Comparison tables: BBOB 2012 noisy testbed in 10-D

The BBOBies

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Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2012, see `http://coco.gforge.inria.fr/doku.php?id=bbob-2012`. 4 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 [4, 2]. The experimental set-up is described in [3].

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 [1]) 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 [3] 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 2012.

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

algorithm short name	paper	reference
IPOPsaACM	Black-box Optimization Benchmarking of IPOP-saACM-ES on the BBOB-2012 Noisy Testbed (Page 261)	[8]
SNES	Benchmarking Separable Natural Evolution Strategies on the Noiseless and Noisy Black-Box Optimization Testbeds (Page 205)	[7]
xNES	Benchmarking Exponential Natural Evolution Strategies on the Noiseless and Noisy Black-Box Optimization Testbeds (Page 213)	[5]
xNESas	Benchmarking Natural Evolution Strategies with Adaptation Sampling on the Noiseless and Noisy Black-Box Optimization Testbeds (Page 229)	[6]
SNES, xNES, xNESas	Comparing Natural Evolution Strategies to BIPOP-CMA-ES on Noiseless and Noisy Black-Box Optimization Testbeds (Page 237)	[9]

Table 2: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{101}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f101	26	40	181	194	210	226	15/15
IPOPsaACM	3.7(2)	**4.1**(1)$^{\star 2}$	**1.1**(0.3)$^{\star 3}$	**1.4**(0.3)$^{\star 4}$	**1.6**(0.4)$^{\star 4}$	**1.8**(0.2)$^{\star 4}$	15/15
SNES	3.6(2)	5.9(1)	2.4(0.4)	4.4(0.4)	6.2(0.5)	7.7(0.3)	15/15
xNES	3.6(0.7)	11(2)	6.6(1)	13(0.8)	19(0.7)	24(0.7)	15/15
xNESas	**3.4**(2)	10(2)	4.4(1)	7.4(2)	9.1(2)	10(2)	15/15

Table 3: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{102}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f102	26	41	197	226	265	304	15/15
IPOPsaACM	4.7(2)	**4.9**(2)	**1.2**(0.3)$^{\star 3}$	**1.4**(0.3)$^{\star 4}$	**1.5**(0.3)$^{\star 4}$	**1.5**(0.3)$^{\star 4}$	15/15
SNES	3.9(2)	6.0(1.0)	2.3(0.3)	3.8(0.3)	4.9(0.4)	5.7(0.3)	15/15
xNES	**3.3**(1)	11(4)	5.9(0.7)	12(1.0)	15(0.8)	18(0.4)	15/15
xNESas	3.6(1)	10(2)	4.3(0.9)	7.1(2)	8.2(2)	8.5(2)	15/15

Table 4: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{103}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f103	26	47	126	360	363	364	15/15
IPOPsaACM	4.4(2)	**3.7**(0.8)$^{\star 2}$	**1.7**(0.3)$^{\star 4}$	**0.95**(0.3)$^{\star 4}$	**1.5**(0.3)$^{\star 4}$	**2.2**(0.5)$^{\star 4}$	15/15
SNES	4.1(0.9)	5.0(0.9)	3.6(0.2)	2.5(0.2)	5.1(2)	13(10)	15/15
xNES	**3.0**(0.9)	8.9(4)	9.3(0.7)	7.5(0.5)	12(0.4)	17(1.0)	15/15
xNESas	3.9(1)	9.1(2)	6.6(1)	4.2(1)	7.1(2)	11(2)	15/15

Table 5: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{104}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f104	610	9987	16641	19364	20764	22011	15/15
IPOPsaACM	**0.58**(0.2)$^{\star 3}_{\downarrow 3}$	**1.2**(0.8)	**0.81**(0.4)	**0.71**(0.4)	**0.67**(0.4)	**0.63**(0.3)	15/15
SNES	1.9(2)	7.6(9)	11(12)	∞	∞	∞ *1e5*	0/15
xNES	3.1(0.2)	4.7(6)	3.4(4)	3.4(3)	3.2(3)	3.1(3)	15/15
xNESas	2.4(0.5)	16(17)	15(19)	13(17)	12(15)	11(15)	15/15

