Comparison tables: BBOB 2012 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`. More than 27 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
ACOR	An ACO Algorithm Benchmarked on the BBOB Noiseless Function Testbed (Page 159)	[5]
BIPOPaCMA	Black-Box Optimization Benchmarking of IPOP-SaACM-ES and BIPOP-SaACM-ES on the BBOB-2012 Noiseless Testbed (Page 175)	[12]
BIPOPsaACM	Black-box Optimization Benchmarking of IPOP-SaACM-ES and BIPOP-SaACM-ES on the BBOB-2012 Noiseless Testbed (Page 175)	[12]
CMA	Comparing Mirrored Mutations and Active Covariance Matrix Adaptation in the IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 297)	[14]
CMAES	Benchmarking the Differential Evolution with Adaptive Encoding on Noiseless Functions (Page 189)	[9]
CMAa	Comparing Mirrored Mutations and Active Covariance Matrix Adaptation in the IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 297)	[14]
CMAm	Comparing Mirrored Mutations and Active Covariance Matrix Adaptation in the IPOP-CMA-ES on the Noiseless BBOB Testbed (Page 297)	[14]
CMAma	On the Impact of a Small Initial Population Size in the IPOP Active CMA-ES with Mirrored Mutations on the Noiseless BBOB Testbed (Page 285)	[19]
CMAmah	On the Impact of a Small Initial Population Size in the IPOP Active CMA-ES with Mirrored Mutations on the Noiseless BBOB Testbed (Page 285)	[19]
CMAmh	On the Impact of Active Covariance Matrix Adaptation in the CMA-ES With Mirrored Mutations and Small Initial Population Size on the Noiseless BBOB Testbed (Page 291)	[20]
DBRCGA	Black-Box Optimization Benchmarking for Noiseless Function Testbed Using A Direction-Based RCGA (Page 167)	[11]
DE	Benchmarking the Differential Evolution with Adaptive Encoding on Noiseless Functions (Page 189)	[9]
DE-AUTO	MEMPSODE: An Empirical Assessment of Local Search Algorithm Impact on a Memetic Algorithm Using Noiseless Testbed (Page 245)	[17]
DE-BFGS	MEMPSODE: Comparing Particle Swarm Optimization and Differential Evolution Within a Hybrid Memetic Global Optimization Framework (Page 253)	[18]
DE-ROLL	MEMPSODE: An Empirical Assessment of Local Search Algorithm Impact on a Memetic Algorithm Using Noiseless Testbed (Page 245)	[17]
DE-SIMPLEX	MEMPSODE: An Empirical Assessment of Local Search Algorithm Impact on a Memetic Algorithm Using Noiseless Testbed (Page 245)	[17]
DEctpb	JADE, an Adaptive Differential Evolution Algorithm, Benchmarked on the BBOB Noiseless Testbed (Page 197)	[16]
IPOPsaACM	Black-box Optimization Benchmarking of NIPOP-aCMA-ES and NBIPOP-aCMA-ES on the BBOB-2012 Noiseless Testbed (Page 269)	[14]
JADEctpb	JADE, an Adaptive Differential Evolution Algorithm, Benchmarked on the BBOB Noiseless Testbed (Page 197)	[16]
MVDE	Benchmarking the Multi-View Differential Evolution on the Noiseless BBOB-2012 Function Testbed (Page 183)	[10]
NBIPOPaCMA	Black-box Optimization Benchmarking of NIPOP-aCMA-ES and NBIPOP-aCMA-ES on the BBOB-2012 Noiseless Testbed (Page 269)	[13]
