Comparison tables: BBOB 2012 noisy testbed in 3-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: 03-D, running time excess ERT/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	3.6	13	19	28	33	38	15/15
IPOPsaACM	**3.7**(4)	**3.0**(2)	**3.3**(0.6)	**3.1**(0.7)$^{\star 3}$	**3.4**(0.5)$^{\star 4}$	**3.5**(0.4)$^{\star 4}$	15/15
SNES	4.3(3)	3.2(1)	3.9(2)	7.7(1)	11(1)	13(0.9)	15/15
xNES	5.3(4)	3.8(2)	5.4(2)	8.6(2)	12(2)	14(1)	15/15
xNESas	4.9(4)	3.3(2)	4.3(2)	7.6(2)	11(2)	13(2)	15/15

Table 3: 03-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	3.6	12	23	32	39	48	15/15
IPOPsaACM	4.4(6)	3.2(2)	**2.5**(1)	**2.7**(0.5)$^{\star 4}$	**2.9**(0.6)$^{\star 4}$	**3.0**(0.5)$^{\star 4}$	15/15
SNES	4.9(6)	3.8(2)	3.4(2)	6.7(1)	9.1(1)	10(1)	15/15
xNES	4.6(4)	3.5(2)	4.1(3)	6.9(1)	10(2)	11(1)	15/15
xNESas	**3.6**(5)	**3.2**(2)	3.8(2)	6.8(1)	8.6(1)	10(2)	15/15

Table 4: 03-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	3.6	13	19	19	23	43	15/15
IPOPsaACM	**2.9**(3)	**2.6**(2)	**3.1**(0.8)	**4.8**(1.0)$^{\star 4}$	**6.8**(3)$^{\star 3}$	**4.9**(2)$^{\star 4}$	15/15
SNES	4.4(4)	3.1(2)	4.2(1)	12(2)	24(15)	32(25)	15/15
xNES	4.5(5)	3.0(2)	4.3(3)	11(2)	18(4)	14(2)	15/15
xNESas	5.2(5)	3.5(2)	4.6(2)	12(3)	15(5)	12(2)	15/15

Table 5: 03-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	30	207	602	648	658	668	15/15
IPOPsaACM	3.0(2)	**1.4**(0.4)	**0.83**(1)	**0.91**(1)*	**0.95**(1)$^{\star 2}$	**0.98**(1)$^{\star 2}$	15/15
SNES	**1.8**(0.9)	1.9(4)	28(26)	125(120)	∞	∞ *3e4*	0/15
xNES	2.4(1)	1.7(2)	2.3(4)	3.3(4)	3.4(4)	3.6(4)	15/15
xNESas	2.7(1)	4.0(0.5)	4.9(8)	10(16)	10(16)	10(15)	15/15

Table 6: 03-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	28	507	1070	3247	3271	3297	5/15
IPOPsaACM	3.4(2)	0.97(2)	**1.3**(2)	**0.47**(0.5)	**0.48**(0.5)	**0.48**(0.5)	15/15
SNES	**2.4**(2)	**0.92**(0.9)	16(15)	45(46)	135(143)	∞ *3e4*	0/15
xNES	2.4(0.9)	2.8(8)	3.9(8)	3.0(3)	3.0(3)	3.1(3)	15/15
xNESas	17(2)	6.0(15)	9.3(11)	6.0(10)	6.7(10)	6.6(10)	15/15

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Table 7: 03-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	29	68	156	759	1294	1447	15/15
IPOPsaACM	2.5(1)	**2.7**(2)	**1.8**(0.9)*	**0.48**(0.2)$^{\star 2}$	**0.36**(0.1)$^{\star 2}_{\downarrow 4}$	**0.36**(0.1)$^{\star 3}_{\downarrow 4}$	15/15
SNES	2.6(2)	5.7(9)	77(86)	∞	∞	∞ *3e4*	0/15
xNES	**2.3**(1)	3.9(2)	10(20)	2.6(4)	1.8(2)	1.7(2)	15/15
xNESas	2.7(2)	16(3)	9.3(4)	3.3(6)	2.1(4)	2.0(3)	15/15