Table 6: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{105}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f105	950	21491	70146	74217	78195	79729	15/15
IPOPsaACM	**0.58**(0.1)$^{\star 2}_{\downarrow 3}$	**1.3**(0.6)$^{\star 2}$	**0.40**(0.2)$^{\star 2}_{\downarrow 2}$	**0.39**(0.2)$^{\star 2}_{\downarrow 3}$	**0.37**(0.2)$^{\star 2}_{\downarrow 3}$	**0.37**(0.2)$^{\star 2}_{\downarrow 3}$	15/15
SNES	0.90(0.2)	6.4(6)	21(24)	∞	∞	∞ *1e5*	0/15
xNES	1.9(0.3)	35(35)	44(49)	69(59)	65(57)	64(55)	7/15
xNESas	1.4(0.2)	80(120)	84(105)	80(99)	75(94)	74(94)	8/15

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Table 7: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{106}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f106	288	3425	7705	8501	8968	9372	15/15
IPOPsaACM	**1.1**(0.3)$^{\star 4}$	**0.34**(0.1)$^{\star 4}$	**0.20**(0.0)$^{\star 4}_{\downarrow 4}$	**0.25**(0.1)$^{\star 4}_{\downarrow 4}$	**0.28**(0.1)$^{\star 4}_{\downarrow 4}$	**0.30**(0.1)$^{\star 4}_{\downarrow 4}$	15/15
SNES	2.4(0.3)	22(26)	29(28)	∞	∞	∞ *1e5*	0/15
xNES	5.9(0.4)	1.5(0.3)	0.88(0.2)	0.94(0.2)	1.0(0.2)	1.2(0.2)	15/15
xNESas	5.0(1)	1.6(0.4)	0.97(0.3)	1.1(0.4)	1.1(0.4)	1.2(0.4)	15/15

Table 8: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{107}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f107	945	2255	3871	7352	11340	14303	15/15
IPOPsaACM	0.97(1)	1.1(0.8)	1.2(0.8)	**1.1**(0.4)	**1.00**(0.2)	**0.92**(0.2)	15/15
SNES	1.2(1)	1.1(0.6)	**0.92**(0.6)	1.4(2)	1.3(1)	2.4(2)	13/15
xNES	**0.58**(0.4)	**0.86**(0.4)	6.0(6)	10(8)	27(28)	95(137)	5/15
xNESas	0.79(0.7)	1.1(0.7)	1.9(0.5)	13(17)	33(50)	38(39)	15/15

Table 9: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{108}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f108	10015	31433	47589	1.1e5	1.8e5	3.1e5	15/15
IPOPsaACM	**0.90**(1)	**0.79**(0.4)$^{\star 4}$	**1.1**(0.5)$^{\star 4}$	**1.1**(0.6)	**1.2**(0.6)	**0.84**(0.3)	15/15
SNES	3.0(3)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	14(15)	∞	∞	∞	∞	∞ *2e6*	0/15
xNESas	8.8(11)	2334(2545)	∞	∞	∞	∞ *5e6*	0/15

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

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f109	28	286	499	1159	1786	2415	15/15
IPOPsaACM	3.9(2)	**0.73**(0.2)$_{\downarrow 2}$	**0.91**(0.3)	**1.0**(0.2)$^{\star 2}$	**1.1**(0.3)$^{\star 3}$	**1.1**(0.3)$^{\star 4}$	15/15
SNES	3.9(1)	0.90(0.2)	1.1(0.2)	2.8(2)	15(20)	296(312)	0/15
xNES	3.6(1)	1.5(0.5)	3.1(0.6)	4.0(0.3)	4.6(0.3)	4.8(0.3)	15/15
xNESas	**3.1**(0.9)	1.7(0.4)	2.9(1)	4.0(0.3)	4.4(0.4)	4.6(0.3)	15/15

Table 11: 10-D, running time excess ERT/$\text{ERT}_{\text{best 2009}}$ on f_{110}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f110	11224	3.3e7	7.0e7	∞	∞	∞	0
IPOPsaACM	**0.77**(0.5)	∞	∞	.	.	.	0/15
SNES	1.5(2)	**0.01**(0.0)	**0.02**(0.0)	.	.	.	0/15
xNES	3.3(7)	1.1(1)	∞	.	.	.	0/15
xNESas	4.1(4)	∞	∞	.	.	.	0/15

Table 12: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{111}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f111	82927	∞	∞	∞	∞	∞	0
IPOPsaACM	**0.85**(0.5)$^{\star 4}$	.	.	.	.	.	0/15
SNES	∞	.	.	.	.	.	0/15
xNES	∞	.	.	.	.	.	0/15
xNESas	∞	.	.	.	.	.	0/15