NIPOPaCMA	Black-box Optimization Benchmarking of NIPOP-aCMA-ES and NBIPOP-aCMA-ES on the BBOB-2012 Noiseless Testbed (Page 269)	[13]
PSO-BFGS	MEMPSODE: Comparing Particle Swarm Optimization and Differential Evolution Within a Hybrid Memetic Global Optimization Framework (Page 253)	[18]
SNES	Benchmarking Separable Natural Evolution Strategies on the Noiseless and Noisy Black-box Optimization Testbeds (Page 205)	[8]
xNES	Benchmarking Exponential Natural Evolution Strategies on the Noiseless and Noisy Black-Box Optimization Testbeds (Page 213)	[6]
xNESas	Benchmarking Natural Evolution Strategies with Adaptation Sampling on the Noiseless and Noisy Black-Box Optimization Testbeds (Page 229)	[7]
xNESas	Investigating the Impact of Adaptation Sampling in Natural Evolution Strategies on Black-Box Optimization Testbeds (Page 221)	[15]

Table 2: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_1, 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
f1	3.6	8.0	8.0	8.0	8.0	8.0	15/15
ACOR	**1.9**(2)	6.8(6)	17(6)	40(7)	59(7)	82(7)	15/15
BIPOPaCMA	4.1(5)	4.8(2)	11(3)	22(4)	32(4)	42(6)	15/15
BIPOPsaACM	3.1(3)	**4.0**(3)	7.9(2)	**12**(0.8)	15(1)	19(1)	15/15
CMA	**2.1**(3)	5.6(3)	10(3)	22(5)	33(6)	46(3)	15/15
CMAES	3.4(3)	5.4(4)	11(4)	25(5)	36(4)	46(6)	15/15
CMAa	**2.9**(3)	**4.2**(3)	9.0(4)	20(5)	30(7)	41(4)	15/15
CMAm	**2.4**(2)	4.4(4)	9.2(3)	17(3)	25(5)	34(4)	15/15
CMAma	3.2(4)	5.0(3)	9.5(3)	18(4)	26(5)	35(5)	15/15
CMAmah	**2.8**(3)	**3.8**(3)	**7.0**(4)	15(3)	22(3)	30(4)	15/15
CMAmh	**2.2**(2)	**3.6**(2)	**7.7**(2)	16(3)	24(5)	33(5)	15/15
DBRCGA	**1.8**(2)	15(12)	34(22)	79(27)	129(31)	171(34)	15/15
DE	**2.4**(2)	11(4)	21(14)	49(8)	77(11)	102(11)	15/15
DE-AUTO	**1.9**(2)	5.8(3)	8.1(0.1)	**8.1**(0.1)	**8.1**(0.1)	**8.1**(0.1)	15/15
DE-BFGS	**2.3**(3)	5.8(3)	**7.3**(0.2)	**7.3**(0.2)	**7.3**(0.2)	**7.3**(0.2)	15/15
DE-ROLL	**2.6**(2)	10(15)	13(12)	13(11)	**13**(11)	**13**(11)	15/15
DE-SIMPLEX	**2.8**(3)	8.6(4)	12(3)	15(3)	18(3)	21(3)	15/15
DEctpb	3.6(3)	13(6)	27(6)	58(10)	84(12)	116(10)	15/15
IPOPsaACM	3.2(3)	5.5(3)	9.3(1)	12(2)	16(2)	19(2)	15/15
JADEctpb	3.5(3)	8.4(6)	18(7)	42(8)	65(8)	87(11)	15/15
MVDE	**1.6**(2)	15(12)	49(17)	125(17)	197(26)	285(18)	15/15
NBIPOPaCMA	**2.7**(3)	5.0(4)	11(5)	21(4)	33(6)	42(8)	15/15
NIPOPaCMA	3.8(4)	5.7(5)	10(6)	22(7)	34(7)	44(7)	15/15
PSO-BFGS	**1.8**(2)	7.0(0.2)	**7.4**(0.2)	**7.4**(0.2)	**7.4**(0.2)	**7.4**(0.2)	15/15
SNES	3.9(5)	4.8(3)	9.2(2)	27(6)	44(6)	62(6)	15/15
xNES	3.9(4)	5.1(2)	12(4)	29(6)	49(7)	67(7)	15/15
xNESas	5.4(5)	5.7(3)	12(4)	28(4)	45(7)	57(7)	15/15

Table 3: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_2, 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
f2	38	42	43	45	47	48	15/15
ACOR	8.1(2)	9.4(1)	11(0.8)	14(1)	17(0.9)	20(1)	15/15
BIPOPaCMA	11(5)	13(4)	14(3)	16(3)	17(3)	18(3)	15/15
BIPOPsaACM	4.3(1)	4.5(1)	4.9(0.9)	5.3(0.9)	5.7(1)	6.2(1)	15/15
