Comparison tables: BBOB 2012 noisy testbed in 20-D

The BBOBies

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Abstract

This document provides tabular results of the workshop for Black-Box Optimization Benchmarking at GECCO 2010, 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: 20-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	59	425	571	700	739	783	15/15
IPOPsaACM	4.7(1)	**0.86**(0.2)$^{\star 4}$	**0.73**(0.1)$^{\star 4}_{\downarrow 2}$	**0.78**(0.1)$^{\star 4}_{\downarrow 3}$	**0.88**(0.1)$^{\star 4}_{\downarrow}$	**0.99**(0.1)$^{\star 4}$	15/15
SNES	**4.1**(0.7)	1.5(0.2)	1.9(0.1)	2.8(0.2)	3.9(0.1)	4.7(0.2)	15/15
xNES	5.5(2)	7.1(0.9)	10(0.7)	17(0.6)	24(0.4)	30(0.6)	15/15
xNESas	4.8(2)	5.1(0.8)	5.7(2)	6.7(2)	7.7(3)	8.4(2)	30/30

Table 3: 20-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	231	399	579	921	1157	1407	15/15
IPOPsaACM	1.2(0.2)	**0.93**(0.2)$^{\star 3}$	**0.75**(0.1)$^{\star 4}_{\downarrow 3}$	**0.61**(0.1)$^{\star 4}_{\downarrow 4}$	**0.60**(0.0)$^{\star 4}_{\downarrow 4}$	**0.60**(0.0)$^{\star 4}_{\downarrow 4}$	15/15
SNES	**1.1**(0.2)	1.6(0.3)	1.9(0.1)	2.1(0.1)	2.5(0.1)	2.7(0.1)	15/15
xNES	1.5(0.7)	7.7(0.9)	10(0.5)	13(0.3)	15(0.2)	17(0.4)	15/15
xNESas	1.5(0.5)	5.8(2)	6.2(2)	5.6(2)	5.4(2)	5.4(2)	30/30

Table 4: 20-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	65	417	629	1313	1893	2464	14/15
IPOPsaACM	3.9(0.8)	**0.83**(0.2)$^{\star4}_{\downarrow2}$	**0.66**(0.1)^{*4}	**0.52**(0.1)$^{\star4}_{\downarrow4}$	**0.55**(0.1)$^{\star4}_{\downarrow4}$	**0.58**(0.1)$^{\star4}_{\downarrow3}$	15/15
SNES	**3.8**(0.9)	1.5(0.2)	1.7(0.1)	1.6(0.1)	1.7(0.1)	3.4(2)	15/15
xNES	6.2(2)	7.4(0.8)	10(0.4)	9.4(0.3)	10(0.4)	11(0.3)	15/15
xNESas	5.0(2)	5.0(1)	4.9(2)	4.1(2)	5.5(2)	6.8(2)	30/30

Table 5: 20-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	23690	85656	1.7e5	1.8e5	1.9e5	2.0e5	15/15
IPOPsaACM	**3.5**(2)	**1.1**(0.6)$^{\star 4}$	**0.55**(0.3)$^{\star 4}$	**0.52**(0.3)$^{\star 4}$	**0.50**(0.3)$^{\star 4}$	**0.49**(0.3)$^{\star 4}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	8.1(10)	∞	∞	∞	∞	∞ *8e6*	0/15
xNESas	24(29)	∞	∞	∞	∞	∞ *2e7*	0/30

Table 6: 20-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	1.9e5	6.1e5	6.3e5	6.5e5	6.6e5	6.7e5	15/15
IPOPsaACM	**1.0**(0.4)$^{\star 2}$	**0.36**(0.1)$_{\downarrow 3}$	**0.35**(0.1)$_{\downarrow 3}$	**0.34**(0.1)$_{\downarrow 3}$	**0.34**(0.1)$_{\downarrow 3}$	**0.33**(0.1)$_{\downarrow 3}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	17(16)	∞	∞	∞	∞	∞ *7e6*	0/15
xNESas	24(33)	∞	∞	∞	∞	∞ *2e7*	0/21