Table 8: 03-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	5.9	47	153	325	505	685	15/15
IPOPsaACM	**4.0**(3)	**1.4**(1)	**0.96**(0.5)	**1.3**(0.7)	**1.3**(0.6)	1.3(0.4)	15/15
SNES	15(23)	3.3(5)	1.5(2)	1.5(0.7)	1.4(0.4)	**1.3**(0.4)	15/15
xNES	64(26)	17(32)	5.6(10)	3.9(5)	3.0(3)	2.5(2)	15/15
xNESas	107(24)	14(3)	5.0(1)	3.0(1.0)	2.4(0.5)	2.9(6)	15/15

Table 9: 03-D, running time excess ERT/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	5.8	98	1966	10825	17187	32181	15/15
IPOPsaACM	**11**(15)	7.2(11)	1.1(1)	**0.83**(0.5)$^{\star 4}$	**1.1**(0.8)$^{\star 4}$	**0.93**(0.4)$^{\star 4}$	15/15
SNES	26(40)	**6.0**(8)	**0.69**(0.5)	∞	∞	∞ *3e4*	0/15
xNES	62(34)	36(54)	12(19)	150(165)	∞	∞ *2e5*	0/15
xNESas	213(641)	56(101)	10(11)	80(85)	∞	∞ *4e5*	0/15

Table 10: 03-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	3.6	21	93	193	251	251	15/15
IPOPsaACM	**3.2**(3)	**1.7**(1)	0.85(0.2)	2.1(2)	3.2(2)	**4.5**(3)	15/15
SNES	3.9(5)	1.8(1)	**0.73**(0.4)	1.8(1)	9.1(11)	502(593)	0/15
xNES	3.6(5)	1.9(1)	1.00(0.6)	**1.7**(0.8)	3.0(2)	5.7(2)	15/15
xNESas	3.8(4)	1.8(2)	0.86(0.5)	1.8(0.7)	**2.6**(0.8)	6.6(5)	15/15

Table 11: 03-D, running time excess ERT/$\mathrm{ERT}_{\mathrm{best\ 2009}}$ 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	56	922	6277	35327	61979	63571	15/15
IPOPsaACM	1.6(1)	2.7(4)	3.0(4)	**0.97**(1.0)	**0.57**(0.6)	**0.57**(0.6)	15/15
SNES	2.7(3)	**0.82**(1)	2.8(2)	1.8(2)	∞	∞ *3e4*	0/15
xNES	2.9(3)	4.5(6)	**2.1**(3)	1.1(1)	0.74(0.9)	0.72(0.8)	15/15
xNESas	**1.5**(1.0)	2.5(4)	4.5(3)	1.8(2)	1.1(0.9)	1.3(1.0)	15/15

Table 12: 03-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	174	3475	29972	1.9e5	1.4e6	1.5e6	14/15
IPOPsaACM	3.8(6)	1.2(2)	9.1(18)	**4.9**(4)	**0.70**(0.6)	**0.71**(0.6)	15/15
SNES	**2.1**(2)	**0.94**(0.4)	7.1(8)	∞	∞	∞ *3e4*	0/15
xNES	12(16)	4.7(6)	3.1(3)	∞	∞	∞ *2e5*	0/15
xNESas	12(20)	3.5(4)	**1.3**(2)	16(17)	∞	∞ *4e5*	0/15

Table 13: 03-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	29	338	1568	2849	3105	3534	15/15
IPOPsaACM	3.3(2)	1.7(2)	**0.87**(0.9)	**0.78**(0.4)	**0.83**(0.4)	**0.82**(0.4)	15/15
SNES	2.8(2)	1.8(2)	9.0(10)	∞	∞	∞ *3e4*	0/15
xNES	**2.5**(2)	**1.0**(0.7)	1.4(2)	2.7(3)	4.0(5)	4.1(4)	15/15
xNESas	2.8(3)	8.0(13)	5.6(7)	5.3(6)	5.2(6)	7.2(8)	15/15