CMA	14(4)	16(6)	19(2)	20(2)	21(2)	23(2)	15/15
CMAES	12(5)	17(4)	18(3)	20(2)	21(2)	23(2)	15/15
CMAa	11(4)	13(2)	14(2)	16(2)	17(2)	18(2)	15/15
CMAm	14(6)	17(5)	18(3)	20(2)	20(2)	21(2)	15/15
CMAma	11(6)	13(5)	14(2)	16(2)	16(2)	18(2)	15/15
CMAmah	16(6)	19(2)	19(3)	20(3)	20(2)	21(2)	15/15
CMAmh	21(10)	25(6)	26(4)	27(4)	27(4)	28(4)	15/15
DBRCGA	15(4)	20(4)	23(6)	31(7)	38(7)	45(7)	15/15
DE	9.4(2)	11(2)	13(2)	18(3)	21(2)	28(4)	15/15
DE-AUTO	**2.1**(0.2)	**2.0**(0.1)	**2.1**(0.2)	**2.2**(0.2)	**2.4**(0.8)	**2.6**(0.8)	15/15
DE-BFGS	**2.1**(0.2)	**2.0**(0.3)	**2.1**(0.3)	**2.2**(0.3)	**2.3**(0.3)	**2.4**(0.3)	15/15
DE-ROLL	3.8(3)	3.7(3)	**3.7**(3)	**3.9**(3)	**4.1**(2)	**4.3**(2)	15/15
DE-SIMPLEX	**2.7**(0.9)	**3.3**(1)	3.7(0.8)	4.3(0.7)	4.6(0.7)	4.9(0.6)	15/15
DEctpb	9.5(3)	13(2)	14(2)	20(2)	23(1)	28(3)	15/15
IPOPsaACM	4.1(1)	4.3(0.8)	4.7(1.0)	5.1(1)	5.6(1)	6.1(1)	15/15
JADEb	6.2(2)	7.3(2)	8.4(2)	11(2)	14(2)	17(2)	15/15
JADEctpb	7.8(2)	10(2)	12(1)	16(1)	19(2)	23(2)	15/15
MVDE	22(4)	27(5)	33(4)	47(4)	58(5)	70(5)	15/15
NBIPOPaCMA	9.2(4)	12(4)	14(4)	16(2)	17(2)	18(2)	15/15
NIPOPaCMA	11(6)	13(3)	14(2)	16(3)	17(2)	18(2)	15/15
PSO-BFGS	**2.1**(0.2)	**2.0**(0.3)	**2.1**(0.3)	**2.3**(0.5)	**2.3**(0.5)	**2.5**(0.6)	15/15
SNES	6.7(2)	8.1(2)	9.3(2)	12(1)	15(2)	17(1)	15/15
xNES	10(3)	13(4)	14(4)	21(7)	25(6)	28(5)	15/15
xNESas	8.5(3)	10(3)	11(4)	14(3)	15(4)	17(3)	15/15

Table 4: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_3, 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
f3	38	822	830	842	847	853	15/15
ACOR	5.0(2)	11(1)	113(122)	112(121)	112(120)	111(119)	15/15
BIPOPaCMA	**3.1**(1)	4.3(5)	12(17)	12(17)	12(17)	12(18)	15/15
BIPOPsaACM	**2.6**(1)	**2.1**(2)	13(17)	13(17)	13(17)	13(17)	15/15
CMA	10(16)	4.0(4)	21(23)	41(69)	42(70)	43(71)	15/15
CMAES	6.1(5)	5.3(6)	21(16)	21(15)	21(15)	21(15)	15/15
CMAa	7.8(12)	**2.8**(2)	23(43)	30(51)	31(53)	32(54)	15/15
CMAm	5.4(11)	**2.2**(2)	18(13)	21(15)	21(15)	22(15)	15/15
CMAma	**3.2**(2)	4.2(7)	11(12)	12(13)	12(13)	13(13)	15/15
CMAmah	7.2(11)	**2.7**(3)	27(28)	33(31)	34(32)	34(32)	15/15
CMAmh	4.4(4)	3.4(2)	30(44)	86(122)	89(126)	90(128)	15/15
DBRCGA	7.9(3)	**1.9**(0.8)	3.3(2)	3.8(2)	4.1(2)	4.5(2)	15/15
DE	4.8(3)	**0.65**(0.3)$\downarrow_4$	**1.6**(2)	**1.8**(2)	**2.1**(2)	**2.3**(2)	15/15
DE-AUTO	7.6(12)	3.1(3)	6.8(6)	6.7(6)	6.7(6)	6.7(6)	15/15
DE-BFGS	8.2(9)	**1.4**(0.6)	**2.9**(3)	**2.9**(3)	**2.9**(2)	**2.9**(2)	15/15
DE-ROLL	5.9(6)	**1.4**(1)	3.6(2)	3.6(2)	3.6(2)	3.5(2)	15/15
DE-SIMPLEX	11(9)	3.1(2)	8.7(14)	8.6(14)	8.6(14)	8.6(14)	15/15
DEctpb	4.7(2)	**0.96**(0.5)	**1.3**(0.3)	**1.9**(0.4)	**2.3**(0.3)	**2.6**(0.3)	15/15
IPOPsaACM	5.2(3)	3.4(4)	17(21)	76(116)	76(117)	77(117)	15/15
JADEb	3.5(2)	**0.81**(1)	4.1(5)	4.2(5)	4.4(5)	4.5(5)	15/15
JADEctpb	3.4(2)	**0.78**(0.3)	**1.2**(0.4)	**1.5**(0.2)	**1.8**(0.3)	**2.1**(0.4)	15/15
MVDE	8.8(4)	**1.5**(0.3)	**1.8**(0.4)	**2.8**(0.4)	3.5(0.3)	4.2(0.3)	15/15