∞

Table 7: 20-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	11480	21668	23746	25470	26492	27360	15/15
IPOPsaACM	**0.28**(0.1)$^{\star 4}_{\downarrow 4}$	**0.37**(0.3)$^{\star 4}_{\downarrow 4}$	**0.39**(0.2)$^{\star 4}_{\downarrow 4}$	**0.45**(0.2)$^{\star 4}_{\downarrow 4}$	**0.46**(0.2)$^{\star 4}_{\downarrow 4}$	**0.47**(0.2)$^{\star 4}_{\downarrow 4}$	15/15
SNES	123(138)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	1.3(0.1)	1.2(0.1)	1.3(0.1)	1.3(0.1)	1.5(0.1)	1.7(0.1)	15/15
xNESas	1.2(0.2)	1.4(0.3)	1.5(0.5)	1.7(0.9)	1.8(0.7)	2.0(0.7)	30/30

Table 8: 20-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	8571	13582	16226	27357	52486	65052	15/15
IPOPsaACM	**0.83**(0.5)	**1.3**(0.8)$^{\star 3}$	**1.4**(0.7)$^{\star 4}$	**1.3**(0.8)$^{\star 4}$	**1.0**(0.5)$^{\star 4}$	**0.94**(0.4)$^{\star 4}$	15/15
SNES	2.6(3)	14(15)	∞	∞	∞	∞ *2e5*	0/15
xNES	1.7(0.4)	69(69)	879(893)	∞	∞	∞ *7e6*	0/15
xNESas	1.6(0.9)	44(41)	786(1027)	∞	∞	∞ *1e7*	0/15

Table 9: 20-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	58063	97228	2.0e5	4.5e5	6.3e5	9.0e5	15/15
IPOPsaACM	**0.72**(0.3)$^{\star 4}$	**1.2**(0.6)$^{\star 4}$	**1.1**(0.6)	**1.2**(0.7)	**1.6**(0.3)	**1.4**(0.3)	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	∞	∞	∞	∞	∞	∞ *6e6*	0/15
xNESas	∞	∞	∞	∞	∞	∞ *1e7*	0/15

Table 10: 20-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	333	632	1138	2287	3583	4952	15/15
IPOPsaACM	0.93(0.3)	**0.78**(0.2)$^{\star 2}_{\downarrow}$	**0.78**(0.2)$^{\star 3}_{\downarrow 2}$	**0.89**(0.3)$^{\star 4}$	**0.79**(0.2)$^{\star 4}_{\downarrow}$	**0.75**(0.2)$^{\star 4}_{\downarrow 2}$	15/15
SNES	**0.77**(0.1)$_{\downarrow 2}$	1.1(0.1)	1.3(0.2)	3.8(3)	15(13)	103(111)	3/15
xNES	0.94(0.3)	5.5(0.7)	7.7(0.4)	10(0.5)	10(0.5)	10(0.3)	15/15
xNESas	1.0(0.2)	4.7(0.6)	6.9(0.8)	9.4(0.7)	10(0.5)	13(8)	15/15

Table 11: 20-D, running time excess ERT/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	∞	∞	∞	∞	∞	∞	0
IPOPsaACM	.	.	.	.	.	.	0/15
SNES	.	.	.	.	.	.	0/15
xNES	.	.	.	.	.	.	0/15
xNESas	.	.	.	.	.	.	0/15

Table 12: 20-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	∞	∞	∞	∞	∞	∞	0
IPOPsaACM	.	.	.	.	.	.	0/15
SNES	.	.	.	.	.	.	0/15
xNES	.	.	.	.	.	.	0/15
xNESas	.	.	.	.	.	.	0/15

Table 13: 20-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	25552	64124	69621	73557	76137	78238	15/15
IPOPsaACM	**0.89**(0.3)	**0.79**(0.1)$^{\star 4}$	**0.84**(0.1)$^{\star 4}$	**0.88**(0.1)$^{\star 4}$	**0.88**(0.1)$^{\star 4}$	**0.88**(0.1)$^{\star 4}$	15/15
SNES	113(122)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	0.93(0.2)	52(64)	1454(1519)	∞	∞	∞ *7e6*	0/15
xNESas	0.99(0.2)	59(67)	952(948)	3878(4383)	3747(3875)	3646(3690)	1/15

