.1(4)	**22**(9)	15/15
fminunc pa	**1.6**(1)	**1.4**(0.5)	**5.7**(2)	5.8(2)	113(111)	15/15
ga100 hol	**1.5**(2)	**2.8**(4)	37(12)	25(7)	∞ *1e6*	0/15
grid100 ho	**0.89**(0.8)	3.2(5)	128(40)	117(26)	∞ *1e6*	0/15
grid16 hol	5.1(9)	6.4(8)	28(7)	19(7)	∞ *1e6*	0/15
hill hol	4.5(3)	3.7(2)	7.5(7)	6.4(3)	∞ *1e6*	0/15
lmmCMA aug	**0.53**(0.5)	**0.68**(0.7)	**7.2**(2)	**3.8**(0.8)	**14**(1)	15/15
memPSODE v	4.1(4)	4.8(3)	12(19)	12(14)	53(44)	15/15
prcga saw	**0.50**(0.6)	**1.3**(1)	17(6)	11(2)	1.7e4(2e4)	4/15
ring100 ho	**2.2**(1)	4.9(9)	77(14)	58(8)	∞ *1e6*	0/15
ring16 hol	3.3(3)	4.6(2)	16(4)	12(3)	∞ *1e6*	0/15
simplex pa	27(15)	22(10)	52(13)	1532(1738)	∞ *4e5*	0/15

Table 100: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*6.3e+2*:33	*4.0e+2*:44	*1.6e+2*:109	*1.0e+2*:255	*2.5e+1*:3277	15/15
BIPOP-aCMA	**2.8**(0.7)	3.0(0.4)	**1.8**(0.2)$^{\star 2}$	**1.0**(0.2)$^{\star 3}$	**0.29**(0.0)	15/15
BIPOP-saAC	**1.9**(1)	3.1(1.0)	7.1(3)	6.3(2)	**2.7**(2)	15/15
CMAES hut	**2.2**(1)	3.9(2)	7.5(3)	8.1(4)	4.5(5)	2/15
DE pal	5.0(4)	14(5)	35(10)	59(23)	1828(1953)	1/15
HCMA los	**1.6**(0.6)	3.3(2)	**2.8**(0.1)	**1.4**(0.1)	**0.29**(0.0)	15/15
HMLSL pal	6.6(6)	33(32)	60(13)	41(0.7)	17(11)	15/15
IPOP-10DDr	**2.3**(1)	3.7(0.8)	6.5(3)	6.6(2)	3.1(2)	15/15
IPOP-500 l	**2.3**(1)	3.7(0.8)	6.5(3)	6.6(2)	3.1(2)	15/15
IPOP-tany	**1.1**(0.5)	**2.9**(1)	6.2(2)	6.9(2)	**2.2**(2)	15/15
IPOP-texp	**0.57**(0.5)	**1.5**(0.8)	6.7(4)	5.9(1)	3.2(2)	15/15
IPOP lia	**2.3**(1)	3.7(0.8)	6.5(3)	6.6(2)	3.1(2)	15/15
MLSL pal	6.5(6)	41(29)	3849(4480)	7279(7179)	∞ *4e5*	0/15
OQNLP pal	13(18)	36(30)	780(803)	1324(1298)	∞ *3e5*	0/15
P-DCN tra	8.2(10)	25(33)	89(104)	113(153)	76(51)	15/15
P-zero tra	6.0(10)	27(45)	131(101)	105(68)	126(130)	15/15
SMAC hut	**0.49**(0.5)$_{\downarrow 2}$	**2.1**(3)	124(147)	114(122)	∞ *2000*	0/15
U-DCN tra	**1.9**(1)	3.4(2)	**5.3**(2)	**4.3**(2)	**1.9**(0.4)	15/15
U-zero tra	**1.5**(1)	**2.6**(1)	**3.6**(0.9)	**2.6**(0.6)	**0.78**(0.1)	15/15
fmincon pa	6.6(6)	32(29)	6179(6457)	2.3e4(3e4)	∞ *4e5*	0/15
fminunc pa	19(23)	36(31)	3868(3633)	2.3e4(3e4)	∞ *4e5*	0/15
ga100 hol	6.8(7)	17(5)	23(3)	14(1)	**2.8**(0.5)	15/15
grid100 ho	12(11)	54(25)	78(17)	52(16)	13(2)	15/15
grid16 hol	7.9(5)	16(4)	16(4)	10(2)	**2.4**(0.3)	15/15
hill hol	4.0(2)	4.1(1)	**3.0**(1)	**1.8**(0.6)	**0.54**(0.2)	15/15
lmmCMA aug	**1.0**(1)	**2.3**(1)	5.9(2)	4.8(0.9)	**2.1**(1.0)	14/15
memPSODE v	5.7(3)	5.9(1)	18(35)	21(16)	6.5(5)	15/15
prcga saw	**2.6**(3)	10(3)	20(5)	15(4)	**2.3**(0.4)	15/15
ring100 ho	8.5(8)	33(12)	52(8)	32(3)	6.4(0.5)	15/15
ring16 hol	5.7(4)	11(3)	10(2)	6.3(1.0)	**1.3**(0.1)	15/15
simplex pa	39(34)	782(1292)	∞	∞	∞ *4e5*	0/15

Table 101: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*6.3e+2*:22	*4.0e+2*:91	*2.5e+2*:250	*1.6e+2*:332	*6.3e+1*:1927	15/15
BIPOP-aCMA	5.1(0)	**2.1**(0.7)	**1.1**(0.1)	**1.2**(0.2)	**0.34**(0.0)	15/15
BIPOP-saAC	6.7(4)	3.0(1)	**2.3**(0.5)	3.6(1)	**2.2**(2)	15/15
CMAES hut	5.8(3)	**2.8**(1)	**2.1**(0.7)	3.9(1)	**2.5**(2)	6/15
DE pal	21(9)	14(3)	12(3)	21(4)	54(27)	15/15
HCMA los	4.9(2)	**2.7**(1)	**1.4**(0.0)	**1.2**(0.1)	**0.34**(0.0)	15/15
HMLSL pal	**1.4**(2)	18(22)	19(12)	27(3)	7.7(5)	15/15
IPOP-10DDr	4.6(6)	3.8(0.9)	**2.3**(0.5)	3.7(1)	**1.4**(0.3)	15/15
IPOP-500 l	4.6(6)	3.8(0.9)	**2.3**(0.5)	3.7(1)	**1.4**(0.3)	15/15
IPOP-tany	3.4(4)	**2.9**(1)	**2.4**(0.9)	4.1(2)	**1.4**(0.3)	15/15
IPOP-texp	**0.59**(0.7)	**0.92**(0.5)*	**1.4**(0.4)	3.2(1)	**2.5**(2)	15/15
IPOP lia	4.6(6)	3.8(0.9)	**2.3**(0.5)	3.7(1)	**1.4**(0.3)	15/15
MLSL pal	**1.4**(2)	25(35)	656(810)	8305(9213)	∞ *4e5*	0/15
OQNLP pal	**1.6**(2)	45(82)	133(155)	874(899)	∞ *3e5*	0/15
P-DCN tra	41(55)	37(41)	31(32)	49(30)	54(35)	15/15
P-zero tra	48(44)	63(46)	56(29)	82(41)	74(61)	15/15
SMAC hut	6.9(10)	102(121)	∞	∞	∞ *2000*	0/15
U-DCN tra	6.2(3)	**3.0**(1)	**1.9**(0.8)	**2.6**(0.8)	**1.4**(0.4)	15/15
U-zero tra	4.1(2)	**1.9**(0.7)	**1.3**(0.4)	**1.6**(0.4)	**0.80**(0.2)	15/15
fmincon pa	**1.4**(2)	42(49)	524(762)	5111(6004)	∞ *4e5*	0/15
fminunc pa	**2.0**(2)	62(59)	3766(4717)	1.7e4(2e4)	∞ *4e5*	0/15
ga100 hol	27(10)	14(3)	8.8(2)	10(1)	3.3(0.6)	15/15
grid100 ho	71(52)	53(24)	35(8)	41(10)	14(4)	15/15
grid16 hol	23(12)	10(3)	6.1(2)	7.2(2)	**2.5**(0.5)	15/15
hill hol	7.0(4)	**2.3**(0.6)	**1.2**(0.3)	**1.3**(0.3)	**0.55**(0.1)	15/15
lmmCMA aug	**1.3**(2)	**2.2**(0.9)	**2.0**(0.6)	**3.0**(0.8)	**2.0**(2)	13/15
memPSODE v	22(37)	19(41)	11(16)	13(13)	4.7(4)	15/15
prcga saw	6.8(4)	7.0(3)	6.8(2)	9.0(2)	**2.8**(0.4)	15/15
ring100 ho	46(31)	29(7)	19(2)	22(2)	7.5(1)	15/15
ring16 hol	14(8)	7.2(2)	4.0(0.7)	4.3(0.5)	**1.5**(0.2)	15/15
simplex pa	18(22)	2835(3439)	∞	∞	∞ *4e5*	0/15

Table 102: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*2.5e+2*:19	*1.6e+2*:34	*1.0e-8*:41	*1.0e-8*:41	*1.0e-8*:41	15/15
BIPOP-aCMA	**1.9**(0.6)	**1.2**(0)	**1.0**(0)	**1.0**(0)	**1.0**(0)	15/15
BIPOP-saAC	**1.9**(1)	**2.1**(0.9)	5.4(0.6)	5.4(0.6)	5.4(0.6)	15/15
CMAES hut	**1.9**(1)	**2.2**(0.7)	6.7(1)	6.7(1)	6.7(1)	15/15
DE pal	4.7(4)	26(7)	8276(216)	8276(216)	8276(216)	15/15
HCMA los	**2.2**(0)	**1.2**(0.0)	**1.4**(0.3)	**1.4**(0.3)	**1.4**(0.3)	15/15
HMLSL pal	**1.2**(0)	**1.3**(0)	1.0e4(284)	1.0e4(284)	1.0e4(284)	14/15
IPOP-10DDr	**1.1**(0.7)	**1.7**(1.0)	418(295)	418(295)	418(295)	15/15
IPOP-500 l	**1.1**(0.7)	**1.7**(1.0)	418(295)	418(295)	418(295)	15/15
IPOP-tany	**1.5**(0.7)	**2.3**(0.6)	285(214)	285(214)	285(196)	15/15
IPOP-texp	3.8(0.6)	3.6(0.9)	471(320)	471(320)	471(320)	15/15
IPOP lia	**1.1**(0.7)	**1.7**(1.0)	418(295)	418(295)	418(295)	15/15
MLSL pal	**1.2**(0)	**1.3**(0)	1.4e5(2e5)	1.4e5(2e5)	1.4e5(2e5)	1/15
OQNLP pal	**2.7**(0)	**1.5**(0)	**1.3**(0)	**1.3**(0)	**1.3**(0)	15/15
P-DCN tra	6.0(2)	27(19)	461(36)	461(36)	461(36)	15/15
P-zero tra	5.0(5)	27(18)	226(29)	226(29)	226(29)	15/15
SMAC hut	**0.46**$(0.2)_{\downarrow 2}$	**0.33**$(0.1)^{\star 4}$	**0.66**$(0.2)^{\star 2}$	**0.66**$(0.2)^{\star 2}$	**0.66**$(0.2)^{\star 2}$	15/15
U-DCN tra	**2.5**(1)	4.3(2)	∞	∞	∞ *2e7*	0/15
U-zero tra	**1.9**(0.9)	3.3(1)	∞	∞	∞ *2e7*	0/15
fmincon pa	**1.2**(0)	**1.3**(0)	3.0e4(3e4)	3.0e4(4e4)	3.0e4(4e4)	4/15
fminunc pa	**2.3**(0)	**1.3**(0)	**2.6**(0)	**2.6**(0)	**2.6**(0)	15/15
ga100 hol	8.5(8)	19(9)	133(18)	133(18)	133(18)	15/15
grid100 ho	6.8(11)	79(41)	486(90)	486(90)	486(90)	15/15
grid16 hol	7.8(5)	15(9)	81(17)	81(17)	81(17)	15/15
hill hol	3.9(3)	3.9(2)	15(5)	15(5)	15(5)	15/15
lmmCMA aug	**1.8**(0.5)	**2.1**(0.6)	6.1(1)	6.1(1)	6.1(1)	15/15
memPSODE v	**1.4**(1)	**2.7**(1)	3.1(0.3)	3.1(0.3)	3.1(0.3)	15/15
prcga saw	11(8)	16(10)	∞	∞	∞ *1e6*	0/15
ring100 ho	5.2(12)	44(9)	265(28)	265(28)	265(28)	15/15
ring16 hol	5.4(4)	11(3)	52(7)	52(7)	52(7)	15/15
simplex pa	40(15)	63(30)	227(93)	227(93)	227(93)	15/15

Table 103: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*2.5e+5*:16	*6.3e+4*:43	*1.6e+4*:62	*1.6e+2*:353	*1.6e+1*:1078	15/15
BIPOP-aCMA	3.8(4)	3.5(1)	3.4(1)	**3.0**(0.7)	**1.8**(0.2)	15/15
BIPOP-saAC	3.0(3)	**2.3**(1)	**2.1**(0.6)	**2.4**(1)	**1.6**(0.6)	15/15
CMAES hut	3.1(2)	**2.1**(0.9)	**2.0**(0.9)	**2.6**(1)	**1.9**(1.0)	13/15
DE pal	9.1(11)	17(12)	23(18)	16(9)	45(24)	15/15
HCMA los	**2.6**(0.0)	**1.1**(0.1)	**0.90**(0.2)	**1.6**(2)	**1.8**(0.3)	15/15
HMLSL pal	5.3(12)	6.5(10)	6.9(9)	3.0(2)	**1.9**(1)	15/15
IPOP-10DDr	**3.0**(3)	**2.8**(1)	3.1(1)	**1.5**(0.6)	**1.3**(0.3)	15/15
IPOP-500 l	**3.0**(3)	**2.8**(1)	3.1(1)	**1.5**(0.6)	**1.3**(0.3)	15/15
IPOP-tany	**2.0**(2)	**2.6**(2)	**2.9**(1)	**1.6**(0.4)	**1.4**(0.4)	15/15
IPOP-texp	**2.1**(2)	**2.1**(2)	**2.4**(1)	**1.4**(0.5)	**1.4**(0.3)	15/15
IPOP lia	**3.0**(3)	**2.8**(1)	3.1(1)	**1.5**(0.6)	**1.3**(0.3)	15/15
MLSL pal	5.3(12)	6.5(10)	6.9(9)	3.0(2)	**1.9**(1)	15/15
OQNLP pal	**2.3**(2)	**1.3**(0.3)	**1.2**(0.5)	**0.58**(0.2)	**0.94**(0.7)*	15/15
P-DCN tra	5.7(8)	12(13)	15(14)	8.5(3)	8.3(3)	15/15
P-zero tra	17(22)	21(18)	22(15)	10(5)	9.3(5)	15/15
SMAC hut	**1.6**(1)	**1.2**(0.9)	**1.6**(1.0)	**2.8**(3)	∞ *2000*	0/15
U-DCN tra	3.2(3)	4.0(3)	4.9(4)	6.5(4)	324(433)	15/15
U-zero tra	3.2(3)	**2.9**(2)	4.2(3)	10(9)	698(1970)	15/15
fmincon pa	6.0(13)	5.3(7)	5.9(6)	**2.6**(1)	**1.6**(0.5)	15/15
fminunc pa	**2.0**(2)	**1.6**(1)	**1.6**(0.5)	**0.64**(0.3)	**2.2**(0.9)	15/15
ga100 hol	13(15)	16(9)	15(7)	10(2)	19(8)	15/15
grid100 ho	26(38)	52(55)	67(50)	68(51)	908(1032)	9/15
grid16 hol	8.6(12)	11(8)	13(8)	15(10)	240(466)	13/15
hill hol	6.1(5)	4.0(3)	3.6(2)	5.3(5)	235(468)	13/15
lmmCMA aug	**1.6**(1)	**1.6**(1)	**2.0**(0.9)	6.8(3)	9.0(6)	11/15
memPSODE v	5.8(5)	4.3(1)	3.6(2)	6.4(5)	6.9(2)	15/15
prcga saw	11(14)	13(10)	16(10)	7.1(4)	366(709)	14/15
ring100 ho	19(26)	32(28)	38(22)	24(7)	46(10)	15/15
ring16 hol	5.5(6)	7.4(4)	8.4(3)	7.2(4)	17(14)	15/15
simplex pa	65(73)	46(24)	40(4)	98(92)	∞ *4e5*	0/15