NBIPOPaCMA	3.8(2)	6.8(7)	37(37)	43(36)	43(36)	43(36)	15/15
NIPOPaCMA	5.0(3)	4.0(3)	13(13)	43(14)	43(15)	43(15)	15/15
PSO-BFGS	14(16)	4.8(4)	9.0(7)	8.9(7)	8.8(7)	8.8(7)	15/15
SNES	4.3(4)	10(9)	47(51)	46(50)	46(50)	46(50)	15/15
xNES	**3.0**(3)	11(11)	69(98)	69(97)	68(96)	68(96)	15/15
xNESas	11(23)	7.1(7)	66(59)	65(58)	65(58)	64(57)	15/15

Table 5: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_4, 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
f4	40	808	866	952	1015	1044	15/15
ACOR	7.1(4)	81(95)	218(147)	199(134)	187(126)	182(122)	15/15
BIPOPaCMA	**4.0**(3)	183(415)	2702(3463)	3633(4725)	3408(4330)	3315(4211)	8/15
BIPOPsaACM	5.9(4)	47(57)	3272(4131)	3097(3757)	2905(3551)	2826(3430)	9/15
CMA	7.1(5)	390(461)	∞	∞	∞	∞ *6e5*	0/15
CMAES	8.3(13)	19(17)	134(119)	122(108)	114(111)	111(108)	11/15
CMAa	9.1(14)	621(843)	∞	∞	∞	∞ *6e5*	0/15
CMAm	6.5(11)	538(559)	4727(4980)	∞	∞	∞ *6e5*	0/15
CMAma	6.6(12)	789(938)	∞	∞	∞	∞ *6e5*	0/15
CMAmah	10(13)	1039(1256)	8693(8872)	∞	∞	∞ *5e5*	0/15
CMAmh	15(11)	653(795)	∞	∞	∞	∞ *5e5*	0/15
DBRCGA	8.9(5)	3.1(1)	5.9(4)	5.7(3)	5.6(3)	5.7(3)	15/15
DE	5.8(2)	**1.5**(2)	**2.9**(2)	**2.9**(2)	**3.0**(2)	**3.1**(2)	15/15
DE-AUTO	18(19)	6.1(5)	16(19)	14(17)	13(16)	13(15)	15/15
DE-BFGS	13(10)	**1.6**(0.7)	**5.6**(9)	**5.1**(8)	**4.9**(8)	**4.8**(8)	15/15
DE-ROLL	5.7(4)	3.1(2)	6.1(5)	5.6(4)	5.3(4)	5.2(4)	15/15
DE-SIMPLEX	23(17)	5.3(7)	9.0(7)	8.2(7)	7.7(6)	7.6(6)	15/15
DEctpb	6.7(3)	**1.6**(0.6)	**2.0**(2)	**2.4**(2)	**2.6**(2)	**2.8**(2)	15/15
IPOPsaACM	8.5(7)	240(358)	1.6e4(2e4)	1.5e4(1e4)	1.4e4(1e4)	1.3e4(1e4)	3/15
JADEb	**4.0**(2)	**2.9**(3)	8.4(9)	7.8(8)	7.5(7)	7.5(7)	15/15
JADEctpb	**4.5**(2)	**1.7**(0.4)	**2.2**(2)	**2.3**(2)	**2.5**(2)	**2.6**(2)	15/15
MVDE	13(4)	**2.1**(0.4)	180(577)	165(525)	155(493)	151(479)	13/15
NBIPOPaCMA	10(17)	29(27)	243(391)	221(355)	208(333)	202(324)	15/15
NIPOPaCMA	**3.8**(2)	254(377)	1.1e4(1e4)	1.3e4(2e4)	1.3e4(1e4)	1.2e4(1e4)	3/15
PSO-BFGS	28(31)	11(11)	49(49)	44(45)	42(42)	41(41)	15/15
SNES	14(38)	28(32)	140(133)	128(121)	120(113)	117(110)	14/15
xNES	6.0(4)	37(50)	285(285)	259(258)	244(243)	237(240)	9/15
xNESas	4.9(3)	31(31)	136(208)	124(189)	116(178)	113(173)	14/15

Table 6: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_5, 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
f5	6.6	6.6	6.6	6.6	6.6	6.6	15/15
ACOR	7.3(3)	12(2)	13(2)	13(3)	13(3)	13(3)	15/15
BIPOPaCMA	3.4(2)	5.2(2)	5.3(2)	5.3(2)	5.3(2)	5.3(2)	15/15
BIPOPsaACM	4.2(3)	6.2(3)	6.4(3)	6.4(3)	6.4(3)	6.4(3)	15/15
CMA	**2.9**(2)	**4.5**(3)	**4.9**(3)	**5.0**(3)	**5.0**(3)	**5.0**(3)	15/15
CMAES	3.7(3)	6.0(4)	6.2(4)	6.2(4)	6.2(4)	6.2(4)	15/15
CMAa	4.9(2)	6.7(3)	6.9(3)	6.9(3)	6.9(3)	6.9(3)	15/15
CMAm	**3.0**(2)	5.3(2)	5.6(2)	5.6(2)	5.6(2)	5.6(2)	15/15
CMAma	3.3(1)	**4.5**(2)	**4.7**(2)	**4.8**(2)	**4.8**(2)	**4.8**(2)	15/15
CMAmah	**2.5**(1)	**4.1**(2)	**4.4**(2)	**4.4**(2)	**4.4**(2)	**4.4**(2)	15/15