Table 13: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{112}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f112	884	11583	16109	18239	19461	20444	15/15
IPOPsaACM	**0.43**(0.1)$^{\star 3}_{\downarrow 3}$	**0.92**(0.3)	**0.92**(0.2)*	**0.99**(0.2)$^{\star 3}$	**1.00**(0.2)$^{\star 3}$	**0.99**(0.2)$^{\star 3}$	15/15
SNES	1.2(1)	3.6(4)	15(17)	∞	∞	∞ *1e5*	0/15
xNES	2.0(0.2)	1.7(2)	6.7(6)	26(21)	54(68)	53(63)	13/15
xNESas	1.5(0.3)	3.0(3)	10(14)	65(67)	87(100)	185(215)	11/15

Table 14: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{113}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f113	4469	27633	1.0e5	1.1e5	1.1e5	1.1e5	15/15
IPOPsaACM	0.71(0.7)	0.67(0.5)	**0.28**(0.2)$_{\downarrow 2}$	**0.29**(0.1)$^{\star}_{\downarrow 2}$	**0.29**(0.1)$^{\star}_{\downarrow 2}$	**0.30**(0.1)$^{\star}_{\downarrow 3}$	15/15
SNES	0.62(0.5)	2.1(3)	4.4(5)	∞	∞	∞ *1e5*	0/15
xNES	**0.38**(0.5)	1.7(2)	1.8(2)	5.7(6)	5.7(6)	5.7(6)	14/15
xNESas	0.83(0.4)	**0.63**(1.0)	0.63(0.8)	4.8(7)	4.8(7)	5.2(8)	15/15

Table 15: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{114}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f114	36612	1.3e5	3.3e5	3.9e5	3.9e5	4.1e5	15/15
IPOPsaACM	**0.59**(0.4)*	**0.49**(0.3)$^{\star 3}_{\downarrow}$	**0.35**(0.2)$_{\downarrow 2}$	**0.41**(0.2)$_{\downarrow 2}$	**0.41**(0.2)$_{\downarrow 2}$	**0.41**(0.2)$_{\downarrow 2}$	15/15
SNES	19(21)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	18(23)	262(264)	∞	∞	∞	∞ *2e6*	0/15
xNESas	14(15)	∞	∞	∞	∞	∞ *5e6*	0/15

Table 16: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{115}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f115	398	2899	8595	12602	12602	12807	15/15
IPOPsaACM	**0.70**(0.3)	0.70(0.5)	0.65(0.6)	0.95(0.4)	0.95(0.4)	0.95(0.4)	15/15
SNES	1.4(1)	3.0(3)	24(27)	∞	∞	∞ *1e5*	0/15
xNES	0.98(0.3)	0.45(0.1)	0.63(0.0)	1.3(2)	1.3(2)	1.6(2)	15/15
xNESas	0.87(0.3)	**0.44**(0.1)	**0.60**(1)	**0.62**(0.8)	**0.62**(0.8)	**0.80**(0.8)	15/15

Table 17: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{116}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f116	71444	1.1e5	1.1e5	1.2e5	1.2e5	1.7e5	15/15
IPOPsaACM	**0.53**(0.3)	**0.48**(0.3)	**0.49**(0.3)*	**0.50**(0.3)$^{\star 3}$	**0.50**(0.3)$^{\star 4}$	**0.39**(0.3)$^{\star 4}_{\downarrow}$	15/15
SNES	21(23)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	0.87(0.9)	2.0(1)	2.9(4)	6.2(8)	30(28)	111(117)	2/15
xNESas	1.1(2)	1.6(2)	3.0(3)	14(16)	29(28)	55(49)	5/15

Table 18: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{117}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f117	2.3e5	4.0e5	4.9e5	6.5e5	7.2e5	7.9e5	15/15
IPOPsaACM	$\mathbf{0.42}(0.2)^{\star 4}_{\downarrow 3}$	$\mathbf{0.37}(0.2)_{\downarrow 3}$	$\mathbf{0.33}(0.2)_{\downarrow 3}$	$\mathbf{0.31}(0.1)_{\downarrow 3}$	$\mathbf{0.34}(0.1)_{\downarrow 3}$	$\mathbf{0.40}(0.2)_{\downarrow 3}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	∞	∞	∞	∞	∞	∞ *2e6*	0/15
xNESas	∞	∞	∞	∞	∞	∞ *5e6*	0/15