Table 104: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*1.0e+3*:11	*4.0e+2*:39	*2.5e+2*:74	*6.3e+1*:319	*1.0e+1*:1351	15/15
BIPOP-aCMA	4.3(3)	4.2(2)	3.9(2)	**1.9**(0.6)	**1.5**(1)	15/15
BIPOP-saAC	3.2(3)	**2.8**(2)	**2.5**(1)	**1.1**(0.2)	**0.52**(0.2)	15/15
CMAES hut	**1.3**(1)	**2.0**(1)	**2.1**(0.8)	**1.4**(0.4)	**1.3**(0.9)	12/15
DE pal	3.4(4)	9.4(8)	12(5)	16(4)	21(5)	15/15
HCMA los	**2.1**(2)	**1.3**(0.3)	**0.87**(0.3)	**1.6**(1)	**0.98**(0.9)	15/15
HMLSL pal	**2.7**(4)	21(14)	23(6)	19(7)	21(5)	15/15
IPOP-10DDr	**1.7**(2)	3.2(0.7)	**2.5**(0.6)	**1.4**(0.3)	**1.7**(2)	15/15
IPOP-500 l	**1.7**(2)	3.2(0.7)	**2.5**(0.6)	**1.4**(0.3)	**1.7**(2)	15/15
IPOP-tany	**0.93**(2)	**2.1**(1)	**1.9**(0.7)	**1.5**(0.4)	**1.0**(0.3)	15/15
IPOP-texp	**1.1**(2)	**1.3**(0.9)	**1.1**(0.6)	**1.2**(0.3)	**1.6**(2)	15/15
IPOP lia	**1.7**(2)	3.2(0.7)	**2.5**(0.6)	**1.4**(0.3)	**1.7**(2)	15/15
MLSL pal	4.6(7)	185(247)	674(765)	∞	∞ *2e5*	0/15
OQNLP pal	6.7(4)	24(23)	36(30)	58(56)	∞ *2e4*	0/15
P-DCN tra	**1.4**(1)	10(19)	18(23)	181(295)	1.7e4(2e4)	8/15
P-zero tra	**1.6**(2)	27(32)	63(60)	282(323)	2528(2942)	15/15
SMAC hut	**0.58**(0.6)	**0.61**(0.6)	**0.49**(0.3)*	**0.39**(0.3)*	**0.57**(0.3)	15/15
U-DCN tra	**1.3**(1)	**2.3**(2)	**2.3**(1)	38(57)	1.8e4(2e4)	8/15
U-zero tra	**1.8**(2)	**2.3**(2)	**2.4**(1)	11(15)	2.1e4(2e4)	7/15
fmincon pa	**2.9**(5)	166(168)	469(328)	∞	∞ *2e5*	0/15
fminunc pa	4.9(7)	144(214)	933(1264)	∞	∞ *2e5*	0/15
ga100 hol	**2.2**(3)	10(6)	10(4)	8.4(2)	175(224)	14/15
grid100 ho	**1.3**(2)	30(23)	50(38)	105(101)	5054(5182)	2/15
grid16 hol	3.7(2)	9.4(6)	9.2(5)	23(30)	2371(2391)	4/15
hill hol	6.3(6)	3.9(2)	3.2(1)	7.7(9)	2235(2591)	4/15
lmmCMA aug	**0.49**(0.7)	**1.2**(0.9)	**1.7**(1)	**1.0**(0.2)	**0.48**(0.1)	15/15
memPSODE v	**2.6**(2)	15(9)	13(13)	17(12)	26(21)	15/15
prcga saw	**2.2**(3)	5.7(4)	6.7(3)	5.4(2)	513(788)	10/15
ring100 ho	**1.4**(1)	20(9)	24(9)	23(10)	93(121)	15/15
ring16 hol	3.3(4)	5.6(3)	6.1(2)	8.8(5)	842(1104)	8/15
simplex pa	4.3(7)	248(379)	1019(917)	∞	∞ *3e5*	0/15

Table 105: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*4.0e+4*:19	*2.5e+4*:35	*4.0e+3*:67	*2.5e+2*:231	*1.6e+1*:1470	15/15
BIPOP-aCMA	8.0(2)	5.2(2)	5.9(1)	3.1(0.4)	**2.8**(2)	15/15
BIPOP-saAC	4.6(2)	3.5(1)	**2.7**(0.3)	**1.3**(0.3)	**0.76**(0.2)	15/15
CMAES hut	7.0(4)	4.3(2)	4.2(0.8)	3.4(2)	∞ *2006*	0/15
DE pal	28(11)	21(7)	32(7)	27(3)	12(1)	15/15
HCMA los	**2.2**(0)	**1.2**(0)	**0.91**(0.3)	**1.8**(1)	**1.1**(0.3)	15/15
HMLSL pal	**1.1**(1)	**0.99**(0.9)	**1.6**(1)	**1.4**(0.5)	**0.83**(0.2)	15/15
IPOP-10DDr	5.2(4)	4.9(0.6)	4.2(0.4)	**2.7**(0.6)	**2.6**(0.8)	15/15
IPOP-500 l	5.2(4)	4.9(0.6)	4.2(0.4)	**2.7**(0.6)	**2.6**(0.8)	15/15
IPOP-tany	3.8(3)	3.5(1.0)	4.3(0.6)	**2.9**(0.7)	3.1(1)	15/15
IPOP-texp	**1.6**(2)	**1.4**(1)	**2.5**(2)	**2.3**(0.3)	**2.9**(1.0)	15/15
IPOP lia	5.2(4)	4.9(0.6)	4.2(0.4)	**2.7**(0.6)	**2.6**(0.8)	15/15
MLSL pal	**1.1**(1)	**0.99**(0.9)	**1.6**(1)	**1.4**(0.5)	**0.83**(0.2)	15/15
OQNLP pal	**1.7**(1)	**1.2**(0.7)	**0.97**(0.2)	**0.72**(0.3)	**0.67**(0.2)	15/15
P-DCN tra	28(37)	22(18)	24(8)	12(3)	135(178)	15/15
P-zero tra	37(20)	27(12)	25(6)	12(3)	62(27)	15/15
SMAC hut	**1.4**(2)	**1.5**(1)	**2.5**(0.8)	4.1(3)	∞ *2000*	0/15
U-DCN tra	7.9(3)	5.6(2)	8.8(3)	22(7)	461(684)	15/15
U-zero tra	5.7(2)	4.1(2)	5.5(1)	8.5(4)	1013(1581)	15/15
fmincon pa	**1.1**(1)	**0.99**(0.9)	**1.6**(1)	**1.4**(0.5)	**0.84**(0.2)	15/15
fminunc pa	**0.87**(0.6)	**0.86**(0.6)	**0.97**(0.3)	**0.94**(0.2)	**1.3**(0.7)	15/15
ga100 hol	31(10)	24(8)	31(9)	26(4)	1124(1691)	6/15
grid100 ho	122(71)	98(64)	128(24)	127(40)	2099(2403)	4/15
grid16 hol	30(16)	20(11)	23(6)	22(9)	526(701)	9/15
hill hol	10(5)	5.7(2)	4.9(1)	6.0(6)	309(473)	11/15
lmmCMA aug	**2.2**(2)	**2.5**(1)	3.3(1.0)	**2.6**(0.5)	**1.3**(0.5)	15/15
memPSODE v	40(53)	22(29)	14(16)	8.4(6)	4.6(2)	15/15
prcga saw	12(5)	10(7)	18(4)	16(5)	573(692)	13/15
ring100 ho	73(37)	60(18)	66(12)	58(7)	206(305)	14/15
ring16 hol	20(7)	14(4)	15(2)	12(3)	2033(2380)	4/15
simplex pa	46(62)	45(38)	65(28)	3286(2621)	∞ *4e5*	0/15

Table 106: 20-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*1.0e+2*:357	*6.3e+1*:560	*4.0e+1*:684	*2.5e+1*:756	*1.0e+1*:1716	15/15
BIPOP-aCMA	**2.5**(0.9)	**1.8**(0.8)	**1.6**(0.7)	**1.7**(0.6)	3.9(0.6)	15/15
BIPOP-saAC	**1.3**(0.4)	**0.89**(0.2)	**0.80**(0.2)	**0.78**(0.2)	**1.3**(0.2)	15/15
CMAES hut	**2.2**(0.5)	**1.5**(0.3)	**1.4**(0.2)	**1.5**(0.3)	∞ *2006*	0/15
DE pal	48(78)	129(357)	108(293)	101(265)	∞ *4e5*	0/15
HCMA los	**2.1**(0.6)	**1.5**(0.4)	**1.2**(0.4)	**1.2**(0.3)	**1.6**(0.3)	15/15
HMLSL pal	**0.30**$(0.0)_{\downarrow 4}$	**0.31**$(3e\text{-}3)_{\downarrow 4}$	**0.32**(0.0)	**0.34**(0.0)	**0.17**(0.0)	15/15
IPOP-10DDr	**2.8**(0.7)	3.4(5)	**2.9**(5)	**2.8**(4)	5.0(1)	15/15
IPOP-500 l	**2.8**(0.7)	3.4(5)	**2.9**(5)	**2.8**(4)	5.0(1)	15/15
IPOP-tany	**2.1**(0.6)	**2.2**(0.8)	**2.0**(0.7)	**2.0**(0.7)	5.0(1)	15/15
IPOP-texp	**1.3**(0.2)	**0.96**(0.1)	**0.92**(0.1)	**1.0**(0.1)	4.8(1)	15/15
IPOP lia	**2.8**(0.7)	3.4(5)	**2.9**(5)	**2.8**(4)	5.0(1)	15/15
MLSL pal	**0.30**$(0.0)_{\downarrow 4}$	**0.31**$(3e\text{-}3)_{\downarrow 4}$	**0.32**(0.0)	**0.34**(0.0)	**0.17**(0.0)	15/15
OQNLP pal	**0.20**$(4e\text{-}3)^{\star 4}_{\downarrow 4}$	**0.74**(0.0)	**0.73**(2e-3)	**0.66**(4e-3)	**0.32**(1e-3)	15/15
P-DCN tra	145(7)	131(98)	108(80)	98(73)	1600(1101)	15/15
P-zero tra	42(92)	33(86)	27(70)	25(64)	412(296)	15/15
SMAC hut	5.0(3)	26(28)	∞	∞	∞ *2000*	0/15
U-DCN tra	58(47)	1040(773)	891(716)	828(667)	1.7e4(1e4)	9/15
U-zero tra	2351(309)	2082(4003)	1714(3302)	1554(2990)	4.0e4(4e4)	4/15
fmincon pa	**0.30**$(0.0)_{\downarrow 4}$	**0.31**$(3e\text{-}3)_{\downarrow 4}$	**0.32**(0.0)	**0.34**(0.0)	**0.17**(0.0)	15/15
fminunc pa	**0.25**$(0.0)_{\downarrow 4}$	**0.33**$(0.0)_{\downarrow 4}$	**0.34**(0.0)	**0.33**(0.0)	**0.16**(0.0)	15/15
ga100 hol	233(30)	195(277)	169(237)	163(218)	∞ *1e6*	0/15
grid100 ho	1812(2803)	2834(3593)	2357(2937)	2194(2660)	∞ *1e6*	0/15
grid16 hol	70(91)	210(216)	183(200)	176(188)	∞ *1e6*	0/15
hill hol	241(171)	728(1004)	601(823)	547(744)	∞ *1e6*	0/15
lmmCMA aug	**1.6**(0.4)	**1.3**(0.2)	**1.1**(0.2)	**1.2**(0.2)	**2.1**(0.5)	15/15
memPSODE v	7.0(6)	7.1(8)	6.3(6)	5.8(6)	8.8(3)	15/15
prcga saw	8.4(3)	181(606)	167(517)	160(470)	688(1166)	10/15
ring100 ho	61(15)	51(8)	53(12)	68(10)	∞ *1e6*	0/15
ring16 hol	215(16)	186(327)	156(272)	145(246)	∞ *1e6*	0/15
simplex pa	∞	∞	∞	∞	∞ *4e5*	0/15

Table 107: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*1.6e+6*:15	*1.0e+6*:27	*4.0e+5*:70	*6.3e+4*:231	*4.0e+3*:1015	15/15
BIPOP-aCMA	7.3(6)	7.1(5)	8.2(4)	5.2(1)	3.1(0.9)	15/15
BIPOP-saAC	4.6(4)	4.9(4)	4.7(4)	**2.9**(0.6)	**0.90**(0.2)	15/15
CMAES hut	5.2(4)	5.3(3)	5.8(4)	4.6(1)	30(32)	1/15
DE pal	17(10)	12(9)	29(18)	330(203)	∞ *4e5*	0/15
HCMA los	**3.1**(1)	**2.0**(0.6)	**1.0**(0.4)	**1.6**(2)	**1.2**(0.2)	15/15
HMLSL pal	5.2(3)	3.8(2)	**2.6**(1)	**1.5**(0.6)	**0.57**(0.1)	15/15
IPOP-10DDr	7.5(4)	6.9(2)	5.6(1)	5.0(2)	3.4(0.9)	15/15
IPOP-500 l	7.5(4)	6.9(2)	5.6(1)	5.0(2)	3.4(0.9)	15/15
IPOP-tany	5.3(5)	5.5(4)	4.8(2)	4.9(2)	3.3(1)	15/15
IPOP-texp	**2.5**(2)	**2.1**(2)	3.1(2)	4.0(1)	3.1(0.7)	15/15
IPOP lia	7.5(4)	6.9(2)	5.6(1)	5.0(2)	3.4(0.9)	15/15
MLSL pal	5.2(3)	3.8(2)	**2.6**(1)	**1.5**(0.6)	**0.57**(0.1)	15/15
OQNLP pal	**3.7**(0.9)	**2.3**(0.5)	**1.4**(0.4)	**1.6**(0.9)	**0.83**(0.3)	15/15
P-DCN tra	13(15)	11(13)	12(10)	17(6)	396(333)	15/15
P-zero tra	18(23)	17(19)	13(11)	14(8)	160(119)	15/15
SMAC hut	**3.7**(3)	5.5(5)	6.2(5)	18(19)	∞ *2000*	0/15
U-DCN tra	6.0(6)	5.7(4)	16(13)	353(405)	3303(2513)	15/15
U-zero tra	5.5(3)	4.9(3)	8.6(13)	108(100)	1.1e4(1e4)	12/15
fmincon pa	5.2(3)	3.8(2)	**2.7**(1)	**1.7**(0.8)	**0.67**(0.2)	15/15
fminunc pa	**2.7**(1)	**2.2**(2)	**1.6**(1)	**1.7**(0.6)	**1.5**(0.7)	15/15
ga100 hol	15(13)	20(9)	20(7)	42(53)	4567(5015)	3/15
grid100 ho	48(54)	59(47)	82(57)	1317(2279)	∞ *1e6*	0/15
grid16 hol	15(14)	14(16)	17(9)	145(145)	1.4e4(1e4)	1/15
hill hol	8.0(5)	5.7(3)	4.8(3)	41(61)	∞ *1e6*	0/15
lmmCMA aug	3.7(3)	**3.5**(3)	4.2(1)	**2.3**(0.5)	**1.0**(0.2)	15/15
memPSODE v	14(9)	11(9)	7.7(5)	18(8)	10(4)	15/15
prcga saw	10(11)	11(9)	14(8)	22(12)	1278(1113)	13/15
ring100 ho	23(29)	24(16)	30(11)	63(31)	6727(7828)	2/15
ring16 hol	12(6)	10(5)	13(6)	37(27)	1.4e4(2e4)	1/15
simplex pa	60(28)	54(33)	33(1)	14(1)	1070(1006)	5/15

Table 108: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*4.0e+4*:11	*2.5e+3*:27	*1.6e+2*:313	*1.0e+2*:481	*1.0e+1*:1002	15/15
BIPOP-aCMA	**2.6**(3)	**2.1**(3)	12(2)	7.9(1)	4.8(0.4)	15/15
BIPOP-saAC	**2.4**(2)	**1.9**(2)	4.7(1)	3.2(0.7)	**1.6**(0.4)	15/15
CMAES hut	**1.9**(1)	**2.5**(2)	∞	∞	∞ *2006*	0/15
DE pal	**2.6**(3)	**2.8**(2)	10(11)	50(32)	∞ *4e5*	0/15
HCMA los	**2.4**(2)	**1.6**(0.7)	4.2(3)	3.4(0.4)	**1.7**(0.2)	15/15
HMLSL pal	4.4(2)	**2.7**(1)	**0.33**(0.1)	**0.22**(0.1)	**0.17**(0.0)	15/15
IPOP-10DDr	**2.2**(3)	**2.5**(3)	14(9)	14(3)	10(0.6)	15/15
IPOP-500 l	**2.2**(3)	**2.5**(3)	14(9)	14(3)	10(0.6)	15/15
IPOP-tany	**1.0**(1.0)	**1.6**(1)	12(10)	14(2)	9.4(0.4)	15/15
IPOP-texp	**1.9**(2)	**1.8**(1)	11(9)	13(1)	8.4(0.6)	15/15
IPOP lia	**2.2**(3)	**2.5**(3)	14(9)	14(3)	10(0.6)	15/15
MLSL pal	4.4(2)	**2.7**(1)	**0.33**(0.1)	**0.22**(0.1)	**0.17**(0.0)	15/15
OQNLP pal	4.5(0.3)	**2.2**(0.8)	**0.27**(0.2)	**0.21**(0.1)	**0.16**(0.0)	15/15
P-DCN tra	**1.8**(2)	**1.9**(1)	102(129)	155(136)	457(265)	15/15
P-zero tra	**1.9**(2)	**1.7**(1)	170(185)	250(196)	676(222)	15/15
SMAC hut	**0.59**(0.5)	**0.68**(0.6)	**2.5**(3)	7.3(8)	∞ *2000*	0/15
U-DCN tra	**1.7**(1)	**1.6**(2)	30(33)	55(48)	786(641)	15/15
U-zero tra	**1.2**(1)	**1.0**(0.8)	44(49)	84(51)	1213(560)	15/15
fmincon pa	4.4(2)	**2.7**(1)	**0.33**(0.1)	**0.22**(0.1)	**0.16**(0.0)	15/15
fminunc pa	5.2(2)	**2.6**(1)	**0.35**(0.2)	**0.60**(0.4)	**0.51**(0.1)	15/15
ga100 hol	**2.4**(3)	4.1(6)	18(18)	43(27)	333(121)	15/15
grid100 ho	**1.3**(2)	5.1(6)	901(852)	3491(3481)	∞ *1e6*	0/15
grid16 hol	**2.0**(3)	**1.9**(2)	164(206)	315(222)	2753(2555)	5/15
hill hol	**2.7**(2)	**1.7**(1.0)	118(136)	168(135)	577(255)	15/15
lmmCMA aug	**1.3**(1)	**1.4**(1)	4.5(3)	3.7(0.6)	**2.1**(0.2)	15/15
memPSODE v	**2.4**(3)	**2.1**(1)	12(6)	8.9(2)	4.5(1.0)	15/15
prcga saw	**2.7**(4)	**2.7**(2)	3.5(4)	96(205)	1.3e4(1e4)	2/15
ring100 ho	**1.3**(1.0)	3.1(4)	29(43)	154(71)	808(199)	14/15
ring16 hol	**1.8**(2)	**2.2**(2)	27(48)	61(56)	470(240)	14/15
simplex pa	40(7)	18(2)	**2.9**(4)	34(47)	∞ *4e5*	0/15