Table 14: 20-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	50123	3.6e5	5.6e5	5.9e5	5.9e5	5.9e5	15/15
IPOPsaACM	**0.54**(0.2)	**0.35**$(0.2)^{\star 4}_{\downarrow 2}$	**0.31**$(0.1)^{\star 4}_{\downarrow 4}$	**0.32**$(0.1)^{\star 4}_{\downarrow 4}$	**0.32**$(0.1)^{\star 4}_{\downarrow 4}$	**0.32**$(0.1)^{\star 4}_{\downarrow 4}$	15/15
SNES	4.5(5)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	5.0(5)	137(150)	∞	∞	∞	∞ *7e6*	0/15
xNESas	1.4(1)	179(204)	∞	∞	∞	∞ *1e7*	0/15

Table 15: 20-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	2.1e5	1.1e6	1.4e6	1.6e6	1.6e6	1.6e6	15/15
IPOPsaACM	**0.71**(0.3)$^{\star 4}$	**0.39**(0.3)$_{\downarrow 3}$	**0.40**(0.2)$_{\downarrow 3}$	**0.50**(0.3)$_{\downarrow 2}$	**0.50**(0.3)$_{\downarrow 2}$	**0.55**(0.3)$_{\downarrow}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	∞	∞	∞	∞	∞	∞ *6e6*	0/15
xNESas	∞	∞	∞	∞	∞	∞ *1e7*	0/15

Table 16: 20-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	2405	30268	91749	1.3e5	1.3e5	1.3e5	15/15
IPOPsaACM	**0.75**(2)	0.67(0.3)	0.31(0.2)	4.8(15)	4.8(15)	4.7(14)	15/15
SNES	1.2(1)	29(33)	∞	∞	∞	∞ *2e5*	0/15
xNES	1.0(0.2)	0.25(0.0)$_{\downarrow 4}$	0.14(9e-3)$_{\downarrow}$	0.62(0.8)	0.62(0.8)	0.69(0.8)	15/15
xNESas	1.0(0.1)	**0.24**(0.0)$_{\downarrow 4}$	**0.14**(0.0)$_{\downarrow}$	**0.37**(0.3)	**0.37**(0.3)	**0.46**(0.5)	15/15

Table 17: 20-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	5.0e5	6.9e5	8.9e5	1.0e6	1.1e6	1.1e6	15/15
IPOPsaACM	**0.46**(0.1)	**0.35**(0.1)	**0.30**(0.1)	**0.28**(0.1)$_{\downarrow 4}$	**0.29**(0.1)$_{\downarrow 4}$	**0.30**(0.1)$_{\downarrow 4}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	101(116)	∞	∞	∞	∞	∞ *7e6*	0/15
xNESas	39(42)	∞	∞	∞	∞	∞ *2e7*	0/15

Table 18: 20-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	1.8e6	2.5e6	2.6e6	2.9e6	3.2e6	3.6e6	15/15
IPOPsaACM	$\mathbf{0.29}(0.1)_{\downarrow 3}$	$\mathbf{0.26}(0.1)_{\downarrow 4}$	$\mathbf{0.29}(0.1)_{\downarrow 4}$	$\mathbf{0.35}(0.2)_{\downarrow 4}$	$\mathbf{0.42}(0.2)_{\downarrow 3}$	$\mathbf{0.48}(0.4)_{\downarrow 2}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	∞	∞	∞	∞	∞	∞ *5e6*	0/15
xNESas	∞	∞	∞	∞	∞	∞ *8e6*	0/30