CMAmh	**2.4**(1)	**3.8**(1)	**4.2**(1)	**4.3**(1)	**4.3**(1)	**4.3**(1)	15/15
DBRCGA	5.5(5)	17(9)	18(9)	19(9)	19(9)	19(9)	15/15
DE	4.2(2)	8.2(5)	9.1(4)	9.1(4)	9.1(4)	9.1(4)	15/15
DE-AUTO	5.7(3)	9.2(0.4)	9.2(0.4)	9.2(0.4)	9.2(0.4)	9.2(0.4)	15/15
DE-BFGS	5.1(2)	8.7(2)	8.9(2)	8.9(2)	8.9(2)	8.9(2)	15/15
DE-ROLL	5.1(3)	8.4(2)	8.8(0.6)	8.8(0.6)	8.8(0.6)	8.8(0.6)	15/15
DE-SIMPLEX	3.8(2)	17(7)	25(10)	45(22)	87(54)	96(53)	15/15
DEctpb	5.1(3)	12(5)	14(5)	14(5)	14(5)	14(5)	15/15
IPOPsaACM	4.0(1)	5.9(3)	6.2(3)	6.3(3)	6.3(3)	6.3(3)	15/15
JADEb	4.3(3)	8.9(6)	10(5)	10(7)	10(7)	10(7)	15/15
JADEctpb	6.1(3)	15(9)	16(10)	16(10)	16(10)	16(10)	15/15
MVDE	18(12)	51(13)	61(18)	63(18)	63(18)	63(18)	15/15
NBIPOPaCMA	3.5(2)	6.1(3)	6.5(3)	6.5(3)	6.5(3)	6.5(3)	15/15
NIPOPaCMA	3.9(2)	5.9(3)	6.3(3)	6.3(3)	6.3(3)	6.3(3)	15/15
PSO-BFGS	7.7(3)	10(0.6)	10(0.6)	10(0.6)	10(0.6)	10(0.6)	15/15
SNES	6.9(4)	12(5)	13(4)	13(4)	13(4)	13(4)	15/15
xNES	7.1(5)	12(6)	13(7)	13(8)	13(8)	13(8)	15/15
xNESas	5.7(3)	10(5)	11(5)	11(5)	11(5)	11(5)	15/15

Table 7: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_6, 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
f6	34	56	90	149	215	265	15/15
ACOR	**2.4**(2)	5.3(2)	5.7(1)	6.6(2)	6.6(1)	7.2(2)	15/15
BIPOPaCMA	**2.8**(2)	**2.8**(1)	**2.8**(1)	**2.7**(0.8)	**2.7**(0.4)	**2.8**(0.5)	15/15
BIPOPsaACM	**2.5**(1)	3.3(2)	**2.9**(2)	3.1(2)	3.1(1)	3.2(1)	15/15
CMA	**2.2**(2)	3.1(1)	3.0(1)	3.0(0.4)	**2.9**(0.4)	**2.9**(0.4)	15/15
CMAES	**2.3**(2)	3.1(2)	3.1(1)	3.3(0.6)	3.1(0.6)	3.2(0.5)	15/15
CMAa	**2.1**(2)	3.0(1.0)	**2.9**(0.5)	**3.0**(0.7)	**2.8**(0.7)	3.0(0.5)	15/15
CMAm	**2.1**(2)	3.1(2)	3.1(1)	3.0(1)	3.2(0.6)	3.3(0.7)	15/15
CMAma	**2.9**(2)	3.1(1.0)	**2.8**(0.9)	**2.9**(0.6)	**2.9**(0.6)	3.1(0.4)	15/15
CMAmah	**2.1**(2)	**2.8**(1)	**2.6**(2)	**2.4**(0.8)	**2.2**(0.6)	**2.3**(0.4)	15/15
CMAmh	**2.1**(2)	**2.6**(2)	**2.4**(0.9)	**2.6**(0.6)	**2.3**(0.5)	**2.4**(0.5)	15/15
DBRCGA	5.0(3)	9.5(4)	10(3)	11(3)	10(2)	10(3)	15/15
DE	3.8(3)	7.3(3)	7.7(2)	8.7(2)	8.9(3)	10(4)	15/15
DE-AUTO	**2.4**(1)	**2.2**(0.7)	**1.6**(0.4)	**1.3**(0.4)	**1.2**(0.5)	**1.5**(0.9)	15/15
DE-BFGS	**2.8**(2)	**2.7**(0.8)	**2.2**(0.8)	**1.7**(0.6)	**1.6**(0.8)	**2.1**(2)	15/15
DE-ROLL	27(30)	28(37)	25(24)	28(31)	35(59)	51(97)	15/15
DE-SIMPLEX	3.2(2)	**2.8**(2)	**2.4**(1)	**1.8**(0.9)	**1.6**(0.7)	**1.5**(0.6)	15/15
DEctpb	5.4(3)	7.8(3)	8.2(3)	8.8(3)	9.2(3)	10(3)	15/15
IPOPsaACM	**2.8**(2)	3.3(1)	**2.9**(1)	3.3(2)	3.2(2)	3.6(2)	15/15
JADEb	**2.3**(2)	3.6(1)	4.0(1)	4.6(0.9)	4.9(1)	5.1(1)	15/15
JADEctpb	**2.5**(1)	4.7(2)	5.0(1)	5.4(1)	5.5(0.9)	5.9(0.9)	15/15
MVDE	8.2(4)	14(5)	19(6)	27(8)	35(9)	40(10)	15/15
NBIPOPaCMA	**2.3**(2)	3.3(2)	3.0(0.9)	**2.9**(0.6)	**2.8**(0.4)	**2.9**(0.5)	15/15
NIPOPaCMA	**2.9**(2)	3.4(1)	**3.0**(0.7)	3.0(0.4)	**2.8**(0.4)	**2.9**(0.4)	15/15
PSO-BFGS	**2.8**(1)	**2.8**(0.7)	**2.0**(0.4)	**1.6**(0.5)	**1.5**(0.7)	**2.7**(1)	15/15
SNES	**1.3**(1)	**2.7**(1)	**3.0**(0.8)	3.6(1)	5.1(2)	24(3)	15/15