Table 109: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*1.0e+8*:23	*6.3e+7*:39	*2.5e+7*:76	*4.0e+6*:209	*1.0e+1*:1042	15/15
BIPOP-aCMA	8.0(4)	6.2(2)	4.7(1)	**2.8**(0.5)	3.1(3)	15/15
BIPOP-saAC	3.5(2)	3.3(1)	**2.4**(0.5)	**1.3**(0.2)	**0.83**(0.1)	15/15
CMAES hut	5.2(3)	4.6(2)	3.8(1)	**2.4**(0.4)	4.8(4)	6/15
DE pal	13(9)	17(10)	22(6)	22(2)	102(112)	14/15
HCMA los	**2.8**(0.9)	**2.1**(0.4)	**1.8**(0.5)	**1.8**(1)	**1.7**(1)	15/15
HMLSL pal	**1.9**(2)	**1.8**(1)	**1.6**(0.7)	**1.4**(0.7)	**0.81**(0.6)	15/15
IPOP-10DDr	4.2(3)	4.1(1)	3.5(0.4)	**2.3**(0.2)	**2.6**(2)	15/15
IPOP-500 l	4.2(3)	4.1(1)	3.5(0.4)	**2.3**(0.2)	**2.6**(2)	15/15
IPOP-tany	3.6(2)	3.5(1)	3.4(0.7)	**2.3**(0.3)	**2.4**(0.2)	15/15
IPOP-texp	**2.3**(3)	**2.0**(2)	**2.4**(0.8)	**2.1**(0.4)	**2.3**(0.2)	15/15
IPOP lia	4.2(3)	4.1(1)	3.5(0.4)	**2.3**(0.2)	**2.6**(2)	15/15
MLSL pal	**1.9**(2)	**1.8**(1)	**1.6**(0.7)	**1.4**(0.7)	**0.81**(0.6)	15/15
OQNLP pal	**2.1**(2)	**1.7**(0.4)	**1.0**(0.2)	**0.80**(0.6)	**1.1**(0.5)	15/15
P-DCN tra	25(29)	29(15)	27(8)	15(4)	7018(9607)	11/15
P-zero tra	38(38)	35(23)	28(12)	14(4)	6998(9606)	11/15
SMAC hut	**2.8**(4)	38(52)	∞	∞	∞ *2000*	0/15
U-DCN tra	5.5(3)	5.1(2)	5.3(2)	8.4(4)	3164(9601)	13/15
U-zero tra	3.9(2)	3.9(2)	3.8(1)	3.8(1)	7490(9691)	11/15
fmincon pa	**1.9**(2)	**1.8**(1)	**1.6**(0.7)	**1.4**(0.7)	**0.81**(0.5)	15/15
fminunc pa	**1.9**(2)	**1.7**(1)	**1.5**(1)	**0.88**(0.6)	**0.61**(0.2)	15/15
ga100 hol	21(13)	22(7)	24(6)	19(3)	721(648)	11/15
grid100 ho	71(46)	91(43)	100(31)	71(20)	∞ *1e6*	0/15
grid16 hol	24(16)	22(12)	19(6)	14(3)	2612(2511)	5/15
hill hol	6.9(2)	5.0(1)	3.9(1)	**2.5**(0.5)	685(630)	11/15
lmmCMA aug	**2.0**(2)	**2.4**(1)	**2.6**(0.7)	**1.9**(0.3)	**1.1**(0.1)	15/15
memPSODE v	16(5)	25(26)	17(14)	9.1(6)	5.7(4)	15/15
prcga saw	8.5(6)	11(7)	13(5)	11(2)	214(226)	14/15
ring100 ho	34(29)	40(21)	55(11)	43(5)	605(147)	15/15
ring16 hol	14(6)	13(4)	12(3)	8.9(1)	571(547)	12/15
simplex pa	66(51)	55(26)	37(2)	560(730)	∞ *4e5*	0/15

Table 110: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*1.6e+3*:28	*1.0e+3*:64	*6.3e+2*:79	*4.0e+1*:211	*2.5e+0*:1724	15/15
BIPOP-aCMA	6.4(2)	5.2(1)	6.2(1)	6.0(0.8)	**2.4**(2)	15/15
BIPOP-saAC	**3.0**(1)	**2.4**(0.3)	**2.3**(0.2)	**1.8**(0.2)	**0.67**(0.5)	15/15
CMAES hut	3.2(2)	3.4(1)	4.5(0.9)	5.5(0.5)	3.4(3)	5/15
DE pal	14(8)	20(7)	38(9)	89(13)	63(99)	14/15
HCMA los	**1.5**(0.1)	**0.85**(0.2)	**0.89**(0.2)	**2.3**(1)	**0.78**(0.5)	15/15
HMLSL pal	**1.1**(0.4)	**1.2**(0.8)	**1.8**(1.0)	**2.8**(0.6)	**0.51**(0.1)	15/15
IPOP-10DDr	4.0(1)	3.3(0.6)	4.6(0.8)	5.4(0.3)	**2.8**(3)	15/15
IPOP-500 l	4.0(1)	3.3(0.6)	4.6(0.8)	5.4(0.3)	**2.8**(3)	15/15
IPOP-tany	**2.9**(2)	3.3(1.0)	4.3(0.2)	6.0(0.6)	4.5(4)	15/15
IPOP-texp	**1.6**(0.8)	**1.9**(0.4)	3.6(0.4)	5.3(0.6)	3.6(3)	15/15
IPOP lia	4.0(1)	3.3(0.6)	4.6(0.8)	5.4(0.3)	**2.8**(3)	15/15
MLSL pal	**1.1**(0.4)	**1.2**(0.8)	**1.8**(1.0)	**2.8**(0.6)	**0.51**(0.1)	15/15
OQNLP pal	**1.8**(0.0)	**0.84**(0.2)	**1.0**(0.2)	**2.9**(0.1)	**0.51**(0.0)	15/15
P-DCN tra	7.9(10)	15(9)	23(8)	1.5e4(5e4)	1.7e4(2e4)	6/15
P-zero tra	18(20)	19(10)	24(9)	2.4e4(5e4)	3.2e4(4e4)	4/15
SMAC hut	**0.81**(0.5)	**0.66**(0.2)	**0.84**(0.1)	**1.4**(0.4)	∞ *2000*	0/15
U-DCN tra	3.2(2)	4.1(2)	10(6)	1.5e4(5e4)	2.3e4(3e4)	5/15
U-zero tra	**2.5**(1)	3.3(0.9)	5.9(3)	69(22)	1.0e4(2e4)	8/15
fmincon pa	**1.1**(0.4)	**1.2**(0.8)	**1.8**(1.0)	**2.8**(0.6)	**0.51**(0.1)	15/15
fminunc pa	**1.3**(0.8)	**0.97**(0)	**1.0**(0.3)	**1.9**(0.4)	**0.94**(0.1)	15/15
ga100 hol	18(7)	21(4)	30(5)	148(37)	817(934)	7/15
grid100 ho	47(46)	79(28)	124(32)	1526(1175)	∞ *1e6*	0/15
grid16 hol	13(9)	17(7)	26(6)	176(51)	1929(2210)	4/15
hill hol	5.5(3)	3.9(2)	4.7(1)	39(18)	3919(4349)	2/15
lmmCMA aug	**1.6**(0.7)	**2.6**(1)	3.3(0.9)	4.2(0.4)	**1.1**(0.2)	15/15
memPSODE v	9.3(3)	18(17)	22(16)	19(8)	3.9(1)	15/15
prcga saw	7.9(6)	14(7)	21(6)	67(14)	1825(2343)	6/15
ring100 ho	30(16)	46(13)	70(14)	298(43)	522(562)	10/15
ring16 hol	9.1(4)	10(2)	15(3)	1255(2385)	1252(1456)	5/15
simplex pa	53(35)	42(5)	79(74)	∞	∞ *4e5*	0/15

Table 111: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*2.5e+1*:15	*1.6e+1*:42	*1.0e+1*:75	*1.6e+0*:219	*6.3e-4*:1106	15/15
BIPOP-aCMA	13(9)	7.1(3)	5.4(1)	3.3(0.8)	3.1(0.4)	15/15
BIPOP-saAC	7.2(3)	4.0(1)	3.1(0.7)	**1.9**(0.3)	**1.3**(0.1)	15/15
CMAES hut	6.6(4)	4.6(3)	3.8(1)	**2.8**(0.6)	∞ *2006*	0/15
DE pal	28(11)	20(9)	22(7)	28(3)	∞ *4e5*	0/15
HCMA los	3.9(1)	**1.7**(0.4)	**1.3**(0.3)	**2.0**(1)	**1.5**(0.1)	15/15
HMLSL pal	**1.9**(0.8)	**1.1**(0.5)	**0.74**(0.3)	**0.49**(0.1)	**0.60**(0.1)	15/15
IPOP-10DDr	8.5(3)	4.7(2)	3.8(0.7)	**2.7**(0.4)	4.0(0.5)	15/15
IPOP-500 l	8.5(3)	4.7(2)	3.8(0.7)	**2.7**(0.4)	4.0(0.5)	15/15
IPOP-tany	5.7(4)	4.1(1)	3.6(1)	**2.9**(0.5)	4.3(0.4)	15/15
IPOP-texp	**2.5**(2)	**1.5**(0.8)	**1.6**(0.8)	**2.2**(0.3)	3.9(0.4)	15/15
IPOP lia	8.5(3)	4.7(2)	3.8(0.7)	**2.7**(0.4)	4.0(0.5)	15/15
MLSL pal	**1.9**(0.8)	**1.1**(0.5)	**0.74**(0.3)	**0.49**(0.1)	**0.60**(0.1)	15/15
OQNLP pal	3.1(0.1)	**1.6**(0.3)	**1.1**(0.0)	**0.64**(0.1)	**0.51**(0.1)$^{\star 2}$	15/15
P-DCN tra	25(26)	23(13)	22(8)	15(3)	1804(494)	15/15
P-zero tra	41(42)	29(18)	25(9)	16(5)	1.1e4(1e4)	13/15
SMAC hut	**2.0**(2)	3.3(7)	19(19)	∞	∞ *2000*	0/15
U-DCN tra	8.5(5)	6.0(4)	6.6(3)	12(3)	3944(1429)	15/15
U-zero tra	7.0(4)	4.2(2)	4.0(2)	5.0(1)	∞ *2e7*	0/15
fmincon pa	**1.9**(0.8)	**1.1**(0.5)	**0.74**(0.3)	**0.49**(0.1)	**0.60**(0.1)	15/15
fminunc pa	**2.1**(0.7)	**1.2**(0.2)	**1.0**(0.3)	**0.94**(0.3)	**0.78**(0.1)	15/15
ga100 hol	29(19)	21(11)	19(8)	22(6)	∞ *1e6*	0/15
grid100 ho	95(102)	115(61)	100(46)	105(21)	∞ *1e6*	0/15
grid16 hol	45(27)	26(15)	22(10)	19(4)	∞ *1e6*	0/15
hill hol	8.0(4)	4.1(2)	3.5(1)	3.4(0.7)	∞ *1e6*	0/15
lmmCMA aug	3.8(5)	**2.9**(2)	3.0(1)	**2.2**(0.5)	**1.9**(0.1)	15/15
memPSODE v	17(5)	11(2)	10(14)	10(6)	5.3(1)	15/15
prcga saw	12(10)	12(4)	12(5)	15(4)	4543(4521)	5/15
ring100 ho	50(56)	45(17)	50(11)	57(6)	∞ *1e6*	0/15
ring16 hol	19(10)	13(5)	11(5)	11(2)	∞ *1e6*	0/15
simplex pa	93(67)	53(21)	37(6)	2598(2622)	∞ *4e5*	0/15

Table 112: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*6.3e+2*:15	*4.0e+2*:67	*2.5e+2*:292	*1.6e+2*:846	*1.0e+2*:1671	15/15
BIPOP-aCMA	7.9(4)	3.8(1)	**1.5**(0.3)	**1.1**(0.3)	**1.5**(0.5)	15/15
BIPOP-saAC	4.0(2)	**2.1**(0.6)	**0.83**(0.3)	**0.93**(0.6)	**1.2**(0.4)	15/15
CMAES hut	4.2(4)	**2.3**(1)	**1.1**(0.2)	**0.90**(0.3)	**2.1**(1)	8/15
DE pal	13(8)	11(6)	7.2(2)	12(5)	142(122)	13/15
HCMA los	**3.3**(0.9)	**2.4**(3)	**1.5**(0.8)	**1.3**(0.9)	**1.3**(0.4)	15/15
HMLSL pal	26(61)	24(21)	10(7)	11(2)	6.2(0.1)	15/15
IPOP-10DDr	6.1(2)	**2.4**(0.5)	**1.0**(0.2)	**0.95**(0.5)	**1.3**(0.2)	15/15
IPOP-500 l	6.1(2)	**2.4**(0.5)	**1.0**(0.2)	**0.95**(0.5)	**1.3**(0.2)	15/15
IPOP-tany	**3.5**(2)	**1.9**(0.6)	**1.0**(0.2)	**0.88**(0.3)	**1.4**(0.3)	15/15
IPOP-texp	**1.9**(1)	**1.1**(0.5)	**0.80**(0.3)	**0.80**(0.3)	**1.3**(0.3)	15/15
IPOP lia	6.1(2)	**2.4**(0.5)	**1.0**(0.2)	**0.95**(0.5)	**1.3**(0.2)	15/15
MLSL pal	26(59)	22(18)	13(15)	253(185)	∞ *4e5*	0/15
OQNLP pal	61(54)	135(119)	189(198)	199(164)	358(380)	6/15
P-DCN tra	9.3e4(166)	2.6e5(4e5)	4.5e5(5e5)	∞	∞ *2e7*	0/15
P-zero tra	8.7e5(1e6)	∞	∞	∞	∞ *2e7*	0/15
SMAC hut	**1.1**(0.8)	**2.9**(1)	**2.8**(4)	∞	∞ *2000*	0/15
U-DCN tra	5.2(3)	3.4(2)	3.7(3)	31(55)	1.4e4(2e4)	7/15
U-zero tra	4.5(4)	**2.4**(1)	4.8(5)	3990(1e4)	2.4e4(3e4)	5/15
fmincon pa	29(59)	20(20)	41(88)	323(356)	1681(1799)	2/15
fminunc pa	20(50)	30(18)	144(286)	644(692)	3548(3660)	1/15
ga100 hol	16(12)	12(5)	5.5(1)	5.1(2)	11(3)	15/15
grid100 ho	24(23)	51(29)	65(49)	802(828)	3979(4490)	2/15
grid16 hol	13(12)	14(9)	261(43)	344(621)	1762(2094)	4/15
hill hol	7.8(6)	6.0(6)	636(1712)	2371(2958)	8394(9129)	1/15
lmmCMA aug	**1.4**(2)	**1.3**(0.9)	**0.77**(0.4)	**0.72**(0.3)	**0.86**(0.3)*	15/15
memPSODE v	83(65)	31(17)	21(20)	16(11)	20(10)	15/15
prcga saw	4.7(5)	6.6(3)	4.1(1)	3.9(1)	5.5(2)	15/15
ring100 ho	15(24)	27(12)	17(5)	18(7)	31(12)	15/15
ring16 hol	12(7)	6.8(4)	4.6(2)	5.9(3)	66(75)	14/15
simplex pa	66(52)	250(734)	1119(1189)	∞	∞ *4e5*	0/15