Table 19: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{118}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f118	1348	3241	4345	6097	7070	8063	15/15
IPOPsaACM	**0.44**(0.1)$^{\star 4}_{\downarrow 4}$	**0.37**(0.2)$^{\star}_{\downarrow 3}$	**0.49**(0.2)$_{\downarrow 3}$	**0.53**(0.2)$^{\star 4}_{\downarrow 4}$	**0.58**(0.2)$^{\star 4}_{\downarrow 4}$	**0.62**(0.1)$^{\star 4}_{\downarrow 4}$	15/15
SNES	93(106)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	1.2(0.1)	0.70(0.1)$_{\downarrow 2}$	0.76(0.0)	1.1(0.1)	1.4(0.1)	1.7(0.1)	15/15
xNESas	1.1(0.2)	0.62(0.1)$_{\downarrow 4}$	0.66(0.1)$_{\downarrow 3}$	1.0(0.2)	1.3(0.2)	1.6(0.2)	15/15

Table 20: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{119}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f119	128	3122	4969	36536	3.0e5	4.0e5	15/15
IPOPsaACM	**1.5**(1)	**1.3**(1)	**1.1**(0.6)	**0.69**(0.5)^{*3}	**0.28**(0.0)$^{\star4}_{\downarrow4}$	**0.25**(0.0)$^{\star4}_{\downarrow4}$	15/15
SNES	1.9(1)	1.5(2)	2.3(2)	∞	∞	∞ *1e5*	0/15
xNES	1.7(1)	2.4(5)	4.3(6)	19(21)	∞	∞ *3e6*	0/15
xNESas	1.5(1)	2.1(0.6)	7.4(8)	15(14)	33(34)	∞ *5e6*	0/15

Table 21: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{120}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f120	471	39910	74629	4.4e5	1.3e6	2.5e6	15/15
IPOPsaACM	4.3(5)	**0.66**(0.8)$^{\star 2}$	**0.90**(0.4)$^{\star 3}$	**0.51**(0.3)$_{\downarrow 2}$	**0.50**(0.3)$_{\downarrow 2}$	**0.47**(0.2)$_{\downarrow 2}$	15/15
SNES	5.3(5)	11(13)	∞	∞	∞	∞ *1e5*	0/15
xNES	**3.8**(4)	53(46)	∞	∞	∞	∞ *2e6*	0/15
xNESas	31(32)	65(57)	∞	∞	∞	∞ *5e6*	0/15

Table 22: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{121}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f121	72	317	631	3676	9995	18211	15/15
IPOPsaACM	1.1(0.8)	0.98(0.4)	1.1(0.4)	**0.76**(0.2)$^{\star 4}_{\downarrow 2}$	**0.76**(0.1)$^{\star 3}_{\downarrow 3}$	**0.72**(0.1)$^{\star 2}_{\downarrow 4}$	15/15
SNES	**0.76**(0.6)	**0.79**(0.3)	**1.0**(0.2)	94(98)	∞	∞ *1e5*	0/15
xNES	0.90(0.6)	1.2(0.6)	2.7(0.5)	1.6(0.2)	1.1(0.3)	0.90(0.2)	15/15
xNESas	0.98(0.6)	1.0(0.4)	2.5(0.4)	1.6(0.2)	1.0(0.1)	0.83(0.1)$_{\downarrow 2}$	15/15

Table 23: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{122}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f122	55	11563	33165	1.4e5	4.4e5	8.2e5	15/15
IPOPsaACM	8.0(8)	**0.74**(0.5)	**0.72**(0.4)$^{\star 4}$	**0.68**(0.5)$^{\star 4}$	**0.51**(0.4)	**0.81**(0.6)	15/15
SNES	5.2(9)	2.0(2)	∞	∞	∞	∞ *1e5*	0/15
xNES	3.1(3)	8.8(12)	511(540)	∞	∞	∞ *2e6*	0/15
xNESas	**2.7**(4)	7.7(9)	1066(1112)	∞	∞	∞ *5e6*	0/15

Table 24: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{123}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f123	40	94387	3.9e5	1.3e6	3.3e6	1.0e7	7/15
IPOPsaACM	**20**(30)	**0.84**(0.6)$^{\star 3}$	**0.64**(0.3)	**0.64**(0.4)	**0.79**(0.5)	**0.79**(0.6)	11/15
SNES	39(80)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	95(72)	∞	∞	∞	∞	∞ *2e6*	0/15
xNESas	20(27)	786(927)	∞	∞	∞	∞ *5e6*	0/15