Table 14: 03-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	26	126	1948	3236	3236	3428	12/15
IPOPsaACM	4.2(6)	4.4(7)	0.75(1)	**0.70**(0.9)	**0.70**(0.9)	**0.74**(0.8)	15/15
SNES	2.6(3)	**2.7**(3)	**0.69**(1)	0.92(0.9)	0.92(0.9)	1.1(1)	15/15
xNES	**1.5**(0.9)	5.4(13)	1.5(3)	1.5(2)	1.5(2)	1.5(2)	15/15
xNESas	8.8(8)	25(28)	4.8(6)	3.4(4)	3.4(4)	3.6(3)	15/15

Table 15: 03-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	26	1015	6279	28324	28324	32580	15/15
IPOPsaACM	**10**(15)	**1.3**(2)	**0.96**(0.9)	**0.40**(0.3)$^{\star 2}$	**0.40**(0.3)$^{\star 2}$	**0.41**(0.3)$^{\star 2}$	15/15
SNES	12(15)	1.4(2)	2.8(3)	16(16)	16(15)	∞ *3e4*	0/15
xNES	30(89)	4.7(6)	6.3(8)	13(14)	13(14)	21(24)	3/15
xNESas	146(189)	11(17)	9.5(11)	24(20)	24(20)	45(49)	2/15

Table 16: 03-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	12	118	593	890	890	1246	15/15
IPOPsaACM	**2.8**(2)	**1.1**(0.5)	**1.2**(1.0)	**1.5**(2)	**1.5**(2)	**1.5**(2)	15/15
SNES	3.8(3)	1.9(2)	1.6(1)	10(17)	10(17)	11(14)	9/15
xNES	6.5(4)	6.9(13)	4.8(10)	4.6(9)	4.6(9)	3.4(7)	15/15
xNESas	4.9(5)	4.3(0.6)	3.8(5)	2.7(4)	2.7(4)	4.1(8)	15/15

Table 17: 03-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	169	2642	4419	7143	9614	11370	15/15
IPOPsaACM	3.9(7)	**0.77**(0.9)	**0.60**(0.6)	**0.50**(0.3)	**0.41**(0.3)	**0.37**(0.2)	15/15
SNES	**3.8**(4)	1.2(1)	3.8(4)	30(32)	∞	∞ *3e4*	0/15
xNES	9.5(15)	1.3(3)	1.1(2)	0.74(1)	0.60(0.9)	0.80(0.9)	15/15
xNESas	24(63)	4.7(7)	3.1(4)	1.9(2)	1.7(2)	1.5(2)	15/15

Table 18: 03-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	2392	14361	39508	61720	73678	80041	15/15
IPOPsaACM	2.5(3)	**1.3**(1)	**0.71**(0.4)	**0.54**(0.2)	**0.57**(0.2)	**0.60**(0.2)	15/15
SNES	**1.5**(2)	1.8(2)	11(13)	∞	∞	∞ *3e4*	0/15
xNES	3.9(7)	2.3(3)	3.1(4)	57(59)	∞	∞ *2e5*	0/15
xNESas	3.6(5)	5.1(7)	6.9(7)	∞	∞	∞ *4e5*	0/15