Table 113: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*4.0e+1*:26	*2.5e+1*:127	*1.6e+1*:540	*1.6e+1*:540	*1.0e+1*:1384	15/15
BIPOP-aCMA	5.1(6)	13(10)	4.0(2)	4.0(2)	**2.3**(0.9)	15/15
BIPOP-saAC	3.1(4)	10(4)	**2.9**(1.0)	**2.9**(1.0)	**1.3**(0.3)	15/15
CMAES hut	10(9)	12(8)	3.7(2)	3.7(3)	**2.1**(2)	9/15
DE pal	3.4(4)	30(35)	879(996)	879(937)	∞ *4e5*	0/15
HCMA los	**2.2**(0.9)	**3.5**(6)	3.2(3)	3.2(3)	**1.8**(0.8)	15/15
HMLSL pal	17(16)	44(44)	68(56)	68(56)	478(486)	7/15
IPOP-10DDr	**2.9**(3)	8.3(3)	**2.6**(0.7)	**2.6**(0.7)	**1.2**(0.3)	15/15
IPOP-500 l	**2.9**(3)	8.3(3)	**2.6**(0.7)	**2.6**(0.7)	**1.2**(0.3)	15/15
IPOP-tany	3.7(3)	9.2(6)	3.0(0.9)	3.0(0.9)	**1.3**(0.4)	15/15
IPOP-texp	3.1(4)	5.7(3)	**1.8**(0.7)	**1.8**(0.7)	**0.86**(0.3)	15/15
IPOP lia	**2.9**(3)	8.3(3)	**2.6**(0.7)	**2.6**(0.7)	**1.2**(0.3)	15/15
MLSL pal	17(16)	29(23)	78(83)	78(83)	1274(1415)	3/15
OQNLP pal	52(28)	183(326)	233(263)	233(236)	642(648)	3/15
P-DCN tra	**2.9**(2)	7.6(2)	8.0(18)	8.0(18)	2687(7227)	13/15
P-zero tra	**2.2**(1)	272(843)	9631(2e4)	9631(2e4)	2.3e4(3e4)	6/15
SMAC hut	**2.4**(3)	**1.5**(1)	**0.78**(0.4)	**0.78**(0.4)	**0.76**(0.5)	14/15
U-DCN tra	3.5(3)	**4.8**(3)	74(8)	74(8)	2759(7235)	13/15
U-zero tra	3.1(4)	**4.4**(5)	969(26)	969(26)	7416(7415)	12/15
fmincon pa	22(13)	29(21)	51(45)	51(45)	675(765)	5/15
fminunc pa	130(65)	938(1594)	1.0e4(1e4)	1.0e4(1e4)	∞ *4e5*	0/15
ga100 hol	**2.3**(3)	21(18)	14(6)	14(6)	59(2)	14/15
grid100 ho	3.7(4)	17(16)	37(30)	37(30)	294(387)	12/15
grid16 hol	**2.8**(4)	5.9(4)	98(73)	98(73)	276(365)	13/15
hill hol	**2.0**(2)	**4.4**(7)	26(44)	26(44)	322(382)	11/15
lmmCMA aug	4.8(7)	8.1(6)	**2.7**(0.9)	**2.7**(0.9)	**1.2**(0.4)	15/15
memPSODE v	3.7(5)	5.1(4)	10(8)	10(8)	8.5(9)	15/15
prcga saw	3.0(2)	16(15)	10(5)	10(5)	4.8(2)	15/15
ring100 ho	3.8(5)	13(6)	12(6)	12(6)	16(6)	15/15
ring16 hol	3.6(6)	5.5(5)	5.6(3)	5.6(3)	106(298)	14/15
simplex pa	56(4)	19(0.6)	34(14)	34(14)	130(121)	15/15

Table 114: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*1.6e+1*:11	*1.0e+1*:63	*6.3e+0*:305	*4.0e+0*:468	*1.0e+0*:1030	15/15
BIPOP-aCMA	7.7(7)	4.2(2)	**1.4**(0.4)	**1.3**(0.3)	**2.0**(0.3)	15/15
BIPOP-saAC	5.9(4)	**2.8**(1)	**1.0**(0.3)	**1.0**(0.3)	3.3(4)	15/15
CMAES hut	4.2(4)	**1.8**(1)	**0.89**(0.3)	**0.96**(0.3)	**1.0**(0.5)	15/15
DE pal	8.6(14)	8.2(4)	4.4(2)	8.4(2)	17(3)	15/15
HCMA los	5.6(3)	**2.7**(4)	**1.5**(1.0)	**1.6**(0.2)	**2.8**(1)	15/15
HMLSL pal	28(10)	24(41)	14(15)	17(5)	21(7)	15/15
IPOP-10DDr	4.3(4)	**1.9**(0.8)	**0.82**(0.2)	**0.81**(0.1)	**0.78**(0.1)	15/15
IPOP-500 l	4.3(4)	**1.9**(0.8)	**0.82**(0.2)	**0.81**(0.1)	**0.78**(0.1)	15/15
IPOP-tany	**2.7**(2)	**1.7**(0.8)	**0.88**(0.3)	**0.91**(0.2)	**0.96**(0.2)	15/15
IPOP-texp	**2.4**(4)	**1.2**(0.9)	**0.65**(0.2)	**0.78**(0.4)	**0.96**(0.2)	15/15
IPOP lia	4.3(4)	**1.9**(0.8)	**0.82**(0.2)	**0.81**(0.1)	**0.78**(0.1)	15/15
MLSL pal	28(10)	22(30)	22(23)	1162(1366)	∞ *4e5*	0/15
OQNLP pal	43(83)	100(33)	126(197)	696(697)	∞ *3e5*	0/15
P-DCN tra	3.2(3)	**2.6**(2)	2.4e4(3e4)	∞	∞ *2e7*	0/15
P-zero tra	3.9(2)	2.3e4(7)	4.3e5(5e5)	∞	∞ *2e7*	0/15
SMAC hut	**0.52**(1)	**0.92**(1)	15(19)	61(69)	∞ *2000*	0/15
U-DCN tra	3.8(3)	**1.9**(1)	10(3)	8233(2e4)	∞ *2e7*	0/15
U-zero tra	**2.6**(2)	**1.7**(0.7)	222(48)	2.0e4(4e4)	∞ *2e7*	0/15
fmincon pa	20(10)	21(28)	14(14)	728(834)	∞ *4e5*	0/15
fminunc pa	87(218)	19(38)	106(103)	1499(1794)	∞ *4e5*	0/15
ga100 hol	**3.0**(5)	7.4(3)	4.1(1)	5.1(1)	8.9(3)	15/15
grid100 ho	9.2(16)	25(28)	276(349)	2605(3479)	∞ *1e6*	0/15
grid16 hol	11(21)	21(21)	2350(3274)	8681(9625)	∞ *1e6*	0/15
hill hol	26(27)	6895(7988)	1.3e4(2e4)	∞	∞ *1e6*	0/15
lmmCMA aug	**0.62**(0.8)	**1**(1)	**0.65**(0.4)	**0.79**(0.3)	**1.4**(0.6)	14/15
memPSODE v	136(103)	39(22)	28(18)	55(36)	194(137)	15/15
prcga saw	3.5(6)	**2.6**(2)	**2.5**(1)	3.9(1.0)	490(971)	12/15
ring100 ho	3.7(5)	12(10)	11(6)	20(9)	1587(2000)	6/15
ring16 hol	4.9(7)	4.6(2)	6.2(5)	787(1072)	∞ *1e6*	0/15
simplex pa	49(62)	25(15)	220(485)	5764(6415)	∞ *4e5*	0/15

Table 115: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*4.0e+1*:116	*2.5e+1*:252	*1.6e+1*:430	*1.0e+1*:621	*4.0e+0*:1090	15/15
BIPOP-aCMA	**1.7**(0.7)	**1.3**(0.4)	**1.2**(0.4)	**1.2**(0.2)	**1.1**(0.3)	15/15
BIPOP-saAC	**1.4**(0.7)	**1.2**(0.4)	**1.1**(0.5)	**1.1**(0.5)	**1.1**(0.4)	15/15
CMAES hut	**0.82**(0.8)	**0.95**(0.4)	**0.96**(0.3)	**0.94**(0.3)	**1.0**(0.3)	15/15
DE pal	3.6(3)	5.7(2)	7.7(3)	13(5)	20(5)	15/15
HCMA los	**0.93**(0.6)	**1.5**(1)	**1.6**(0.4)	**1.4**(0.4)	**1.3**(0.4)	15/15
HMLSL pal	6.8(15)	13(12)	16(3)	18(4)	25(12)	15/15
IPOP-10DDr	**0.97**(0.3)	**0.87**(0.4)	**0.84**(0.2)	**0.87**(0.2)	**0.87**(0.2)	15/15
IPOP-500 l	**0.97**(0.3)	**0.87**(0.4)	**0.84**(0.2)	**0.87**(0.2)	**0.87**(0.2)	15/15
IPOP-tany	**0.78**(0.4)	**0.82**(0.2)	**0.83**(0.2)	**0.85**(0.2)	**0.88**(0.2)	15/15
IPOP-texp	**0.53**(0.3)	**0.67**(0.4)	**0.83**(0.3)	**0.97**(0.2)	**1.1**(0.5)	15/15
IPOP lia	**0.97**(0.3)	**0.87**(0.4)	**0.84**(0.2)	**0.87**(0.2)	**0.87**(0.2)	15/15
MLSL pal	6.5(15)	11(9)	1501(1405)	∞	∞ *4e5*	0/15
OQNLP pal	19(47)	87(89)	776(953)	1715(1692)	∞ *3e5*	0/15
P-DCN tra	252(153)	2.9e4(4e4)	3.0e5(4e5)	∞	∞ *2e7*	0/15
P-zero tra	1.3e4(4229)	1.2e5(2e5)	6.5e5(8e5)	∞	∞ *2e7*	0/15
SMAC hut	**0.31**(0.2)$_{\downarrow 2}$	8.3(10)	20(23)	22(26)	∞ *2000*	0/15
U-DCN tra	**0.98**(0.7)	**2.1**(2)	3422(423)	1.7e4(3e4)	7.8e4(9e4)	3/15
U-zero tra	11(0.6)	23(45)	5058(8837)	7.5e4(9e4)	∞ *2e7*	0/15
fmincon pa	7.0(14)	18(21)	823(1085)	∞	∞ *4e5*	0/15
fminunc pa	9.2(21)	37(75)	1943(2813)	∞	∞ *4e5*	0/15
ga100 hol	3.5(3)	4.8(1)	5.6(1)	80(2)	239(461)	12/15
grid100 ho	8.5(8)	138(185)	4123(4764)	1.1e4(1e4)	∞ *1e6*	0/15
grid16 hol	14(12)	1476(2014)	4200(4794)	2.4e4(3e4)	∞ *1e6*	0/15
hill hol	685(152)	3963(5947)	1.5e4(2e4)	∞	∞ *1e6*	0/15
lmmCMA aug	**0.41**(0.6)$_{\downarrow}$	**0.57**(0.3)	**0.77**(0.3)	**0.76**(0.3)	**0.85**(0.3)	15/15
memPSODE v	26(6)	43(20)	51(30)	81(61)	171(124)	15/15
prcga saw	**1.3**(1)	**2.5**(1)	3.3(1)	3.9(1)	16(2)	15/15
ring100 ho	7.3(5)	11(6)	21(8)	54(49)	1176(1407)	7/15
ring16 hol	**2.2**(1)	3.8(2)	258(597)	815(1610)	∞ *1e6*	0/15
simplex pa	15(7)	196(236)	4364(4197)	∞	∞ *4e5*	0/15

Table 116: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:2.5e5	*1.0e-1*:3.4e5	*6.3e-2*:3.4e5	*4.0e-2*:3.4e5	*2.5e-2*:3.4e5	3/15
BIPOP-aCMA	**0.88**(0.7)	**1.2**(1)	**2.6**(2)	5.2(5)	7.1(4)	15/15
BIPOP-saAC	**0.48**(0.4)	**0.72**(0.8)	**1.3**(0.9)	3.3(3)	5.5(3)	15/15
CMAES hut	∞	∞	∞	∞	∞ *2006*	0/15
DE pal	∞	∞	∞	∞	∞ *4e5*	0/15
HCMA los	**0.48**(0.3)	**0.72**(0.7)	**1.8**(1)	5.3(3)	10(6)	15/15
HMLSL pal	**6.2e-4**$(0)_{\downarrow 4}$	**7.3e-4**$(0)_{\downarrow 4}$	**8.8e-4**$(4e\text{-}5)_{\downarrow 4}$	**1.0e-3**$(7e\text{-}5)_{\downarrow 4}$	**1.2e-3**$(7e\text{-}5)_{\downarrow 4}$	15/15
IPOP-10DDr	5.1(5)	4.0(3)	5.0(6)	6.6(6)	7.5(5)	15/15
IPOP-500 l	5.1(5)	4.0(3)	5.1(5)	7.0(6)	16(19)	15/15
IPOP-tany	4.6(6)	3.7(4)	4.3(4)	5.5(5)	7.5(5)	15/15
IPOP-texp	**2.6**(2)	**2.0**(2)	**2.6**(2)	4.0(3)	5.5(2)	15/15
IPOP lia	5.1(5)	4.0(3)	5.0(6)	6.6(6)	7.5(5)	15/15
MLSL pal	**6.2e-4**$(0)_{\downarrow 4}$	**7.3e-4**$(0)_{\downarrow 4}$	**8.8e-4**$(4e\text{-}5)_{\downarrow 4}$	**1.0e-3**$(7e\text{-}5)_{\downarrow 4}$	**1.2e-3**$(7e\text{-}5)_{\downarrow 4}$	15/15
OQNLP pal	**4.6e-4**$(2e\text{-}6)^{\star 4}_{\downarrow 4}$	**5.4e-4**$(1e\text{-}6)^{\star 4}_{\downarrow 4}$	**6.0e-4**$(1e\text{-}6)^{\star 4}_{\downarrow 4}$	**6.7e-4**$(1e\text{-}6)^{\star 4}_{\downarrow 4}$	**7.4e-4**$(1e\text{-}6)^{\star 4}_{\downarrow 4}$	15/15
P-DCN tra	∞	∞	∞	∞	∞ *2e7*	0/15
P-zero tra	∞	∞	∞	∞	∞ *2e7*	0/15
SMAC hut	∞	∞	∞	∞	∞ *2000*	0/15
U-DCN tra	∞	∞	∞	∞	∞ *2e7*	0/15
U-zero tra	∞	∞	∞	∞	∞ *2e7*	0/15
fmincon pa	**6.2e-4**$(0)_{\downarrow 4}$	**7.3e-4**$(0)_{\downarrow 4}$	**8.8e-4**$(4e\text{-}5)_{\downarrow 4}$	**1.0e-3**$(7e\text{-}5)_{\downarrow 4}$	**1.2e-3**$(7e\text{-}5)_{\downarrow 4}$	15/15
fminunc pa	**7.1e-4**$(4e\text{-}5)_{\downarrow 4}$	**6.5e-4**$(3e\text{-}5)_{\downarrow 4}$	**7.6e-4**$(3e\text{-}5)_{\downarrow 4}$	**8.3e-4**$(3e\text{-}5)_{\downarrow 4}$	**8.9e-4**$(3e\text{-}5)_{\downarrow 4}$	15/15
ga100 hol	∞	∞	∞	∞	∞ *1e6*	0/15
grid100 ho	∞	∞	∞	∞	∞ *1e6*	0/15
grid16 hol	∞	∞	∞	∞	∞ *1e6*	0/15
hill hol	∞	∞	∞	∞	∞ *1e6*	0/15
lmmCMA aug	∞	∞	∞	∞	∞ *8805*	0/15
memPSODE v	30(28)	134(137)	∞	∞	∞ *1e7*	0/15
prcga saw	**0.19**$(0.2)_{\downarrow 2}$	**0.35**(0.2)	**0.70**(0.5)	**1.1**(0.7)	**1.4**(1)	15/15
ring100 ho	∞	∞	∞	∞	∞ *1e6*	0/15
ring16 hol	∞	∞	∞	∞	∞ *1e6*	0/15
simplex pa	**2.5e-3**$(6e\text{-}4)_{\downarrow 4}$	**0.18**$(0.6)_{\downarrow 3}$	**1.8**(2)	7.6(9)	∞ *4e5*	0/15

Table 117: 20-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*1.6e+4*:38	*1.0e+4*:42	*2.5e+2*:62	*2.5e+0*:250	*1.6e+0*:2536	15/15
BIPOP-aCMA	4.9(3)	5.6(2)	7.0(1)	5.8(1)	23(25)	15/15
BIPOP-saAC	**2.8**(1)	3.1(0.7)	3.4(0.5)	4.4(1.0)	10(6)	15/15
CMAES hut	**2.7**(1)	**2.8**(2)	5.2(1)	5.1(1)	3.8(4)	3/15
DE pal	11(5)	15(3)	36(8)	68(21)	35(13)	15/15
HCMA los	**1.1**(0)	**1.00**(0)	**0.79**(0.2)	4.1(3)	10(7)	15/15
HMLSL pal	**0.60**(0)$_{\downarrow}$	**0.55**(0)$_{\downarrow 4}$	**1.5**(0)	**2.2**(0.5)	8.2(4)	15/15
IPOP-10DDr	4.0(1)	4.7(1)	6.0(1)	6.6(2)	31(30)	15/15
IPOP-500 l	4.0(1)	4.7(1)	6.0(1)	6.6(2)	31(30)	15/15
IPOP-tany	3.1(1)	3.8(0.8)	5.9(1)	9.1(1)	30(38)	15/15
IPOP-texp	**0.26**(0.2)$_{\downarrow}$	**0.41**(0.2)$_{\downarrow 4}$	**2.0**(0.8)	5.5(2)	41(58)	15/15
IPOP lia	4.0(1)	4.7(1)	6.0(1)	6.6(2)	31(30)	15/15
MLSL pal	**0.60**(0)$_{\downarrow}$	**0.55**(0)$_{\downarrow 4}$	**1.5**(0)	**2.2**(0.5)	5.2(4)	15/15
OQNLP pal	**1.2**(0)	**1.1**(0)	**0.79**(0)	**1.9**(2e-3)	51(54)	10/15
P-DCN tra	9.4(8)	13(8)	24(5)	8.3(1)	7.7(2)	15/15
P-zero tra	11(10)	15(9)	24(6)	8.1(2)	15(39)	15/15
SMAC hut	**0.25**(0.1)$_{\downarrow}$	**0.46**(0.2)$_{\downarrow 4}$	**0.90**(0.2)	∞	∞ *2000*	0/15
U-DCN tra	3.8(1)	5.0(2)	14(7)	10(4)	**2.2**(1)	15/15
U-zero tra	3.2(1)	3.8(2)	8.3(4)	4.7(1)	**1.1**(0.5)	15/15
fmincon pa	**0.60**(0)$_{\downarrow}$	**0.55**(0)$_{\downarrow 4}$	**1.5**(0)	**2.2**(0.5)	6.9(5)	15/15
fminunc pa	**0.57**(0)$_{\downarrow}$	**0.52**(0)$_{\downarrow 4}$	**0.69**(0)	8.5(0.3)	4.2(2)	15/15
ga100 hol	16(6)	21(5)	37(7)	23(3)	3.8(0.6)	15/15
grid100 ho	49(30)	59(40)	151(55)	82(26)	18(7)	15/15
grid16 hol	12(4)	17(8)	27(9)	14(5)	**2.6**(0.8)	15/15
hill hol	3.6(2)	3.9(2)	5.7(2)	**2.7**(1)	**0.73**(0.3)	15/15
lmmCMA aug	**0.91**(0.9)	**1.4**(2)	3.9(0.9)	6.6(1)	23(28)	2/15
memPSODE v	24(27)	27(26)	27(21)	9.5(5)	3.2(2)	15/15
prcga saw	**2.6**(2)	4.1(2)	10(4)	16(4)	5.3(3)	15/15
ring100 ho	28(19)	39(15)	79(13)	44(9)	7.2(1)	15/15
ring16 hol	8.9(4)	11(4)	18(4)	9.3(1)	**1.5**(0.3)	15/15
simplex pa	9.1(0.2)	10(0.2)	68(31)	264(345)	2326(2528)	1/15