xNES	**2.6**(3)	3.3(2)	**2.9**(1.0)	4.1(1)	4.3(0.8)	4.4(0.6)	15/15
xNESas	**2.5**(1)	**2.9**(1)	3.1(1)	3.2(0.7)	3.6(0.7)	3.8(0.7)	15/15

Table 8: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_7, 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
f7	11	65	342	482	482	535	15/15
ACOR	3.8(3)	**2.6**(1)	5.6(2)	4.8(2)	4.8(2)	4.7(4)	15/15
BIPOPaCMA	3.2(2)	**1.7**(1)	**0.74**(0.4)	**0.85**(0.4)	**0.85**(0.4)	**0.89**(0.5)	15/15
BIPOPsaACM	3.1(2)	3.9(5)	**1.4**(1)	**1.5**(1)	**1.5**(1)	**1.4**(0.9)	15/15
CMA	**2.6**(2)	**1.8**(1)	**1.2**(0.7)	**1.0**(0.5)	**1.0**(0.5)	**1.0**(0.5)	15/15
CMAES	3.2(2)	**2.3**(1)	**1.0**(0.6)	**1.5**(2)	**1.5**(2)	**1.6**(1)	15/15
CMAa	**2.6**(1)	**1.6**(1)	**1.0**(0.5)	**1.00**(0.4)	**1.00**(0.4)	**1.00**(0.3)	15/15
CMAm	3.7(4)	**2.5**(2)	**1.4**(0.9)	**1.4**(0.7)	**1.4**(0.7)	**1.4**(0.7)	15/15
CMAma	3.8(4)	**1.7**(1)	**0.87**(0.7)	**0.82**(0.5)	**0.82**(0.5)	**0.79**(0.5)	15/15
CMAmah	7.5(3)	3.3(4)	**1.3**(2)	**1.4**(1)	**1.4**(1)	**1.3**(1.0)	15/15
CMAmh	**2.7**(3)	**2.9**(3)	**2.1**(1)	**1.8**(0.9)	**1.8**(0.9)	**1.7**(0.9)	15/15
DBRCGA	5.5(7)	4.1(3)	**2.0**(0.8)	3.6(3)	3.6(3)	3.8(3)	15/15
DE	3.5(4)	3.4(2)	**1.4**(0.9)	24(1)	24(1)	22(1)	14/15
DE-AUTO	3.1(3)	13(17)	6.0(4)	7.4(6)	7.4(6)	6.7(6)	15/15
DE-BFGS	5.3(8)	9.0(22)	**2.2**(4)	**2.2**(3)	**2.2**(3)	11(9)	15/15
DE-ROLL	4.5(3)	10(9)	4.6(3)	5.3(2)	5.3(2)	7.3(5)	15/15
DE-SIMPLEX	4.2(4)	4.3(3)	**2.2**(0.7)	**2.0**(0.6)	**2.0**(0.6)	**1.8**(0.5)	15/15
DEctpb	**2.8**(3)	3.4(3)	**1.6**(0.9)	**2.0**(1.0)	**2.0**(1.0)	**2.2**(1.0)	15/15
IPOPsaACM	**2.6**(2)	**2.3**(3)	**0.89**(0.9)	**1.1**(1.0)	**1.1**(1.0)	**1.1**(0.8)	15/15
JADEb	3.2(4)	**1.9**(0.8)	32(0.4)	79(156)	79(156)	71(140)	12/15
JADEctpb	**2.9**(2)	**2.0**(0.8)	**0.90**(0.3)	**1.3**(0.4)	**1.3**(0.4)	**1.3**(0.3)	15/15
MVDE	5.9(5)	5.2(3)	**2.6**(1)	4.6(2)	4.6(2)	5.0(1)	15/15
NBIPOPaCMA	3.7(5)	**2.9**(2)	**0.88**(0.7)	**0.92**(0.7)	**0.92**(0.7)	**1.0**(0.5)	15/15
NIPOPaCMA	**2.8**(2)	**1.9**(1)	**0.99**(1)	**0.87**(0.9)	**0.87**(0.9)	**1.0**(0.8)	15/15
PSO-BFGS	36(49)	110(151)	160(258)	147(192)	147(192)	319(399)	6/15
SNES	3.1(2)	18(24)	24(34)	42(38)	42(38)	46(66)	15/15
xNES	3.3(3)	14(24)	5.8(9)	4.4(6)	4.4(6)	4.0(6)	15/15
xNESas	**2.8**(2)	14(46)	8.1(9)	9.2(13)	9.2(13)	8.4(11)	15/15

Table 9: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_8, 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
f8	27	45	152	188	198	208	15/15
ACOR	5.8(3)	10(4)	18(4)	54(11)	95(16)	129(28)	15/15
BIPOPaCMA	**3.0**(2)	7.0(5)	3.7(1)	4.0(2)	4.3(1)	4.5(1)	15/15
BIPOPsaACM	4.1(1)	6.4(7)	**2.5**(2)	**2.4**(2)	**2.7**(2)	**2.7**(2)	15/15
CMA	3.4(2)	8.4(13)	4.7(4)	5.0(3)	5.3(3)	5.5(3)	15/15
CMAES	3.7(2)	6.4(5)	3.8(3)	4.5(2)	4.9(2)	5.2(1)	15/15
CMAa	**3.0**(2)	6.8(5)	3.6(2)	4.1(2)	4.4(1)	4.6(1)	15/15
CMAm	**2.9**(2)	6.1(5)	3.7(1)	4.2(1)	4.6(1)	4.8(1)	15/15
CMAma	3.0(2)	7.3(9)	3.5(3)	3.9(3)	4.2(2)	4.3(2)	15/15