Table 19: 03-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	109	205	712	1008	1283	1593	15/15
IPOPsaACM	**1.1**(0.4)	**0.75**(0.3)*	**0.35**(0.1)$_{\downarrow 3}$	**0.52**(0.2)$_{\downarrow 3}$	**0.70**(0.4)$_{\downarrow}$	**0.76**(0.3)	15/15
SNES	3.9(4)	15(16)	20(16)	∞	∞	∞ *3e4*	0/15
xNES	1.5(1)	2.0(1)	0.79(0.6)	1.3(2)	1.6(2)	1.5(2)	15/15
xNESas	1.6(0.6)	1.3(0.8)	0.53(0.2)$_{\downarrow 2}$	0.60(0.2)$_{\downarrow 2}$	1.1(0.2)	1.1(0.2)	15/15

Table 20: 03-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	2.2	66	421	2005	12038	15719	15/15
IPOPsaACM	**2.8**(3)	**1.3**(2)	**0.45**(0.3)	**0.65**(0.5)	**0.55**(0.4)	**0.84**(0.7)	15/15
SNES	12(20)	2.6(3)	0.68(0.5)	0.67(0.6)	11(12)	∞ *3e4*	0/15
xNES	9.0(14)	18(58)	3.5(9)	2.0(2)	0.65(1)	1.1(1.0)	15/15
xNESas	8.2(9)	7.4(4)	2.6(7)	2.6(3)	1.1(1)	1.3(2)	15/15

Table 21: 03-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	2.2	81	1802	31935	1.2e5	2.7e5	15/15
IPOPsaACM	**20**(50)	9.0(18)	1.6(2)	**0.57**(0.2)$^{\star 4}$	**0.40**(0.2)$_{\downarrow 2}$	**0.51**(0.3)	15/15
SNES	23(67)	**6.9**(10)	**1.2**(2)	∞	∞	∞ *3e4*	0/15
xNES	414(1025)	55(83)	12(14)	50(51)	∞	∞ *2e5*	0/15
xNESas	29(40)	57(53)	13(18)	105(106)	∞	∞ *5e5*	0/15

Table 22: 03-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	2.2	41	116	699	2297	3321	15/15
IPOPsaACM	3.6(5)	**1.0**(1.0)	1.5(0.6)	1.1(1)	0.96(0.3)	1.1(0.8)	15/15
SNES	**2.9**(4)	1.4(1)	1.1(0.4)	2.7(3)	∞	∞ *3e4*	0/15
xNES	7.7(11)	1.4(1.0)	**1.0**(0.5)	0.89(0.6)	**0.65**(0.4)	**0.86**(0.6)	15/15
xNESas	4.8(7)	1.7(3)	1.3(1)	**0.83**(0.3)	0.82(0.5)	1.0(1.0)	15/15

Table 23: 03-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	5.8	357	1802	7595	12242	19009	15/15
IPOPsaACM	3.1(2)	1.4(2)	1.3(2)	**0.90**(0.5)	**1.1**(1)$^{\star 2}$	**1.1**(0.7)$^{\star 3}$	15/15
SNES	6.3(7)	**0.86**(1)	**0.63**(0.6)	9.3(11)	∞	∞ *3e4*	0/15
xNES	**2.3**(2)	1.8(4)	3.9(5)	3.9(5)	17(19)	∞ *3e5*	0/15
xNESas	4.9(6)	13(24)	11(20)	8.0(8)	52(55)	∞ *5e5*	0/15

Table 24: 03-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	4.9	1546	21830	93159	1.9e5	4.4e5	15/15
IPOPsaACM	23(21)	1.9(2)	**0.80**(0.6)$^{\star 3}$	**0.69**(0.2)	**0.78**(0.4)	**0.99**(0.7)	15/15
SNES	5.4(8)	**0.96**(0.8)	∞	∞	∞	∞ *3e4*	0/15
xNES	**5.1**(6)	4.9(6)	70(82)	∞	∞	∞ *2e5*	0/15
xNESas	24(66)	11(11)	38(44)	∞	∞	∞ *5e5*	0/15