Table 118: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*6.3e+1*:36	*4.0e+1*:77	*4.0e+1*:77	*1.6e+1*:456	*4.0e+0*:1094	15/15
BIPOP-aCMA	6.3(3)	3.9(1)	3.9(1)	**2.6**(6)	5.5(6)	15/15
BIPOP-saAC	4.6(1)	4.4(1)	4.4(1)	**1.4**(2)	**2.0**(2)	15/15
CMAES hut	4.5(2)	3.3(1)	3.3(1)	**3.0**(4)	4.1(5)	5/15
DE pal	32(20)	35(18)	35(18)	74(8)	64(183)	13/15
HCMA los	**1.7**(0.3)	**0.94**(0.1)	**0.94**(0.1)	**0.59**(0.5)	**0.96**(1)	15/15
HMLSL pal	**0.82**(0.3)	**0.64**(0.2)	**0.64**(0.2)	3.6(8)	4.4(5)	15/15
IPOP-10DDr	5.2(1)	3.6(0.6)	3.6(0.6)	3.0(6)	10(11)	15/15
IPOP-500 l	5.2(1)	3.6(0.6)	3.6(0.6)	3.0(6)	10(11)	15/15
IPOP-tany	4.3(2)	3.1(0.8)	3.1(0.8)	**2.2**(5)	**1.8**(2)	15/15
IPOP-texp	**2.0**(0.8)	**2.0**(1)	**2.0**(1)	**2.7**(0.7)	66(162)	15/15
IPOP lia	5.2(1)	3.6(0.6)	3.6(0.6)	3.0(6)	10(11)	15/15
MLSL pal	**0.82**(0.3)	**0.64**(0.2)	**0.64**(0.2)	**0.93**(2)	**1.2**(2)	15/15
OQNLP pal	**1.4**(0.0)	**0.88**(0.3)	**0.88**(0.3)	**0.51**(0.7)	**0.84**(0.9)	15/15
P-DCN tra	21(16)	18(9)	18(9)	1.1e4(2e4)	3.7e4(5e4)	5/15
P-zero tra	18(12)	15(7)	15(7)	3134(3)	2.1e4(3e4)	7/15
SMAC hut	7.5(6)	4.2(3)	4.2(3)	**2.7**(4)	5.2(6)	4/15
U-DCN tra	6.5(3)	5.9(3)	5.9(3)	6744(2e4)	2.7e4(4e4)	6/15
U-zero tra	6.4(2)	1.9e4(3)	1.9e4(3)	1.1e4(2e4)	2.7e4(4e4)	6/15
fmincon pa	**0.82**(0.3)	**0.64**(0.2)	**0.64**(0.2)	**0.96**(2)	**0.92**(0.9)	15/15
fminunc pa	**1.5**(0.6)	**1.2**(0.5)	**1.2**(0.5)	**1.1**(2)	**1.6**(2)	15/15
ga100 hol	29(11)	22(6)	22(6)	6.9(2)	806(918)	8/15
grid100 ho	115(57)	1027(54)	1027(54)	1133(2191)	3768(4518)	3/15
grid16 hol	17(7)	16(6)	16(6)	801(1098)	1841(2742)	5/15
hill hol	44(7)	956(139)	956(139)	1462(2191)	1829(2286)	5/15
lmmCMA aug	3.5(1)	**2.5**(1.0)	**2.5**(1.0)	**1.3**(2)	4.3(5)	11/15
memPSODE v	11(1)	8.7(10)	8.7(10)	5.4(8)	21(35)	15/15
prcga saw	20(12)	20(9)	20(9)	1099(2187)	6597(8455)	3/15
ring100 ho	47(21)	45(10)	45(10)	14(2)	12(3)	15/15
ring16 hol	13(5)	11(5)	11(5)	3.5(2)	460(914)	10/15
simplex pa	56(27)	32(3)	32(3)	10(6)	70(73)	15/15

Table 119: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*6.3e+1*:45	*4.0e+1*:68	*4.0e+1*:68	*1.6e+1*:231	*6.3e+0*:1219	15/15
BIPOP-aCMA	6.4(3)	15(35)	15(35)	88(29)	82(213)	15/15
BIPOP-saAC	3.8(2)	13(16)	13(16)	8.3(21)	43(29)	15/15
CMAES hut	3.9(2)	8.4(15)	8.4(15)	6.0(9)	**1.6**(2)	9/15
DE pal	35(11)	45(28)	45(28)	456(870)	498(657)	6/15
HCMA los	**2.3**(0.3)	6.9(3)	6.9(3)	8.2(12)	32(74)	15/15
HMLSL pal	**0.99**(0.0)	6.7(0.3)	6.7(0.3)	13(22)	124(168)	11/15
IPOP-10DDr	4.4(1)	4.0(1)	4.0(1)	10(26)	1610(1374)	14/15
IPOP-500 l	4.4(1)	4.0(1)	4.0(1)	10(26)	4374(8204)	12/15
IPOP-tany	4.4(2)	9.0(3)	9.0(3)	17(27)	1469(1146)	14/15
IPOP-texp	3.2(2)	**4.0**(3)	**4.0**(3)	20(27)	194(423)	15/15
IPOP lia	4.4(1)	4.0(1)	4.0(1)	10(26)	4178(8204)	12/15
MLSL pal	**0.99**(0.0)	**2.7**(0.3)	**2.7**(0.3)	**3.2**(4)	**2.4**(3)	15/15
OQNLP pal	**1.2**(0.0)	**1.8**(0.4)	**1.8**(0.4)	**1.2**(1)	9.1(16)	13/15
P-DCN tra	23(17)	25(13)	25(13)	3.2e4(4e4)	2.5e4(3e4)	6/15
P-zero tra	3.2e4(6)	2.1e4(13)	2.1e4(13)	3.2e4(4e4)	1.1e4(2e4)	9/15
SMAC hut	10(22)	7.3(15)	7.3(15)	**4.2**(5)	**2.0**(2)	7/15
U-DCN tra	6.3(4)	2.1e4(29)	2.1e4(29)	4.3e4(9e4)	1.9e4(2e4)	7/15
U-zero tra	4.1(2)	2.1e4(3)	2.1e4(3)	2.2e4(4e4)	1.4e4(2e4)	8/15
fmincon pa	**0.99**(0.0)	**2.5**(0.3)	**2.5**(0.3)	**2.9**(4)	**3.5**(2)	15/15
fminunc pa	**1.1**(0.2)	**3.1**(1)	**3.1**(1)	**2.9**(4)	**1.6**(2)	15/15
ga100 hol	24(12)	30(12)	30(12)	325(19)	414(820)	10/15
grid100 ho	90(42)	1164(73)	1164(73)	2953(4352)	1662(2058)	5/15
grid16 hol	25(14)	3724(7404)	3724(7404)	2914(4333)	2258(2871)	4/15
hill hol	3.7(2)	1060(3)	1060(3)	1084(2166)	718(1230)	8/15
lmmCMA aug	3.1(1)	5.8(2)	5.8(2)	5.9(6)	3.8(5)	11/15
memPSODE v	5.6(2)	6.9(3)	6.9(3)	18(9)	18(32)	15/15
prcga saw	19(11)	21(8)	21(8)	387(128)	496(821)	11/15
ring100 ho	44(23)	49(13)	49(13)	26(9)	68(12)	14/15
ring16 hol	12(5)	12(5)	12(5)	316(6)	207(411)	12/15
simplex pa	54(3)	41(6)	41(6)	30(32)	80(87)	15/15

Table 120: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*6.3e+0*:29	*4.0e+0*:118	*2.5e+0*:306	*2.5e+0*:306	*1.0e+0*:1614	15/15
BIPOP-aCMA	**2.9**(4)	19(20)	59(31)	59(31)	23(26)	15/15
BIPOP-saAC	4.7(5)	11(18)	75(69)	75(69)	29(36)	15/15
CMAES hut	7.5(8)	23(25)	97(98)	97(102)	∞ *2006*	0/15
DE pal	**1.4**(1)	7.8(6)	94(111)	94(111)	∞ *4e5*	0/15
HCMA los	3.6(2)	9.5(20)	31(40)	31(40)	23(15)	15/15
HMLSL pal	7.3(7)	**3.8**(2)	**2.8**(2)	**2.8**(2)	**6.4**(5)	15/15
IPOP-10DDr	**1.3**(1)	6.8(7)	50(36)	50(36)	35(39)	15/15
IPOP-500 l	**1.3**(1)	6.8(7)	50(36)	50(36)	35(39)	15/15
IPOP-tany	**1.6**(1)	7.7(10)	57(65)	57(65)	20(23)	15/15
IPOP-texp	**1.4**(1.0)	6.8(5)	46(61)	46(61)	28(36)	15/15
IPOP lia	**1.3**(1)	6.8(7)	50(36)	50(36)	35(39)	15/15
MLSL pal	7.3(7)	**3.8**(2)	**2.8**(2)	**2.8**(2)	**3.4**(3)	15/15
OQNLP pal	13(25)	5.3(6)	**3.7**(3)	**3.7**(3)	**3.5**(4)	15/15
P-DCN tra	**2.1**(2)	**3.1**(2)	4.1(4)	4.1(4)	1083(876)	14/15
P-zero tra	**1.4**(2)	**2.1**(1)	**3.3**(4)	**3.3**(4)	2304(5644)	14/15
SMAC hut	**1.6**(2)	5.0(8)	46(52)	46(49)	∞ *2000*	0/15
U-DCN tra	**1.3**(1)	**3.7**(4)	17(15)	17(15)	4711(6304)	12/15
U-zero tra	**1.1**(1)	5.9(7)	20(19)	20(19)	3936(6378)	12/15
fmincon pa	5.0(5)	4.8(5)	**3.2**(2)	**3.2**(2)	**4.4**(5)	15/15
fminunc pa	20(15)	10(7)	18(16)	18(16)	248(248)	10/15
ga100 hol	**1.1**(1)	7.3(8)	92(102)	92(102)	1486(1693)	5/15
grid100 ho	**1.9**(1)	8.7(13)	40(34)	40(34)	2274(2122)	4/15
grid16 hol	**2.8**(3)	5.4(7)	53(70)	53(70)	459(638)	10/15
hill hol	**1.7**(3)	6.3(8)	20(29)	20(29)	1120(1344)	6/15
lmmCMA aug	**1.9**(3)	8.2(9)	408(454)	408(447)	∞ *8823*	0/15
memPSODE v	12(14)	18(27)	13(13)	13(13)	25(20)	15/15
prcga saw	**1.8**(2)	12(8)	90(124)	90(124)	2615(2671)	4/15
ring100 ho	**2.1**(2)	7.9(11)	46(43)	46(43)	274(336)	12/15
ring16 hol	**2.1**(2)	5.5(5)	21(24)	21(24)	264(353)	12/15
simplex pa	38(25)	17(4)	8.4(0.3)	8.4(0.3)	**1.9**(0.2)	15/15

Table 121: 20-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*2.5e+2*:208	*1.6e+2*:918	*1.0e+2*:6628	*6.3e+1*:9885	*4.0e+1*:31629	15/15
BIPOP-aCMA	**1.6**(0.3)	**1.5**(0.9)	3.4(4)	**2.8**(3)	**1.3**(1)	15/15
BIPOP-saAC	**1.1**(0.5)	**1.3**(0.9)	4.4(5)	6.0(10)	**2.2**(3)	15/15
CMAES hut	**1.1**(0.3)	**1.8**(1)	∞	∞	∞ *2006*	0/15
DE pal	9.3(4)	19(12)	277(288)	∞	∞ *4e5*	0/15
HCMA los	**0.44**(0.2)$_{\downarrow 4}$	**0.47**(0.5)	5.6(6)	5.5(4)	**2.0**(2)	15/15
HMLSL pal	**0.51**(0.3)$_{\downarrow 3}$	**1.9**(6)	**1.9**(0.8)	3.1(3)	12(14)	9/15
IPOP-10DDr	**1.3**(0.3)	**1.5**(1)	**1.6**(2)	**1.6**(1)	**1.4**(0.8)	15/15
IPOP-500 l	**1.3**(0.3)	**1.5**(1)	**1.6**(2)	**1.6**(1)	**1.4**(0.8)	15/15
IPOP-tany	**1.2**(0.3)	**1.7**(1)	**1.8**(1)	**1.4**(0.7)	**1.1**(0.9)	15/15
IPOP-texp	**0.33**(0.3)$_{\downarrow 3}$	**1.2**(1)	**1.8**(2)	**1.4**(1)	**1.2**(1)	15/15
IPOP lia	**1.3**(0.3)	**1.5**(1)	**1.6**(2)	**1.6**(1)	**1.4**(0.8)	15/15
MLSL pal	**0.51**(0.3)$_{\downarrow 3}$	31(108)	893(907)	∞	∞ *4e5*	0/15
OQNLP pal	**0.32**(0.1)$_{\downarrow 4}$	**0.54**(0.2)	3.9(4)	18(17)	37(42)	3/15
P-DCN tra	1.1e5(1e5)	3.0e5(3e5)	∞	∞	∞ *2e7*	0/15
P-zero tra	1.3e6(2e6)	∞	∞	∞	∞ *2e7*	0/15
SMAC hut	**0.65**(0.6)	10(11)	∞	∞	∞ *2000*	0/15
U-DCN tra	**2.6**(1)	39(20)	2680(4526)	∞	∞ *2e7*	0/15
U-zero tra	101(15)	5659(1e4)	4.2e4(4e4)	∞	∞ *2e7*	0/15
fmincon pa	**0.51**(0.3)$_{\downarrow 3}$	12(3)	886(997)	∞	∞ *4e5*	0/15
fminunc pa	**0.62**(0.5)	**0.35**(0.2)	∞	∞	∞ *4e5*	0/15
ga100 hol	7.1(2)	6.0(3)	11(6)	19(18)	43(42)	8/15
grid100 ho	56(35)	796(1015)	2249(2339)	∞	∞ *1e6*	0/15
grid16 hol	33(24)	802(825)	2151(2414)	∞	∞ *1e6*	0/15
hill hol	479(664)	626(1089)	650(761)	∞	∞ *1e6*	0/15
lmmCMA aug	**0.74**(0.2)$_{\downarrow}$	**1.1**(0.8)	**1.4**(1)	**1.2**(1.0)	**1.2**(1)	3/15
memPSODE v	50(25)	20(9)	6.4(4)	9.4(7)	13(8)	15/15
prcga saw	**1.7**(0.6)	7.6(8)	4.9(2)	5.0(5)	**2.7**(4)	15/15
ring100 ho	23(6)	31(14)	23(14)	116(109)	462(506)	1/15
ring16 hol	5.6(3)	13(9)	67(85)	673(799)	∞ *1e6*	0/15
simplex pa	**2.4**(1)	∞	∞	∞	∞ *4e5*	0/15

Table 122: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_1 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f1	*2.5e+2*:48	*1.6e+2*:82	*1.0e-8*:83	*1.0e-8*:83	*1.0e-8*:83	15/15
BIPOP-aCMA	3.4(0.9)	**2.6**(0)	**19**(0)	**19**(0)	**19**(0)	15/15
BIPOP-saAC	**1.7**(1.0)	**1.7**(0.6)	**14**(0.8)	**14**(0.8)	**14**(0.8)	15/15
CMAES hut	**1.7**(1)	**1.9**(0.5)	∞	∞	∞ *4007*	0/15
IPOP-10DDr	**0.44**(1)	**2.4**(0.3)	63(2)	63(2)	63(2)	15/15
IPOP-500 l	**0.44**(1)	**2.4**(0.3)	63(2)	63(2)	63(2)	15/15
IPOP-tany	**0.39**(1)	**1.8**(0.5)	67(2)	67(2)	67(2)	15/15
IPOP-texp	**0.11**(0.2)	**0.69**(0.4)$^{\star 2}$	60(2)	60(2)	60(2)	15/15
IPOP lia	**0.44**(1)	**2.4**(0.3)	63(2)	63(2)	63(2)	15/15
ga100 hol	7.9(5)	12(4)	∞	∞	∞ *2e6*	0/15
grid100 ho	43(19)	82(24)	∞	∞	∞ *2e6*	0/15
grid16 hol	10(6)	14(5)	∞	∞	∞ *2e6*	0/15
hill hol	3.7(2)	3.3(1)	∞	∞	∞ *2e6*	0/15
memPSODE v	**2.9**(0)	**1.8**(0)	**1.8**(0)$^{\star 4}$	**1.8**(0)$^{\star 4}$	**1.8**(0)$^{\star 4}$	15/15
prcga saw	**1.8**(3)	5.6(5)	6936(4284)	6936(4284)	6936(4284)	15/15
ring100 ho	14(11)	28(7)	∞	∞	∞ *2e6*	0/15
ring16 hol	5.0(2)	6.2(2)	∞	∞	∞ *2e6*	0/15