CMAmah	3.5(3)	11(10)	5.5(3)	5.8(2)	6.0(2)	6.0(2)	15/15
CMAmh	5.3(10)	15(23)	6.8(7)	6.8(6)	7.0(6)	7.0(5)	15/15
DBRCGA	7.1(4)	12(8)	8.5(2)	16(9)	21(10)	25(10)	15/15
DE	7.8(5)	12(11)	7.6(4)	11(4)	14(4)	18(4)	15/15
DE-AUTO	**2.4**(0.2)	8.7(2)	**2.7**(0.7)	**2.4**(0.5)	**2.3**(0.5)	**2.2**(0.5)	15/15
DE-BFGS	3.0(0.7)	**3.3**(2)	**1.2**(0.6)	**1.1**(0.5)	**1.1**(0.4)	**1.1**(0.4)	15/15
DE-ROLL	3.7(0.8)	28(48)	46(46)	120(66)	174(57)	645(582)	8/15
DE-SIMPLEX	**2.1**(0.3)	**3.5**(3)	**1.4**(0.8)	**1.4**(0.6)	**1.4**(0.5)	**1.5**(0.5)	15/15
DEctpb	7.0(3)	12(6)	8.6(4)	13(5)	17(5)	21(5)	15/15
IPOPsaACM	3.3(2)	5.9(4)	**2.5**(1)	**2.4**(1)	**2.4**(1)	**2.4**(1)	15/15
JADEb	4.0(1)	13(18)	6.7(5)	7.0(4)	8.0(4)	8.8(3)	15/15
JADEctpb	5.5(2)	8.6(4)	6.9(3)	9.1(3)	10(3)	11(3)	15/15
MVDE	11(5)	24(7)	18(10)	43(14)	65(10)	87(16)	15/15
NBIPOPaCMA	3.7(3)	7.3(5)	3.8(2)	3.9(2)	4.3(1)	4.5(1)	15/15
NIPOPaCMA	3.1(2)	8.7(10)	4.4(3)	4.5(2)	4.8(2)	5.0(2)	15/15
PSO-BFGS	3.4(2)	**4.7**(2)	**1.6**(0.6)	**1.5**(0.5)	**1.4**(0.5)	**1.4**(0.4)	15/15
SNES	**2.8**(1)	211(450)	158(139)	517(118)	932(123)	1491(732)	2/15
xNES	**2.8**(2)	**5.1**(4)	5.8(7)	11(12)	12(16)	13(18)	15/15
xNESas	**2.5**(1)	7.7(8)	5.9(4)	6.9(6)	7.4(6)	7.7(6)	15/15

Table 10: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_9, 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
f9	21	65	127	159	169	178	15/15
ACOR	5.7(4)	6.1(4)	14(10)	60(39)	111(64)	154(97)	15/15
BIPOPaCMA	3.5(2)	3.3(2)	3.4(1)	3.9(1)	4.2(0.9)	4.6(0.9)	15/15
BIPOPsaACM	3.2(0.8)	4.3(3)	3.1(2)	3.0(2)	3.0(1)	3.0(1)	15/15
CMA	4.0(3)	6.0(6)	5.3(4)	5.6(3)	6.0(3)	6.3(3)	15/15
CMAES	3.4(2)	7.3(6)	6.0(4)	6.3(4)	6.7(3)	7.0(3)	15/15
CMAa	3.5(1)	4.0(2)	3.9(1)	4.1(1)	4.4(1)	4.8(1.0)	15/15
CMAm	4.0(1)	4.6(2)	4.8(1)	5.4(1)	5.7(1)	5.9(1)	15/15
CMAma	**2.9**(2)	4.6(3)	4.3(2)	4.7(1)	5.0(1)	5.2(1)	15/15
CMAmah	**2.6**(1)	3.6(4)	4.2(2)	4.7(2)	5.0(2)	5.2(2)	15/15
CMAmh	5.2(2)	7.3(10)	6.7(5)	6.8(5)	7.2(4)	7.2(4)	15/15
DBRCGA	10(4)	12(9)	16(17)	25(23)	34(23)	38(22)	15/15
DE	8.9(7)	9.2(9)	8.6(7)	11(5)	15(4)	20(4)	15/15
DE-AUTO	**3.0**(0.5)	**1.8**(1)	**1.2**(0.7)	**1.1**(0.5)	**1.1**(0.5)	**1.1**(0.5)	15/15
DE-BFGS	3.8(1)	**2.2**(1.0)	**1.4**(0.6)	**1.3**(0.4)	**1.3**(0.4)	**1.2**(0.4)	15/15
DE-ROLL	5.3(2)	41(34)	52(62)	143(70)	213(64)	1142(1147)	4/15
DE-SIMPLEX	3.2(0.4)	**2.2**(2)	**1.6**(0.8)	**1.5**(0.7)	**1.6**(0.6)	**1.7**(0.6)	15/15
DEctpb	8.6(5)	10(3)	11(7)	15(6)	19(7)	23(8)	15/15
IPOPsaACM	4.0(2)	3.1(2)	**2.6**(2)	**2.6**(1)	**2.6**(1)	**2.7**(1)	15/15
JADEb	5.1(2)	5.8(7)	5.6(4)	6.8(3)	7.8(2)	8.6(2)	15/15
JADEctpb	5.7(4)	6.8(2)	7.4(2)	9.3(2)	11(3)	12(2)	15/15
MVDE	15(11)	14(9)	22(15)	48(32)	71(28)	91(28)	15/15
NBIPOPaCMA	3.6(2)	4.9(5)	4.5(3)	4.7(2)	5.1(2)	5.3(2)	15/15
NIPOPaCMA	3.1(0.8)	3.3(2)	3.8(1)	4.2(0.9)	4.5(0.8)	4.7(0.8)	15/15
PSO-BFGS	4.9(1)	**2.5**(1)	**1.6**(0.6)	**1.4**(0.5)	**1.4**(0.4)	**1.4**(0.4)	15/15