Table 25: 03-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	3.6	196	926	7091	12902	14882	14/15
IPOPsaACM	**2.2**(3)	0.71(0.6)	0.90(1)	**0.69**(0.5)	**1.1**(0.5)$^{\star 3}$	**1.3**(0.6)$^{\star 3}$	15/15
SNES	5.6(7)	**0.65**(0.7)	**0.59**(0.7)	∞	∞	∞ *3e4*	0/15
xNES	5.6(5)	2.1(0.5)	0.70(0.3)	1.7(2)	6.5(6)	105(115)	0/15

Table 26: 03-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	24677	36351	38000	15/15
IPOPsaACM	**1**(0)	10(16)	343(650)	**0.91**(0.8)	**0.94**(0.8)	**1.0**(0.7)	15/15
SNES	1.1(0.5)	14(27)	260(286)	8.2(10)	∞	∞ *3e4*	0/15
xNES	1.1(0.5)	**9.3**(14)	189(266)	3.2(3)	8.4(10)	20(22)	3/15
xNESas	1.1(0.5)	15(10)	**131**(95)	5.5(6)	15(13)	29(30)	3/15

Table 27: 03-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	1.1e5	6.3e5	9.6e5	15/15
IPOPsaACM	**1**(0)	12(24)	737(972)	**0.85**(1)	**0.84**(1)	**0.90**(1)	15/15
SNES	1.2(0.5)	39(48)	**399**(496)	∞	∞	∞ *3e4*	0/15
xNES	1.3(0.5)	**7.3**(10)	1716(3734)	14(16)	∞	∞ *2e5*	0/15
xNESas	1.3(0.5)	62(138)	2313(3108)	6.5(7)	∞	∞ *4e5*	0/15

Table 28: 03-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	39085	45347	45996	8/15
IPOPsaACM	**1**(0)	10(9)	144(99)	**0.48**(0.6)	**0.77**(0.9)	**0.95**(1)	15/15
SNES	1.6(0)	11(12)	**112**(106)	1.9(2)	∞	∞ *3e4*	0/15
xNES	1.2(0.5)	**6.2**(6)	139(74)	1.6(2)	12(14)	22(24)	2/15
xNESas	1.3(0.5)	12(12)	244(376)	1.9(2)	5.6(7)	13(13)	8/15

Table 29: 03-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	5.5	426	1125	1917	2715	4340	15/15
IPOPsaACM	2.6(3)	4.6(6)	18(32)	19(31)	198(553)	124(346)	13/15
SNES	2.6(3)	**2.7**(3)	**2.2**(3)	**1.3**(1)	**1.00**(1)	**0.68**(0.7)	15/15
xNES	42(16)	11(21)	9.1(10)	5.4(6)	3.8(4)	2.4(3)	15/15
xNESas	**1.5**(2)	30(21)	20(47)	12(27)	8.6(19)	5.4(12)	15/15

Table 30: 03-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	4.8	362	3392	11584	28362	38534	15/15
IPOPsaACM	3.2(2)	10(6)	2.7(5)	4.6(3)	10(6)	**7.4**(5)	14/15
SNES	**1.8**(2)	**3.7**(4)	**0.69**(0.7)	**3.0**(3)	**4.7**(5)	11(12)	1/15
xNES	3.0(3)	6.5(9)	5.6(8)	6.3(7)	16(19)	21(20)	2/15
xNESas	3.5(7)	23(42)	6.5(9)	13(18)	27(32)	167(187)	0/15

Table 31: 03-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	5.5	245	515	1502	11944	14346	12/15
IPOPsaACM	2.2(2)	12(20)	15(18)	27(8)	13(3)	16(5)	14/15
SNES	3.1(4)	**3.7**(5)	**2.6**(2)	**0.98**(0.7)	**0.17**(0.1)$_\downarrow$	**0.34**(0.4)	12/15
xNES	2.2(2)	46(70)	42(58)	15(20)	2.0(3)	1.9(2)	15/15
xNESas	**1.5**(0.8)	11(22)	48(98)	17(33)	2.2(4)	2.0(4)	15/15

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