Table 123: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_2 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f2	*1.0e+7*:39	*6.3e+6*:71	*4.0e+5*:121	*2.5e+4*:499	*1.0e-8*:1188	15/15
BIPOP-aCMA	**1.9**(2)	**2.6**(0.6)	**3.5**(0.4)$^{\star 4}$	**1.1**(0.1)$^{\star 4}$	**41**(0.8)	15/15
BIPOP-saAC	**1.2**(0.9)	**1.3**(0.9)	11(5)	**4.3**(0.8)	**7.5**(0.9)	15/15
CMAES hut	**1.2**(0.8)	**1.0**(0.7)	15(3)	∞	∞ *4007*	0/15
IPOP-10DDr	**1.8**(2)	**2.1**(2)	11(3)	11(2)	68(1)	15/15
IPOP-500 l	**1.8**(2)	**2.1**(2)	11(3)	11(2)	68(1)	15/15
IPOP-tany	**0.90**(0.7)	**1.1**(0.9)	11(2)	12(1.0)	66(1)	15/15
IPOP-texp	**0.45**(0.5)	**0.49**(0.5)	**7.2**(2)	10(2)	62(1)	15/15
IPOP lia	**1.8**(2)	**2.1**(2)	11(3)	11(2)	68(1)	15/15
ga100 hol	3.9(4)	6.9(3)	33(6)	21(3)	∞ *2e6*	0/15
grid100 ho	9.0(7)	24(20)	142(19)	91(19)	∞ *2e6*	0/15
grid16 hol	6.1(6)	7.8(4)	24(5)	16(4)	∞ *2e6*	0/15
hill hol	7.6(4)	5.0(2)	**5.9**(2)	**4.9**(3)	∞ *2e6*	0/15
memPSODE v	3.0(2)	**2.2**(1)	8.9(4)	6.5(0.5)	**16**(0.5)	15/15
prcga saw	**1.2**(1)	**2.0**(1)	13(2)	8.4(2)	1.1e4(1e4)	4/15
ring100 ho	4.1(7)	11(10)	66(13)	45(6)	∞ *2e6*	0/15
ring16 hol	4.4(4)	4.5(2)	14(3)	10(1)	∞ *2e6*	0/15

Table 124: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_3 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f3	*1.6e+3*:68	*1.0e+3*:222	*6.3e+2*:471	*4.0e+2*:662	*6.3e+1*:6332	15/15
BIPOP-aCMA	**2.5**(0.7)	**0.94**(0)	**0.60**(0)	**0.55**(0)$^{\star 4}$	**0.25**(0.0)$^{\star 4}$	15/15
BIPOP-saAC	**1.5**(0.8)	**0.93**(0.2)	**0.68**(0.1)	**1.5**(0.7)	**1.5**(0.8)	15/15
CMAES hut	**1.2**(0.5)	**1.0**(0.3)	**1.1**(0.3)	**1.7**(0.4)	∞ *4007*	0/15
IPOP-10DDr	**1.2**(1)	**1.1**(0.2)	**0.99**(0.2)	**1.5**(0.3)	3.8(5)	15/15
IPOP-500 l	**1.2**(1)	**1.1**(0.2)	**0.99**(0.2)	**1.5**(0.3)	3.8(5)	15/15
IPOP-tany	**0.65**(0.8)	**0.97**(0.2)	**0.84**(0.2)	**1.5**(0.3)	**2.0**(2)	15/15
IPOP-texp	**0.13**(0.1)	**0.32**(0.2)$^{\star 4}$	**0.50**(0.1)	**1.4**(0.5)	3.3(2)	15/15
IPOP lia	**1.2**(1)	**1.1**(0.2)	**0.99**(0.2)	**1.5**(0.3)	3.8(5)	15/15
ga100 hol	6.7(5)	5.7(1)	5.2(1)	6.0(0.6)	**2.5**(0.3)	15/15
grid100 ho	23(31)	29(17)	25(7)	29(8)	13(3)	15/15
grid16 hol	7.7(6)	6.0(2)	4.7(0.7)	5.1(0.8)	**2.3**(0.3)	15/15
hill hol	**2.9**(2)	**1.3**(0.5)	**0.83**(0.2)	**0.84**(0.2)	**0.44**(0.1)	15/15
memPSODE v3	4(2)	11(0.5)	6.7(0.8)	5.6(0.9)	3.8(2)	15/15
prcga saw	**1.9**(1)	**2.6**(1)	3.3(0.9)	4.9(0.9)	**2.4**(0.6)	15/15
ring100 ho	12(7)	13(2)	13(1)	14(1)	5.7(0.4)	15/15
ring16 hol	4.0(2)	**2.9**(0.6)	**2.5**(0.3)	**2.8**(0.3)	**1.1**(0.1)	15/15

Table 125: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_4 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f4	*1.0e+3*:439	*6.3e+2*:670	*4.0e+2*:707	*2.5e+2*:735	*1.0e+2*:5369	15/15
BIPOP-aCMA	**0.56**(0.1)$_{\downarrow 4}$	**0.71**(0.1)	**0.89**(0.1)	**1.2**(0.2)	**0.27**(0.0)$^{\star 4}$	15/15
BIPOP-saAC	**1.0**(0.2)	**1.2**(0.2)	**2.8**(0.6)	**3.6**(0.7)	**2.9**(0.5)	15/15
CMAES hut	**1.1**(0.3)	**1.4**(0.3)	3.0(0.8)	4.3(0.7)	5.5(6)	2/15
IPOP-10DDr	**1.1**(0.2)	**1.4**(0.2)	**2.9**(0.8)	4.5(0.5)	3.3(2)	15/15
IPOP-500 l	**1.1**(0.2)	**1.4**(0.2)	**2.9**(0.8)	4.5(0.5)	3.3(2)	15/15
IPOP-tany	**0.94**(0.2)	**1.4**(0.2)	**3.0**(0.6)	4.7(0.6)	3.4(2)	15/15
IPOP-texp	**0.27**(0.1)$^{\star 2}_{\downarrow 4}$	**0.65**(0.2)	**2.4**(0.9)	3.8(0.6)	3.4(2)	15/15
IPOP lia	**1.1**(0.2)	**1.4**(0.2)	**2.9**(0.8)	4.5(0.5)	3.3(2)	15/15
ga100 hol	4.7(1)	5.3(0.7)	7.6(0.6)	10(1)	**2.7**(0.3)	15/15
grid100 ho	24(6)	26(7)	36(8)	49(7)	14(1)	15/15
grid16 hol	4.3(1.0)	4.5(0.9)	6.3(1.0)	8.8(2)	**2.6**(0.3)	15/15
hill hol	**0.79**(0.1)$_{\downarrow 2}$	**0.69**(0.2)	**0.91**(0.2)	**1.3**(0.3)	**0.43**(0.0)	15/15
memPSODE v	19(10)	13(7)	13(6)	13(6)	3.6(1)	15/15
prcga saw	**1.8**(1)	3.7(0.6)	7.0(1)	11(3)	3.1(0.9)	15/15
ring100 ho	11(2)	13(2)	18(2)	25(2)	6.2(0.3)	15/15
ring16 hol	**2.4**(0.4)	**2.4**(0.3)	3.4(0.4)	4.6(0.5)	**1.2**(0.2)	15/15

Table 126: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_5 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f5	*4.0e+2*:51	*2.5e+2*:81	*1.0e-1*:120	*1.0e-8*:121	*1.0e-8*:121	15/15
BIPOP-aCMA	**1.6**(0)	**1.0**(0)$^{\star 4}$	**0.68**(0)$^{\star 4}$	**0.68**(0)$^{\star 4}$	**0.68**(0)$^{\star 4}$	15/15
BIPOP-saAC	**1.8**(0.3)	**1.8**(0.3)	**2.9**(0.2)	**2.9**(0.2)	**2.9**(0.2)	15/15
CMAES hut	**2.3**(0.7)	**2.2**(0.4)	**4.7**(0.6)	**4.7**(0.6)	**4.7**(0.6)	15/15
IPOP-10DDr	**1.9**(0.9)	3.9(1)	298(415)	657(535)	657(535)	15/15
IPOP-500 l	**1.9**(0.9)	3.9(1)	298(415)	657(535)	657(535)	15/15
IPOP-tany	**1.9**(0.4)	3.3(1)	261(270)	435(305)	435(305)	15/15
IPOP-texp	3.3(0.5)	3.6(1.0)	1.5e4(5e4)	3.3e4(1e5)	3.3e4(1e5)	15/15
IPOP lia	**1.9**(0.9)	3.9(1)	298(415)	657(535)	657(535)	15/15
ga100 hol	19(4)	25(5)	88(8)	91(8)	91(8)	15/15
grid100 ho	83(30)	128(26)	371(62)	376(66)	376(66)	15/15
grid16 hol	23(6)	26(4)	67(8)	67(8)	67(8)	15/15
hill hol	4.2(1)	4.3(0.9)	12(2)	11(2)	11(2)	15/15
memPSODE v	3.8(0.4)	3.3(0.5)	6.0(0.9)	6.1(0.8)	6.1(0.8)	15/15
prcga saw	15(6)	24(14)	∞	∞	∞ *2e6*	0/15
ring100 ho	45(10)	61(11)	190(13)	190(13)	190(13)	15/15
ring16 hol	9.4(2)	11(2)	35(3)	35(5)	35(5)	15/15

Table 127: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_6 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f6	*6.3e+5*:50	*4.0e+5*:82	*4.0e+4*:127	*4.0e+2*:734	*6.3e+1*:2121	15/15
BIPOP-aCMA	**2.9**(1)	**2.7**(1)	3.6(1)	**3.0**(0.5)	**1.8**(0.3)	15/15
BIPOP-saAC	**1.3**(0.9)	**1.2**(0.5)	**1.7**(0.4)	**1.9**(0.5)	**1.4**(0.2)	15/15
CMAES hut	**1.4**(0.8)	**1.2**(0.6)	**2.1**(0.6)	**2.8**(0.5)	**2.4**(1)	11/15
IPOP-10DDr	**1.2**(1)	**1.8**(0.9)	**2.9**(0.9)	**1.3**(0.3)	**1.2**(0.2)	15/15
IPOP-500 l	**1.2**(1)	**1.8**(0.9)	**2.9**(0.9)	**1.3**(0.3)	**1.2**(0.2)	15/15
IPOP-tany	**0.89**(0.8)	**1.1**(0.6)	**2.4**(0.7)	**1.2**(0.3)	**1.3**(0.1)	15/15
IPOP-texp	**0.53**(0.5)	**0.78**(0.5)	**2.0**(0.9)	**1.1**(0.6)	**1.2**(0.2)	15/15
IPOP lia	**1.2**(1)	**1.8**(0.9)	**2.9**(0.9)	**1.3**(0.3)	**1.2**(0.2)	15/15
ga100 hol	5.9(5)	7.7(4)	16(6)	9.4(6)	19(9)	15/15
grid100 ho	16(20)	31(30)	88(41)	105(60)	769(561)	11/15
grid16 hol	4.5(4)	7.1(5)	17(6)	27(18)	193(181)	14/15
hill hol	**2.4**(2)	**2.1**(1)	3.0(1)	6.4(8)	269(480)	12/15
memPSODE v	**2.6**(1)	**2.1**(0.7)	**1.9**(1)	4.1(7)	8.1(4)	15/15
prcga saw	**2.8**(3)	5.7(4)	15(6)	5.4(2)	190(228)	14/15
ring100 ho	12(12)	17(11)	39(16)	27(14)	57(10)	15/15
ring16 hol	4.4(4)	5.3(4)	10(5)	8.5(5)	17(17)	15/15

Table 128: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_7 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f7	*1.6e+3*:35	*1.0e+3*:106	*6.3e+2*:165	*2.5e+2*:489	*2.5e+1*:2987	15/15
BIPOP-aCMA	4.6(1)	3.1(0.7)	3.5(0.7)	**2.1**(0.3)	**1.1**(0.3)	15/15
BIPOP-saAC	**2.6**(0.8)	**1.5**(0.8)	**1.9**(0.4)	**1.1**(0.2)	**2.2**(2)	15/15
CMAES hut	**1.8**(1)	**1.4**(0.7)	**2.1**(0.7)	**1.6**(0.4)	**0.75**(0.2)	15/15
IPOP-10DDr	3.1(3)	**2.0**(0.6)	**2.1**(0.4)	**1.4**(0.2)	**2.8**(5)	15/15
IPOP-500 l	3.1(3)	**2.0**(0.6)	**2.1**(0.4)	**1.4**(0.2)	**2.8**(5)	15/15
IPOP-tany	**1.5**(1)	**1.5**(0.8)	**1.7**(0.6)	**1.2**(0.2)	**0.72**(0.1)	15/15
IPOP-texp	**0.63**(0.6)	**0.57**(0.4)$^{\star 2}$	**0.68**(0.4)$^{\star 3}$	**0.76**(0.2)$^{\star 3}$	3.4(6)	15/15
IPOP lia	3.1(3)	**2.0**(0.6)	**2.1**(0.4)	**1.4**(0.2)	**2.8**(5)	15/15
ga100 hol	7.1(7)	7.0(2)	9.0(1.0)	8.2(2)	∞ *2e6*	0/15
grid100 ho	19(27)	37(24)	57(27)	90(58)	∞ *2e6*	0/15
grid16 hol	7.0(5)	6.8(4)	10(4)	16(20)	∞ *2e6*	0/15
hill hol	4.5(2)	**2.4**(1)	**2.4**(1)	3.6(2)	∞ *2e6*	0/15
memPSODE v2	24(14)	11(12)	18(16)	16(3)	41(25)	15/15
prcga saw	**2.0**(2)	3.0(2)	4.1(2)	3.9(1)	3423(4069)	3/15
ring100 ho	12(10)	15(5)	20(4)	23(5)	1968(2343)	4/15
ring16 hol	5.6(4)	4.6(2)	5.3(1)	5.8(2)	9455(1e4)	1/15

Table 129: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_8 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f8	*1.0e+5*:85	*6.3e+4*:111	*4.0e+4*:125	*2.5e+3*:430	*6.3e+1*:2106	15/15
BIPOP-aCMA	3.1(0.9)	3.2(1)	4.2(2)	**2.5**(0.2)	**1.4**(0.8)	15/15
BIPOP-saAC	**2.2**(0.4)	**2.0**(0.2)	**1.9**(0.2)	**0.86**(0.2)	**0.65**(0.2)	15/15
CMAES hut	**2.5**(0.5)	**2.5**(0.5)	**2.9**(0.6)	**1.8**(0.2)	**2.2**(2)	9/15
IPOP-10DDr	**2.8**(0.5)	**2.7**(0.4)	**2.8**(0.4)	**1.7**(0.1)	**2.1**(0.2)	15/15
IPOP-500 l	**2.8**(0.5)	**2.7**(0.4)	**2.8**(0.4)	**1.7**(0.1)	**2.1**(0.2)	15/15
IPOP-tany	**2.4**(0.5)	**2.4**(0.5)	**2.7**(0.4)	**1.7**(0.2)	3.5(9)	15/15
IPOP-texp	**0.51**(0.4)$^{\star 2}$	**0.76**(0.4)$^{\star 3}$	**1.0**(0.3)	**1.3**(0.2)	**2.4**(1)	15/15
IPOP lia	**2.8**(0.5)	**2.7**(0.4)	**2.8**(0.4)	**1.7**(0.1)	**2.1**(0.2)	15/15
ga100 hol	16(4)	17(2)	19(4)	16(2)	1632(2001)	6/15
grid100 ho	97(40)	90(36)	102(35)	75(10)	6722(7457)	2/15
grid16 hol	15(4)	15(5)	17(5)	12(2)	1.3e4(2e4)	1/15
hill hol	4.2(2)	3.6(1)	3.6(0.6)	**2.3**(0.5)	578(736)	10/15
memPSODE v	**1.4**(0.2)	**1.3**(0.2)	**1.2**(0.2)	**0.58**(0.1)$^{\star 3}$	**1.5**(2)	15/15
prcga saw	3.7(2)	6.6(6)	9.4(5)	10(2)	1458(2009)	9/15
ring100 ho	39(6)	40(5)	46(7)	37(3)	36(3)	15/15
ring16 hol	8.8(2)	8.6(2)	9.3(1)	7.0(0.9)	1734(2158)	6/15