Table 25: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{124}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f124	37	614	10452	52887	1.4e5	3.3e5	15/15
IPOPsaACM	2.1(1)	**1.2**(0.7)	1.4(3)	1.2(0.9)	**1.2**(1)	**3.3**(7)	15/15
SNES	1.5(2)	1.2(1)	0.96(0.8)	∞	∞	∞ *1e5*	0/15
xNES	**1.2**(1)	1.4(0.4)	**0.42**(0.1)	1.7(2)	∞	∞ *2e6*	0/15
xNESas	1.5(1)	1.4(0.5)	0.42(0.0)	**1.2**(1)	39(42)	∞ *5e6*	0/15

Table 26: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{125}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f125	1	1	1	3.0e6	6.4e6	6.4e6	13/15
IPOPsaACM	**1**(0)	118(110)	**2.3e5**(2e5)	**0.75**(0.6)	**0.45**(0.4)	**1.0**(0.9)	11/15
SNES	1.1(0.5)	124(83)	1.5e6(2e6)	∞	∞	∞ *1e5*	0/15
xNES	1.2(0.5)	**73**(92)	∞	∞	∞	∞ *2e6*	0/15
xNESas	1.1(0)	91(70)	∞	∞	∞	∞ *5e6*	0/15

Table 27: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{126}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f126	1	1	1	∞	∞	∞	0
IPOPsaACM	**1**(0)	1077(1074)	**3.6e6**(2e6)	.	.	.	0/15
SNES	1.2(0.5)	1083(1304)	∞	.	.	.	0/15
xNES	1.2(0.5)	**432**(376)	∞	.	.	.	0/15
xNESas	1.3(0.5)	2529(444)	∞	.	.	.	0/15

Table 28: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{127}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f127	1	1	1	1.3e6	2.1e6	2.1e6	15/15
IPOPsaACM	**1**(0)	76(36)	**4.1e4**(3e4)$^{\star 3}$	**0.67**(0.6)	**0.59**(0.5)	**0.91**(1)	15/15
SNES	**1**(0)	56(49)	∞	∞	∞	∞ *1e5*	0/15
xNES	**1**(0)	**38**(31)	5.9e6(6e6)	∞	∞	∞ *2e6*	0/15
xNESas	1.3(0.5)	51(38)	1.9e6(3e6)	∞	∞	∞ *5e6*	0/15

Table 29: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{128}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f128	9151	1.4e5	1.4e5	2.9e5	3.8e5	5.3e5	9/15
IPOPsaACM	1.2(2)	16(36)	23(36)	15(19)	19(26)	14(19)	10/15
SNES	**0.53**(0.8)	**0.20**(0.4)	**0.21**(0.4)	**0.10**(0.2)	**0.10**(0.1)$_{\downarrow 2}$	**0.09**(0.1)	12/15
xNES	2.7(5)	1.7(2)	1.7(2)	0.81(1.0)	0.84(0.8)	0.65(0.6)	14/15
xNESas	1.1(2)	0.98(0.7)	2.1(3)	1.4(3)	1.3(2)	0.94(2)	15/15

Table 30: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{129}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f129	53967	1.4e6	1.4e6	1.4e6	1.4e6	1.5e6	14/15
IPOPsaACM	**0.68**(0.8)	**4.4**(7)	**4.3**(7)	**4.3**(7)	**4.3**(7)	**4.3**(7)	10/15
SNES	1.9(2)	∞	∞	∞	∞	∞ *1e5*	0/15
xNES	5.7(5)	∞	∞	∞	∞	∞ *2e6*	0/15
xNESas	6.0(5)	54(57)	∞	∞	∞	∞ *5e6*	0/15

Table 31: 10-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{130}, in italics is given the median final function value and the median number of function evaluations to reach this value divided by dimension

Δf_{opt}	1e1	1e0	1e-1	1e-3	1e-5	1e-7	#succ
f130	481	5878	37470	70910	72192	73340	10/15
IPOPsaACM	5.3(8)	240(551)	67(134)	35(71)	35(69)	34(68)	13/15
SNES	**2.0**(3)	**3.0**(4)	**0.68**(1)	**0.43**(0.7)	**1.1**(1)	4.2(5)	3/15
xNES	11(0.4)	36(39)	7.8(9)	4.1(5)	4.1(5)	4.1(5)	15/15
xNESas	10(21)	34(37)	6.7(7)	3.6(3)	3.5(3)	**3.5**(3)	15/15

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