Table 19: 20-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	6908	11786	17514	26342	30062	32659	15/15
IPOPsaACM	**0.42**(0.2)$^{\star 4}_{\downarrow 4}$	**0.49**(0.1)$^{\star 3}_{\downarrow 4}$	**0.54**(0.1)$^{\star 3}_{\downarrow 3}$	**0.54**(0.2)$^{\star 4}_{\downarrow 4}$	**0.56**(0.1)$^{\star 4}_{\downarrow 4}$	**0.58**(0.1)$^{\star 4}_{\downarrow 4}$	15/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	1.0(0.0)	0.90(0.0)	0.90(0.0)	1.1(0.1)	1.5(0.1)	1.8(0.0)	15/15
xNESas	0.94(0.1)	0.77(0.1)	0.80(0.1)	1.1(0.1)	1.7(0.7)	2.1(0.7)	15/15

Table 20: 20-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	2771	29365	35930	4.1e5	1.4e6	1.9e6	15/15
IPOPsaACM	1.5(2)	**0.74**(0.3)$^{\star 2}$	**0.88**(0.3)$^{\star 3}$	**0.33**(0.1)$^{\star 3}_{\downarrow 3}$	**0.25**(0.1)$_{\downarrow 4}$	**0.37**(0.3)$_{\downarrow 3}$	15/15
SNES	1.4(2)	22(24)	∞	∞	∞	∞ *2e5*	0/15
xNES	0.54(0.3)$_{\downarrow 2}$	14(13)	2741(3347)	∞	∞	∞ *7e6*	0/15
xNESas	**0.53**(0.4)$_{\downarrow}$	10(10)	851(808)	∞	∞	∞ *1e7*	0/13

Table 21: 20-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	36040	1.8e5	2.8e5	1.6e6	6.7e6	1.4e7	13/15
IPOPsaACM	**0.65**(0.5)	**0.80**(0.4)$^{\star 4}$	**1.2**(0.6)	**0.87**(0.5)	**0.42**(0.1)$_{\downarrow 3}$	**0.39**(0.2)$_{\downarrow 3}$	15/15
SNES	10(11)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	14(23)	∞	∞	∞	∞	∞ *6e6*	0/15
xNESas	6.9(7)	∞	∞	∞	∞	∞ *1e7*	0/15

Table 22: 20-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	249	769	1426	9304	34434	57404	15/15
IPOPsaACM	1.2(0.4)	**0.85**(0.2)	**0.92**(0.3)$^{\star 2}$	**0.69**(0.1)$^{\star 4}_{\downarrow 3}$	**0.58**(0.1)$^{\star 4}_{\downarrow 4}$	**0.71**(0.1)$^{\star 4}_{\downarrow 3}$	15/15
SNES	0.83(0.2)	0.89(0.2)	1.3(0.2)	∞	∞	∞ *2e5*	0/15
xNES	**0.74**(0.2)	3.4(0.6)	6.7(0.4)	2.9(0.2)	1.3(0.1)	1.1(0.1)	15/15
xNESas	0.81(0.3)	2.8(0.6)	6.3(0.5)	2.9(0.2)	1.7(0.6)	1.7(1)	15/15

Table 23: 20-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	692	52008	1.4e5	7.9e5	2.0e6	5.8e6	15/15
IPOPsaACM	2.5(3)	**0.94**(0.6)$^{\star 3}$	**0.81**(0.3)$^{\star 3}$	**0.53**(0.1)$_{\downarrow}$	**0.51**(0.2)$_{\downarrow}$	**0.57**(0.3)	15/15
SNES	1.9(2)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	0.91(0.8)	∞	∞	∞	∞	∞ *6e6*	0/15
xNESas	**0.81**(0.9)	∞	∞	∞	∞	∞ *1e7*	0/13

Table 24: 20-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	1063	5.3e5	1.5e6	5.3e6	2.7e7	1.6e8	0
IPOPsaACM	**7.6**(8)	**0.77**(0.5)	**0.81**(0.5)	**1.1**(0.7)	**0.63**(0.4)	**0.92**(1)	0/15
SNES	7.7(9)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	9.0(9)	∞	∞	∞	∞	∞ *6e6*	0/15
xNESas	11(14)	∞	∞	∞	∞	∞ *1e7*	0/15