Table 130: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_9 for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f9	*2.5e+2*:676	*1.6e+2*:865	*1.0e+2*:1397	*6.3e+1*:1896	*4.0e+1*:2180	15/15
BIPOP-aCMA	**2.3**(0.3)	**2.0**(0.2)	**1.4**(0.3)	**1.2**(0.2)	**1.3**(0.2)	15/15
BIPOP-saAC	**0.90**(0.3)	**0.79**(0.3)	**0.55**(0.2)	**0.61**(0.3)	**0.60**(0.3)	15/15
CMAES hut	**1.9**(0.2)	**1.7**(0.2)	**1.2**(0.1)	**0.98**(0.1)	**1.2**(0.1)	15/15
IPOP-10DDr	**2.4**(0.3)	**2.3**(0.7)	**1.8**(1)	**2.7**(0.9)	**2.6**(0.7)	15/15
IPOP-500 l	**2.4**(0.3)	**2.3**(0.7)	**1.8**(1)	**2.7**(0.9)	**2.6**(0.7)	15/15
IPOP-tany	**2.1**(0.3)	**1.9**(0.4)	**1.7**(1)	3.8(10)	3.6(9)	15/15
IPOP-texp	**1.1**(0.2)	**1.0**(0.1)	**0.76**(0.1)	**0.69**(0.1)	**0.87**(0.1)	15/15
IPOP lia	**2.4**(0.3)	**2.3**(0.7)	**1.8**(1)	**2.7**(0.9)	**2.6**(0.7)	15/15
ga100 hol	37(26)	77(35)	104(197)	192(315)	193(284)	14/15
grid100 ho	192(98)	423(425)	480(717)	986(1165)	1052(993)	9/15
grid16 hol	139(58)	221(165)	274(671)	426(544)	392(469)	12/15
hill hol	11(12)	14(11)	169(393)	146(329)	136(290)	14/15
memPSODE v	**0.79**(0.3)	**0.83**(0.6)	**1.2**(1)	**1.2**(1.0)	**1.1**(0.9)	15/15
prcga saw	**2.6**(0.7)	29(10)	49(70)	1187(1795)	1049(1091)	11/15
ring100 ho	70(8)	72(10)	61(10)	59(13)	91(25)	15/15
ring16 hol	26(8)	56(39)	262(717)	302(530)	271(463)	12/15

Table 131: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{10} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f10	*1.0e+7*:44	*6.3e+6*:80	*2.5e+6*:126	*2.5e+5*:408	*6.3e+3*:2376	15/15
BIPOP-aCMA	**1.9**(2)	**2.1**(2)	4.3(2)	6.1(2)	**3.8**(0.7)	15/15
BIPOP-saAC	**1.2**(0.6)	**1.1**(0.8)	3.2(3)	4.4(1)	**1.3**(0.2)$^{\star 4}$	15/15
CMAES hut	**0.92**(0.5)	**1.0**(0.6)	**2.8**(1)	5.0(1)	∞ *4007*	0/15
IPOP-10DDr	**1.4**(2)	**1.7**(1.0)	3.2(1)	4.4(0.7)	3.9(0.9)	15/15
IPOP-500 l	**1.4**(2)	**1.7**(1.0)	3.2(1)	4.4(0.7)	3.9(0.9)	15/15
IPOP-tany	**0.73**(0.9)	**1.2**(0.9)	**2.5**(0.9)	**4.3**(0.7)	4.0(0.8)	15/15
IPOP-texp	**0.42**(0.6)	**0.50**(0.4)	**0.85**(0.5)$^{\star 2}$	**3.4**(1.0)	**3.3**(0.5)	15/15
IPOP lia	**1.4**(2)	**1.7**(1.0)	3.2(1)	4.4(0.7)	3.9(0.9)	15/15
ga100 hol	**2.2**(2)	4.6(2)	10(3)	25(11)	∞ *2e6*	0/15
grid100 ho	**2.0**(2)	7.7(6)	38(27)	307(267)	∞ *2e6*	0/15
grid16 hol	**1.9**(3)	3.3(3)	8.1(4)	94(83)	∞ *2e6*	0/15
hill hol	**3.0**(2)	**2.1**(1)	**2.4**(1.0)	16(11)	6137(6734)	2/15
memPSODE v	3.9(4)	**2.8**(3)	3.3(2)	**3.4**(0.9)	31(14)	15/15
prcga saw	**0.96**(1)	**2.5**(2)	5.9(3)	14(5)	625(307)	15/15
ring100 ho	**2.5**(3)	7.0(6)	19(7)	92(44)	∞ *2e6*	0/15
ring16 hol	**1.8**(2)	**2.3**(2)	4.8(1)	27(19)	6191(7103)	2/15

Table 132: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_{11} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f11	*1.0e+4*:22	*2.5e+3*:52	*2.5e+2*:432	*1.6e+2*:887	*1.6e+1*:2204	15/15
BIPOP-aCMA	**2.8**(3)	**1.9**(2)	23(2)	**12**(1)	**5.3**(0.3)	15/15
BIPOP-saAC	**1.5**(1)	**1.0**(0.7)	**15**(8)	**7.3**(4)	**3.0**(2)	15/15
CMAES hut	**1.5**(1)	**1.4**(0.8)	∞	∞	∞ *4007*	0/15
IPOP-10DDr	**2.8**(4)	**1.6**(1)	39(5)	22(2)	13(0.6)	15/15
IPOP-500 l	**2.8**(4)	**1.6**(1)	39(5)	22(2)	13(0.6)	15/15
IPOP-tany	**2.4**(2)	**1.2**(1)	40(5)	22(2)	12(0.5)	15/15
IPOP-texp	**1.3**(0.9)	**0.92**(0.7)	33(5)	20(2)	11(0.4)	15/15
IPOP lia	**2.8**(4)	**1.6**(1)	39(5)	22(2)	13(0.6)	15/15
ga100 hol	**2.1**(3)	**1.5**(2)	43(44)	52(33)	376(222)	15/15
grid100 ho	3.6(4)	3.2(3)	1693(892)	3337(3384)	∞ *2e6*	0/15
grid16 hol	**2.0**(2)	**1.7**(1)	523(322)	472(228)	∞ *2e6*	0/15
hill hol	**2.7**(3)	**1.3**(1)	156(94)	157(87)	592(182)	14/15
memPSODE v	3.6(6)	**2.8**(3)	**1.9**(0.6)	**0.97**(0.3)$^{\star 3}$	**0.75**(0.1)$^{\star 4}$	15/15
prcga saw	**2.6**(3)	**2.0**(2)	**6.5**(8)	76(85)	1601(1144)	11/15
ring100 ho	**2.5**(3)	**2.0**(3)	174(142)	232(91)	804(469)	13/15
ring16 hol	**1.9**(2)	**1.4**(1)	96(66)	90(45)	432(219)	15/15

Table 133: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{12} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f12	*2.5e+8*:54	*1.6e+8*:218	*1.0e+8*:284	*1.0e+7*:424	*4.0e+1*:2479	15/15
BIPOP-aCMA	7.6(2)	**2.5**(0.5)	**2.3**(0.4)	**2.7**(0.2)	**1.9**(0.1)	15/15
BIPOP-saAC	3.7(1)	**1.3**(0.4)	**1.2**(0.4)	**1.2**(0.2)	**0.43**(0.0)	15/15
CMAES hut	4.2(1)	**1.5**(0.3)	**1.5**(0.4)	**2.1**(0.3)	**1.6**(0.1)	14/15
IPOP-10DDr	4.0(1)	**1.4**(0.2)	**1.4**(0.2)	**2.0**(0.2)	**1.5**(0.1)	15/15
IPOP-500 l	4.0(1)	**1.4**(0.2)	**1.4**(0.2)	**2.0**(0.2)	**1.5**(0.1)	15/15
IPOP-tany	**3.1**(1)	**1.3**(0.2)	**1.3**(0.2)	**2.1**(0.2)	**1.6**(0.1)	15/15
IPOP-texp	**0.85**(0.7)$^{\star 2}$	**0.51**(0.2)$^{\star 2}$	**0.58**(0.2)	**1.6**(0.2)	**1.4**(0.1)	15/15
IPOP lia	4.0(1)	**1.4**(0.2)	**1.4**(0.2)	**2.0**(0.2)	**1.5**(0.1)	15/15
ga100 hol	17(6)	7.5(2)	8.9(1)	17(3)	405(409)	13/15
grid100 ho	108(53)	46(17)	52(15)	86(11)	∞ *2e6*	0/15
grid16 hol	20(16)	7.4(4)	8.1(3)	13(3)	1083(844)	9/15
hill hol	4.8(3)	**1.6**(0.5)	**1.7**(0.4)	**2.5**(0.5)	595(808)	10/15
memPSODE v	**3.6**(2)	**0.97**(0.5)	**0.86**(0.4)	**0.77**(0.3)$^{\star 2}$	**0.24**(0.1)$^{\star 4}$	15/15
prcga saw	6.4(5)	3.7(2)	4.9(1)	10(2)	40(30)	15/15
ring100 ho	42(10)	20(4)	23(2)	44(3)	345(75)	15/15
ring16 hol	10(4)	4.4(1)	4.5(0.8)	7.9(0.7)	212(87)	15/15

Table 134: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{13} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f13	*2.5e+3*:85	*1.6e+3*:121	*1.6e+3*:121	*6.3e+1*:429	*1.0e+1*:2029	15/15
BIPOP-aCMA	3.3(2)	5.1(0.9)	5.1(0.9)	5.4(0.3)	**1.6**(0.1)	15/15
BIPOP-saAC	**1.8**(0.5)	**1.9**(0.2)	**1.9**(0.2)	**1.6**(0.1)	**0.76**(0.8)	15/15
CMAES hut	**1.5**(0.8)	3.2(0.9)	3.2(0.9)	5.1(0.4)	**2.1**(1)	12/15
IPOP-10DDr	**2.4**(0.3)	3.3(0.4)	3.3(0.4)	5.0(0.6)	3.1(4)	15/15
IPOP-500 l	**2.4**(0.3)	3.3(0.4)	3.3(0.4)	5.0(0.6)	3.1(4)	15/15
IPOP-tany	**1.5**(0.5)	**2.8**(0.5)	**2.8**(0.5)	5.1(0.5)	**2.6**(4)	15/15
IPOP-texp	**0.53**(0.5)$^{\star 2}$	**1.5**(0.5)	**1.5**(0.5)	**4.4**(0.4)	**1.5**(0.1)	15/15
IPOP lia	**2.4**(0.3)	3.3(0.4)	3.3(0.4)	5.0(0.6)	3.1(4)	15/15
ga100 hol	10(4)	19(3)	19(3)	141(32)	505(553)	11/15
grid100 ho	46(36)	105(26)	105(26)	916(561)	1.5e4(1e4)	1/15
grid16 hol	10(4)	18(5)	18(5)	135(24)	463(546)	12/15
hill hol	**2.6**(1)	3.9(1)	3.9(1)	76(56)	585(985)	10/15
memPSODE v	**1.5**(0.5)	**1.8**(0.7)	**1.8**(0.7)	**1.8**(0.2)	**1.4**(2)	15/15
prcga saw	4.4(3)	13(4)	13(4)	70(14)	769(1001)	11/15
ring100 ho	24(7)	52(4)	52(4)	293(47)	212(76)	15/15
ring16 hol	5.4(2)	10(1)	10(1)	66(12)	1195(1485)	7/15

Table 135: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{14} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f14	*6.3e+1*:34	*4.0e+1*:137	*2.5e+1*:176	*4.0e+0*:438	*1.0e-3*:2207	15/15
BIPOP-aCMA	8.1(6)	3.8(1)	3.9(1.0)	3.1(0.5)	**3.6**(0.3)	15/15
BIPOP-saAC	4.0(2)	**1.9**(0.7)	**2.4**(0.7)	**1.8**(0.4)	**1.4**(0.1)$^{\star 4}$	15/15
CMAES hut	**3.2**(1)	**1.5**(0.8)	**2.4**(0.5)	**2.5**(0.4)	∞ *4007*	0/15
IPOP-10DDr	4.6(3)	**2.0**(0.3)	**2.2**(0.3)	**2.1**(0.3)	4.5(0.3)	15/15
IPOP-500 l	4.6(3)	**2.0**(0.3)	**2.2**(0.3)	**2.1**(0.3)	4.5(0.3)	15/15
IPOP-tany	**2.5**(2)	**1.5**(0.5)	**1.8**(0.5)	**2.2**(0.3)	4.7(0.2)	15/15
IPOP-texp	**0.59**(0.6)*	**0.42**(0.2)$^{\star 3}$	**0.74**(0.3)$^{\star 3}$	**1.8**(0.3)	**4.2**(0.4)	15/15
IPOP lia	4.6(3)	**2.0**(0.3)	**2.2**(0.3)	**2.1**(0.3)	4.5(0.3)	15/15
ga100 hol	13(4)	7.1(3)	12(4)	20(4)	∞ *2e6*	0/15
grid100 ho	43(34)	43(27)	64(20)	96(19)	∞ *2e6*	0/15
grid16 hol	15(16)	9.1(5)	12(5)	17(3)	∞ *2e6*	0/15
hill hol	5.9(2)	**2.2**(0.5)	**2.5**(0.6)	**3.0**(0.7)	∞ *2e6*	0/15
memPSODE v	6.6(2)	**1.9**(0.7)	**1.6**(0.6)	**1.2**(0.3)$^{\star 3}$	8.2(4)	15/15
prcga saw	4.6(4)	3.4(2)	5.3(2)	10(2)	2279(2073)	9/15
ring100 ho	24(24)	19(7)	31(10)	52(6)	∞ *2e6*	0/15
ring16 hol	8.2(5)	4.8(1)	6.9(2)	10(2)	∞ *2e6*	0/15

Table 136: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_{15} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f15	*1.0e+3*:192	*6.3e+2*:458	*4.0e+2*:1170	*2.5e+2*:3875	*2.5e+2*:3875	15/15
BIPOP-aCMA	**2.2**(0.9)	**1.6**(0.3)	**1.3**(0.3)	**1.1**(0.3)	**1.1**(0.3)	15/15
BIPOP-saAC	**1.1**(0.4)	**0.68**(0.1)	**1.00**(0.3)	**0.91**(0.3)	**0.91**(0.3)	15/15
CMAES hut	**0.99**(0.3)	**1.0**(0.3)	**1.1**(0.3)	**1.8**(1)	**1.8**(1)	8/15
IPOP-10DDr	**1.3**(0.4)	**0.93**(0.1)	**0.83**(0.2)	**1.1**(0.3)	**1.1**(0.3)	15/15
IPOP-500 l	**1.3**(0.4)	**0.93**(0.1)	**0.83**(0.2)	**1.1**(0.3)	**1.1**(0.3)	15/15
IPOP-tany	**1.0**(0.2)	**0.85**(0.1)	**0.81**(0.2)	**1.1**(0.3)	**1.1**(0.3)	15/15
IPOP-texp	**0.56**(0.3)$^{\star}_{\downarrow 2}$	**0.61**(0.2)	**0.77**(0.2)	**0.90**(0.3)	**0.90**(0.3)	15/15
IPOP lia	**1.3**(0.4)	**0.93**(0.1)	**0.83**(0.2)	**1.1**(0.3)	**1.1**(0.3)	15/15
ga100 hol	6.2(2)	5.6(0.9)	5.6(1)	6.5(2)	6.5(2)	15/15
grid100 ho	62(25)	1069(1180)	7226(8506)	∞	∞ *2e6*	0/15
grid16 hol	13(5)	975(2187)	4926(5982)	∞	∞ *2e6*	0/15
hill hol	4.7(4)	5030(6576)	∞	∞	∞ *2e6*	0/15
memPSODE v	55(30)	55(12)	37(19)	24(8)	24(8)	15/15
prcga saw	**2.9**(2)	3.4(0.5)	3.7(0.6)	3.2(1)	3.2(1)	15/15
ring100 ho	16(4)	19(3)	34(19)	116(224)	116(224)	14/15
ring16 hol	4.0(1)	6.6(6)	438(856)	605(780)	605(777)	7/15

Table 137: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{16} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f16	*4.0e+1*:117	*2.5e+1*:297	*1.6e+1*:4010	*1.6e+1*:4010	*1.0e+1*:5244	15/15
BIPOP-aCMA	21(17)	14(3)	**1.1**(0.3)	**1.1**(0.3)	**1.0**(0.3)	15/15
BIPOP-saAC	22(10)	12(5)	**1.0**(0.4)	**1.0**(0.4)	**0.94**(0.4)	15/15
CMAES hut	23(17)	14(9)	**1.7**(1)	**1.7**(2)	3.7(4)	3/15
IPOP-10DDr	8.9(6)	**7.0**(1)	**0.61**(0.1)	**0.61**(0.1)	**0.55**(0.1)	15/15
IPOP-500 l	8.9(6)	**7.0**(1)	**0.61**(0.1)	**0.61**(0.1)	**0.55**(0.1)	15/15
IPOP-tany	9.3(6)	7.6(2)	**0.67**(0.1)	**0.67**(0.1)	**0.58**(0.1)	15/15
IPOP-texp	5.8(5)	**5.3**(2)	**0.49**(0.2)	**0.49**(0.2)	**0.45**(0.1)*	15/15
IPOP lia	8.9(6)	**7.0**(1)	**0.61**(0.1)	**0.61**(0.1)	**0.55**(0.1)	15/15
ga100 hol	13(15)	24(11)	42(13)	42(13)	339(480)	8/15
grid100 ho	9.0(7)	96(67)	515(608)	515(748)	∞ *2e6*	0/15
grid16 hol	**3.1**(2)	416(300)	622(770)	622(756)	5566(6102)	1/15
hill hol	**1.3**(1)	19(6)	1077(1496)	1077(1291)	5611(6102)	1/15
memPSODE v	22(4)	26(17)	3.8(3)	3.8(3)	7.5(6)	15/15
prcga saw	11(14)	22(14)	**2.3**(0.7)	**2.3**(0.7)	120(382)	13/15
ring100 ho	5.8(6)	27(12)	8.3(2)	8.3(2)	37(30)	15/15
ring16 hol	**2.9**(2)	8.0(4)	253(499)	253(499)	1058(1158)	4/15