Table 25: 20-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	192	1959	40840	1.3e5	3.9e5	8.0e5	15/15
IPOPsaACM	0.86(0.4)	3.0(0.8)	2.2(2)	**1.4**(0.5)	**0.76**(0.3)	**4.0**(5)	14/15
SNES	**0.58**(0.4)$_{\downarrow}$	**0.69**(0.2)$_{\downarrow}$	0.66(0.5)	∞	∞	∞ *2e5*	0/15
xNES	0.63(0.3)	2.7(0.3)	**0.58**(0.1)	6.4(7)	∞	∞ *7e6*	0/15
xNESas	0.84(0.3)	2.7(0.5)	0.59(0.1)	4.0(3)	∞	∞ *2e7*	0/15

Table 26: 20-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	2.5e7	8.0e7	8.1e7	4/15
IPOPsaACM	**1**(0)	1083(1766)	**3.3e6**(2e6)	**0.61**(0.5)	**1.1**(1)	**1.1**(1)	3/15
SNES	1.3(0.5)	625(509)	∞	∞	∞	∞ *2e5*	0/15
xNES	1.5(1)	**451**(271)	∞	∞	∞	∞ *6e6*	0/30
xNESas	1.7(1)	470(238)	∞	∞	∞	∞ *1e7*	0/15

Table 27: 20-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)	**7156**(4580)	∞	.	.	.	0/15
SNES	1.3(0.5)	2.3e4(2e4)	∞	.	.	.	0/15
xNES	1.2(0.5)	2.5e4(6e4)	∞	.	.	.	0/30
xNESas	1.4(1)	2.7e4(5e4)	∞	.	.	.	0/15

Table 28: 20-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	4.4e6	7.3e6	7.4e6	15/15
IPOPsaACM	**1**(0)	238(106)	**3.3e5**(4e5)	**0.75**(0.6)	**0.93**(0.5)	**0.97**(0.6)	14/15
SNES	1.2(0.5)	167(80)	∞	∞	∞	∞ *2e5*	0/15
xNES	1.4(1)	**128**(63)	∞	∞	∞	∞ *6e6*	0/30
xNESas	1.5(0.5)	131(87)	∞	∞	∞	∞ *1e7*	0/15

Table 29: 20-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	1.4e5	1.3e7	1.7e7	1.7e7	1.7e7	1.7e7	9/15
IPOPsaACM	**1.3**(2)	0.59(0.8)	1.1(1)	1.1(2)	1.1(2)	**1.1**(1)	8/15
SNES	4.2(5)	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	28(32)	0.97(0.9)	1.2(1)	2.0(2)	3.4(4)	3.4(4)	3/30
xNESas	19(23)	**0.40**(0.5)	**0.78**(0.8)	**1.0**(1)	**1.0**(1)	1.3(1)	6/15

Table 30: 20-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	7.8e6	4.1e7	4.2e7	4.2e7	4.2e7	4.2e7	5/15
IPOPsaACM	**0.41**(0.9)	**0.28**(0.5)	**0.36**(0.5)	**0.36**(0.5)	**0.36**(0.5)	**0.36**(0.5)	9/15
SNES	∞	∞	∞	∞	∞	∞ *2e5*	0/15
xNES	∞	∞	∞	∞	∞	∞ *6e6*	0/30
xNESas	∞	∞	∞	∞	∞	∞ *1e7*	0/15

Table 31: 20-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	4904	93149	2.5e5	2.5e5	2.6e5	2.6e5	7/15
IPOPsaACM	**0.55**(1)	27(34)	30(42)	30(43)	30(41)	30(39)	12/15
SNES	0.76(1)	**0.19**(0.3)	**0.09**(0.1)	**0.11**(0.1)	**0.36**(0.3)	**2.1**(2)	2/15
xNES	14(20)	10(9)	4.9(5)	4.9(5)	4.9(5)	4.9(5)	29/30
xNESas	15(23)	5.3(4)	5.4(9)	5.4(9)	5.4(9)	5.4(9)	15/15

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