Table 138: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{17} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f17	*1.6e+1*:54	*1.0e+1*:399	*6.3e+0*:688	*4.0e+0*:1115	*1.0e+0*:4220	15/15
BIPOP-aCMA	6.7(4)	**1.7**(0.6)	**1.4**(0.3)	**1.1**(0.2)	**0.54**(0.1)	15/15
BIPOP-saAC	3.8(2)	**0.99**(0.4)	**1.00**(0.2)	**0.88**(0.1)	**2.4**(0.4)	15/15
CMAES hut	**2.8**(3)	**1.0**(0.4)	**1.1**(0.3)	**1.00**(0.3)	**0.59**(0.2)	15/15
IPOP-10DDr	**2.2**(2)	**0.81**(0.2)	**0.84**(0.2)	**0.77**(0.2)	**0.49**(0.1)	15/15
IPOP-500 l	**2.2**(2)	**0.81**(0.2)	**0.84**(0.2)	**0.77**(0.2)	**0.49**(0.1)	15/15
IPOP-tany	**1.4**(1)	**0.59**(0.2)	**0.71**(0.2)	**0.72**(0.1)	**0.43**(0.1)	15/15
IPOP-texp	**0.37**(0.3)	**0.31**(0.1)$^{\star 2}$	**0.53**(0.2)	**0.61**(0.2)	**0.46**(0.1)	15/15
IPOP lia	**2.2**(2)	**0.81**(0.2)	**0.84**(0.2)	**0.77**(0.2)	**0.49**(0.1)	15/15
ga100 hol	6.3(3)	3.3(0.8)	4.9(0.9)	5.9(2)	717(948)	6/15
grid100 ho	38(13)	1549(2583)	∞	∞	∞ *2e6*	0/15
grid16 hol	48(27)	975(2505)	4.3e4(5e4)	∞	∞ *2e6*	0/15
hill hol	1.5e4(2e4)	∞	∞	∞	∞ *2e6*	0/15
memPSODE v	67(102)	27(18)	56(57)	188(209)	279(156)	15/15
prcga saw	**2.1**(3)	**1.5**(0.9)	**3.0**(1)	3.3(0.8)	1400(1895)	6/15
ring100 ho	10(8)	11(6)	37(23)	1340(1814)	∞ *2e6*	0/15
ring16 hol	5.1(4)	3.8(3)	1162(1525)	2.5e4(3e4)	∞ *2e6*	0/15

Table 139: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{18} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f18	*6.3e+1*:55	*4.0e+1*:329	*4.0e+1*:329	*2.5e+1*:579	*6.3e+0*:2006	15/15
BIPOP-aCMA	5.1(2)	**1.6**(0.5)	**1.6**(0.5)	**1.4**(0.4)	**0.97**(0.2)	15/15
BIPOP-saAC	**2.5**(1)	**1.1**(0.5)	**1.1**(0.5)	**1.1**(0.3)	**0.82**(0.3)	15/15
CMAES hut	**2.5**(1)	**0.97**(0.4)	**0.97**(0.4)	**1.1**(0.3)	**0.96**(0.3)	15/15
IPOP-10DDr	**1.9**(2)	**0.83**(0.2)	**0.83**(0.2)	**0.84**(0.2)	**0.80**(0.2)	15/15
IPOP-500 l	**1.9**(2)	**0.83**(0.2)	**0.83**(0.2)	**0.84**(0.2)	**0.80**(0.2)	15/15
IPOP-tany	**1.0**(0.9)	**0.67**(0.2)	**0.67**(0.2)	**0.79**(0.2)	**0.77**(0.1)	15/15
IPOP-texp	**0.45**(0.5)	**0.38**(0.2)$^{\star 3}$	**0.38**(0.2)$^{\star 3}$	**0.59**(0.1)	**0.73**(0.1)	15/15
IPOP lia	**1.9**(2)	**0.83**(0.2)	**0.83**(0.2)	**0.84**(0.2)	**0.80**(0.2)	15/15
ga100 hol	6.2(4)	3.9(1)	3.9(1)	4.8(1)	1153(1498)	7/15
grid100 ho	12(10)	218(191)	218(191)	1.5e4(2e4)	∞ *2e6*	0/15
grid16 hol	5.0(5)	638(839)	638(839)	1.5e4(2e4)	∞ *2e6*	0/15
hill hol	6026(2e4)	1.3e4(2e4)	1.3e4(2e4)	∞	∞ *2e6*	0/15
memPSODE v	78(94)	34(13)	34(13)	41(20)	283(222)	15/15
prcga saw	**2.0**(3)	**1.7**(0.7)	**1.7**(0.7)	**3.0**(0.8)	337(997)	13/15
ring100 ho	10(9)	11(5)	11(5)	31(18)	∞ *2e6*	0/15
ring16 hol	3.5(3)	4.3(1)	4.3(1)	541(1169)	∞ *2e6*	0/15

Table 140: 40-D, running time excess $\mathrm{ERT}/\mathrm{ERT}_{\text{best 2009}}$ on f_{19} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f19	*1.6e-1*:8.6e5	*1.0e-1*:1.4e6	*6.3e-2*:3.1e6	*4.0e-2*:5.2e6	*2.5e-2*:8.7e6	15/15
BIPOP-aCMA	**1.1**(0.9)	**1.0**(1)	**0.73**(0.6)	**0.77**(0.4)	**0.73**(0.3)	15/15
BIPOP-saAC	**0.75**(0.8)	**0.75**(0.9)	**0.75**(0.7)	**0.89**(0.6)	**1.0**(0.4)	15/15
CMAES hut	∞	∞	∞	∞	∞ *4007*	0/15
IPOP-10DDr	4.4(5)	**2.8**(3)	**1.5**(1)	**1.1**(1)	**0.94**(0.7)	15/15
IPOP-500 l	4.4(5)	**2.8**(3)	**1.5**(1)	**1.2**(1.0)	**1.4**(1)	15/15
IPOP-tany	5.2(8)	3.4(5)	**1.7**(2)	**1.3**(1)	**1.0**(0.9)	15/15
IPOP-texp	**2.4**(4)	**1.6**(3)	**0.94**(1)	**0.97**(0.9)	**0.80**(0.5)	15/15
IPOP lia	4.4(5)	**2.8**(3)	**1.5**(1)	**1.1**(1)	**0.94**(0.7)	15/15
ga100 hol	∞	∞	∞	∞	∞ *2e6*	0/15
grid100 ho	∞	∞	∞	∞	∞ *2e6*	0/15
grid16 hol	∞	∞	∞	∞	∞ *2e6*	0/15
hill hol	∞	∞	∞	∞	∞ *2e6*	0/15
memPSODE v	∞	∞	∞	∞	∞ *2e7*	0/15
prcga saw	**0.43**(0.2)	**0.77**(0.7)	**0.43**(0.4)	**0.31**(0.2)	**0.23**(0.1)	14/15
ring100 ho	∞	∞	∞	∞	∞ *2e6*	0/15
ring16 hol	∞	∞	∞	∞	∞ *2e6*	0/15

Table 141: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{20} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f20	*2.5e+4*:83	*1.6e+4*:86	*1.0e+3*:125	*2.5e+0*:515	*1.6e+0*:5582	15/15
BIPOP-aCMA	5.8(2)	6.4(2)	7.1(0.8)	5.6(0.6)	71(58)	15/15
BIPOP-saAC	**2.9**(0.3)	**3.0**(0.5)	**2.9**(0.5)	**3.3**(1)	52(50)	15/15
CMAES hut	3.4(0.8)	4.0(0.8)	5.0(0.9)	5.1(1.0)	11(11)	1/15
IPOP-10DDr	4.4(0.4)	4.9(0.7)	5.8(0.5)	5.6(1.0)	141(64)	15/15
IPOP-500 l	4.4(0.4)	4.9(0.7)	5.8(0.5)	5.6(1.0)	132(56)	15/15
IPOP-tany	3.2(0.8)	3.8(0.7)	5.1(0.5)	5.8(0.9)	145(112)	15/15
IPOP-texp	**0.44**(0.2)$^{\star 4}_{\downarrow 6}$	**0.67**(0.4)$^{\star 4}$	**2.1**(1)	4.7(0.8)	309(136)	15/15
IPOP lia	4.4(0.4)	4.9(0.7)	5.8(0.5)	5.6(1.0)	141(64)	15/15
ga100 hol	20(4)	24(4)	33(8)	22(3)	3.3(0.4)	15/15
grid100 ho	100(37)	121(39)	174(30)	92(17)	16(5)	15/15
grid16 hol	17(6)	20(6)	27(5)	15(1)	**2.7**(0.6)	15/15
hill hol	4.4(2)	4.7(2)	6.0(2)	**2.9**(0.7)	**0.60**(0.1)*	15/15
memPSODE v	**2.7**(0.5)	**2.6**(0.5)	**2.3**(0.7)	**4.0**(2)	**1.6**(1)	15/15
prcga saw	**2.9**(0.5)	4.6(2)	11(2)	13(3)	4.4(2)	15/15
ring100 ho	51(7)	59(9)	83(8)	48(4)	7.2(0.5)	15/15
ring16 hol	10(2)	12(3)	16(2)	9.0(1)	**1.4**(0.1)	15/15

Table 142: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{21} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f21	*6.3e+1*:160	*4.0e+1*:305	*2.5e+1*:380	*1.6e+1*:784	*6.3e+0*:2510	30/30
BIPOP-aCMA	3.8(0.8)	**2.6**(0.5)	4.0(0.4)	**2.2**(0.4)	3.3(5)	15/15
BIPOP-saAC	**2.4**(0.9)	3.5(5)	3.5(4)	**1.7**(2)	**0.98**(0.7)	15/15
CMAES hut	**2.5**(1)	**2.7**(0.8)	**2.6**(1)	**2.2**(3)	**1.8**(2)	8/15
IPOP-10DDr	**2.1**(0.5)	**1.5**(0.3)	**1.4**(0.4)	**2.7**(0.2)	189(5)	15/15
IPOP-500 l	**2.1**(0.5)	**1.5**(0.3)	**1.4**(0.4)	**2.7**(0.2)	15(5)	15/15
IPOP-tany	**1.8**(0.4)	**1.3**(0.1)	**1.3**(0.3)	**0.79**(0.1)	**2.5**(8)	15/15
IPOP-texp	**1.0**(0.3)$^{\star 3}$	**0.96**(0.3)*	**1.1**(0.2)	**0.69**(0.2)	6.2(5)	15/15
IPOP lia	**2.1**(0.5)	**1.5**(0.3)	**1.4**(0.4)	**2.7**(0.2)	299(5)	15/15
ga100 hol	14(5)	11(2)	12(5)	189(5)	293(400)	11/15
grid100 ho	63(15)	48(13)	51(16)	217(17)	928(1202)	7/15
grid16 hol	11(4)	8.0(2)	9.2(6)	642(1276)	202(399)	12/15
hill hol	**2.6**(1)	470(1)	1917(2635)	1277(1276)	698(798)	8/15
memPSODE v	**2.7**(1)	**2.1**(0.9)	**2.5**(3)	**2.8**(3)	**1.1**(1.0)	15/15
prcga saw	10(3)	7.3(2)	7.2(2)	4.7(1)	411(797)	11/15
ring100 ho	31(10)	25(8)	26(6)	16(4)	8.6(3)	15/15
ring16 hol	7.5(1)	5.9(1)	6.2(1)	3.7(0.8)	125(398)	13/15

Table 143: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{22} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f22	*6.3e+1*:160	*4.0e+1*:231	*2.5e+1*:687	*1.6e+1*:1392	*1.0e+1*:3090	15/15
BIPOP-aCMA	4.0(1)	**3.7**(1)	6.4(7)	10(16)	7.8(16)	15/15
BIPOP-saAC	**2.5**(0.7)	4.8(7)	**2.6**(3)	**2.9**(5)	7.2(4)	15/15
CMAES hut	**2.4**(0.6)	**2.2**(0.7)	**1.4**(0.4)	**1.0**(1)	**0.62**(0.7)	12/15
IPOP-10DDr	**2.3**(0.8)	37(91)	13(31)	9.0(15)	388(848)	15/15
IPOP-500 l	**2.3**(0.8)	37(91)	13(31)	9.0(15)	3262(6474)	12/15
IPOP-tany	**2.0**(0.5)	4.2(0.7)	3.6(6)	135(13)	87(186)	15/15
IPOP-texp	**1.3**(0.9)*	21(15)	17(5)	99(62)	158(294)	15/15
IPOP lia	**2.3**(0.8)	37(91)	13(31)	9.0(15)	1110(924)	14/15
ga100 hol	14(5)	631(5)	214(2)	107(2)	49(2)	14/15
grid100 ho	69(21)	80(47)	755(1458)	543(749)	574(649)	8/15
grid16 hol	908(5)	632(11)	1064(1458)	1261(2155)	742(971)	7/15
hill hol	**2.7**(1.0)	620(1)	729(1455)	719(1437)	740(971)	7/15
memPSODE v	**2.9**(2)	**2.9**(3)	**1.6**(1)	**0.89**(0.7)	**0.77**(0.9)	15/15
prcga saw	11(3)	11(3)	292(2)	340(994)	274(647)	12/15
ring100 ho	37(6)	36(8)	15(3)	10(2)	**5.4**(2)	15/15
ring16 hol	7.8(3)	8.3(4)	451(1455)	361(719)	163(324)	12/15

Table 144: 40-D, running time excess ERT/$\mathrm{ERT}_{\text{best 2009}}$ on f_{23} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\mathrm{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f23	*6.3e+0*:68	*4.0e+0*:292	*2.5e+0*:603	*2.5e+0*:603	*1.6e+0*:2487	15/15
BIPOP-aCMA	5.1(7)	110(112)	185(143)	185(143)	**45**(35)	15/15
BIPOP-saAC	13(15)	86(63)	175(183)	175(183)	**43**(44)	15/15
CMAES hut	15(12)	96(108)	∞	∞	∞ *4007*	0/15
IPOP-10DDr	3.5(3)	49(60)	396(378)	396(378)	96(92)	15/15
IPOP-500 l	3.5(3)	49(60)	396(378)	396(378)	96(92)	15/15
IPOP-tany	**2.4**(3)	65(106)	220(185)	220(185)	53(45)	15/15
IPOP-texp	4.6(5)	54(53)	389(379)	389(379)	102(150)	15/15
IPOP lia	3.5(3)	49(60)	396(378)	396(378)	96(92)	15/15
ga100 hol	4.4(4)	56(44)	1216(1129)	1216(1129)	1531(1656)	6/15
grid100 ho	**2.9**(3)	54(41)	447(177)	447(177)	1094(1050)	8/15
grid16 hol	**2.8**(4)	**35**(33)	572(606)	572(606)	510(651)	11/15
hill hol	**2.4**(2)	**10**(7)	300(110)	300(110)	576(811)	9/15
memPSODE v8	9(63)	42(10)	**51**(36)	**51**(36)	**29**(16)	15/15
prcga saw	4.6(3)	82(93)	1563(1523)	1563(1464)	1.4e4(2e4)	1/15
ring100 ho	3.6(5)	40(33)	**118**(41)	**118**(41)	98(46)	15/15
ring16 hol	**1.8**(2)	**20**(15)	**95**(76)	**95**(76)	839(1091)	8/15

Table 145: 40-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{24} for given run-length based budgets (0.5D, 1.2D, 3D, 10D, and 50D function evaluations). The ERT and in braces, as dispersion measure, the half difference between 90 and 10%-tile of bootstrapped run lengths appear for each algorithm and run-length based target, the corresponding $\text{ERT}_{\text{best 2009}}$ (preceded by the target Δf-value in *italics*) in the first row. #succ is the number of trials that reached the target value of the last column. The median number of conducted function evaluations is additionally given in *italics*, if the target in the last column was never reached. Entries with succeeding star are statistically significantly better (according to the rank-sum test) compared to all other algorithms in the table, with $p = 0.05$ or $p = 10^{-k}$ when the number k following the star is larger than 1, with Bonferroni correction by the number of instances.

#FEs/D	0.5	1.2	3	10	50	#succ
f24	*4.0e+2*:1404	*2.5e+2*:17825	*1.6e+2*:18980	*1.0e+2*:38677	*6.3e+1*:1.6e5	15/15
BIPOP-aCMA	**1.2**(0.8)	7.4(7)	24(32)	13(16)	3.7(4)	15/15
BIPOP-saAC	**0.95**(0.3)	4.9(5)	11(16)	7.9(12)	**2.0**(3)	15/15
CMAES hut	**1.1**(0.7)	∞	∞	∞	∞ *4007*	0/15
IPOP-10DDr	**1.2**(0.5)	**1.4**(0.8)	**1.4**(0.9)	**1.8**(1.0)	**1.3**(0.4)	15/15
IPOP-500 l	**1.2**(0.5)	**1.4**(0.8)	**1.4**(0.9)	**1.8**(1.0)	**1.3**(0.4)	15/15
IPOP-tany	**0.88**(0.4)	**1.5**(1.0)	**1.5**(0.9)	**1.2**(1.0)	**0.84**(0.6)	15/15
IPOP-texp	**0.61**(0.4)	**1.5**(1)	**1.5**(1)	**1.3**(1)	**1.1**(1)	15/15
IPOP lia	**1.2**(0.5)	**1.4**(0.8)	**1.4**(0.9)	**1.8**(1.0)	**1.3**(0.4)	15/15
ga100 hol	5.4(1.0)	5.6(5)	13(5)	28(28)	∞ *2e6*	0/15
grid100 ho	6228(6890)	∞	∞	∞	∞ *2e6*	0/15
grid16 hol	4376(4987)	∞	∞	∞	∞ *2e6*	0/15
hill hol	9458(9974)	∞	∞	∞	∞ *2e6*	0/15
memPSODE v	19(13)	4.0(2)	9.4(5)	19(17)	71(64)	13/15
prcga saw	19(14)	5.7(6)	14(10)	7.7(4)	11(13)	11/15
ring100 ho	45(14)	23(9)	753(876)	∞	∞ *2e6*	0/15
ring16 hol	21(23)	162(181)	∞	∞	∞ *2e6*	0/15

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