SNES	**2.9**(1)	4.8(3)	112(70)	562(340)	1077(659)	2172(2022)	6/15
xNES	3.3(2)	4.7(2)	4.6(2)	5.6(2)	6.2(3)	6.6(3)	15/15
xNESas	3.7(2)	6.6(4)	8.7(9)	12(23)	13(22)	14(21)	15/15

Table 11: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{10}, 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
f10	114	152	168	194	218	242	15/15
ACOR	94(148)	499(587)	1012(1207)	1797(2028)	2276(2339)	1.1e4(2e4)	9/15
BIPOPaCMA	3.4(2)	3.6(1)	3.6(0.8)	3.6(0.8)	3.6(0.7)	3.7(0.6)	15/15
BIPOPsaACM	**1.4**(0.3)	**1.3**(0.2)	**1.3**(0.3)	**1.3**(0.2)	**1.3**(0.2)	**1.3**(0.2)	15/15
CMA	5.3(2)	4.8(0.9)	4.7(0.4)	4.6(0.3)	4.5(0.3)	4.4(0.3)	15/15
CMAES	4.7(3)	4.7(2)	4.7(1)	4.7(0.7)	4.6(0.6)	4.6(0.5)	15/15
CMAa	3.5(2)	3.4(0.6)	3.3(0.7)	3.5(0.5)	3.5(0.6)	3.6(0.5)	15/15
CMAm	5.1(3)	4.9(2)	5.0(0.8)	4.8(0.7)	4.6(0.6)	4.5(0.5)	15/15
CMAma	3.7(2)	3.5(1)	3.6(0.5)	3.7(0.3)	3.5(0.3)	3.5(0.2)	15/15
CMAmah	4.3(2)	4.7(2)	4.8(0.7)	4.5(0.7)	4.3(0.5)	4.2(0.5)	15/15
CMAmh	6.2(3)	6.5(0.9)	6.5(0.6)	6.1(0.4)	5.7(0.4)	5.4(0.4)	15/15
DBRCGA	14(23)	67(81)	89(186)	152(177)	227(250)	258(230)	15/15
DE	9.4(4)	11(3)	13(3)	17(3)	20(3)	22(3)	15/15
DE-AUTO	**0.70**(0.1)	**0.54**(0.1)$\downarrow_4$	**0.51**(0.1)$\downarrow_4$	**0.49**(0.0)$\downarrow_4$	**0.47**(0.0)$\downarrow_4$	**0.47**(0.1)$\downarrow_4$	15/15
DE-BFGS	**0.76**(0.1)	**0.60**(0.1)$\downarrow_2$	**0.56**(0.1)$\downarrow_3$	**0.56**(0.1)$\downarrow_3$	**0.54**(0.1)$\downarrow_3$	**0.53**(0.1)$\downarrow_3$	15/15
DE-ROLL	59(59)	100(64)	158(67)	207(89)	263(74)	1347(1295)	4/15
DE-SIMPLEX	**1.4**(0.7)	**1.5**(1)	**1.4**(0.9)	**1.4**(0.7)	**1.4**(0.7)	**1.3**(0.6)	15/15
DEctpb	11(5)	12(3)	14(3)	18(3)	22(4)	25(3)	15/15
IPOPsaACM	**1.4**(0.3)	**1.3**(0.4)	**1.3**(0.4)	**1.3**(0.3)	**1.3**(0.3)	**1.3**(0.2)	15/15
JADEb	5.5(4)	5.4(3)	6.3(2)	6.7(2)	6.9(2)	7.1(2)	15/15
JADEctpb	5.2(2)	5.1(2)	5.5(1)	6.4(1)	7.0(0.9)	7.2(0.9)	15/15
MVDE	33(17)	51(20)	63(13)	86(17)	105(24)	122(18)	15/15
NBIPOPaCMA	3.6(1)	3.3(1)	3.4(1.0)	3.4(0.8)	3.5(0.6)	3.5(0.5)	15/15
NIPOPaCMA	3.7(2)	3.6(0.9)	3.7(0.4)	3.7(0.5)	3.7(0.4)	3.7(0.3)	15/15
PSO-BFGS	**0.70**(0.1)	**0.57**(0.1)$\downarrow_3$	**0.54**(0.1)$\downarrow_4$	**0.53**(0.1)$\downarrow_4$	**0.53**(0.1)$\downarrow_4$	**0.57**(0.1)$\downarrow_3$	15/15
SNES	356(534)	653(682)	2453(2872)	6450(7067)	∞	∞ *3e5*	0/15
xNES	3.2(3)	4.7(3)	7.8(4)	12(6)	13(5)	13(5)	15/15
xNESas	3.8(2)	3.9(2)	4.3(2)	4.5(2)	4.5(2)	4.7(2)	15/15

Table 12: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{11}, 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
f11	67	105	227	277	302	327	15/15
ACOR	114(112)	192(170)	180(143)	282(137)	381(167)	488(222)	15/15
BIPOPaCMA	5.2(3)	4.2(2)	**2.4**(0.6)	**2.4**(0.4)	**2.5**(0.4)	**2.5**(0.3)	15/15
BIPOPsaACM	**2.3**(0.6)	**1.8**(0.3)	**0.91**(0.2)	**0.84**(0.1)	**0.87**(0.1)	**0.90**(0.1)	15/15
CMA	8.6(4)	7.0(2)	3.8(0.4)	3.5(0.4)	3.6(0.4)	3.6(0.3)	15/15
CMAES	9.2(5)	7.4(2)	3.9(0.8)	3.6(0.6)	3.7(0.4)	3.6(0.5)	15/15
CMAa	5.9(3)	5.1(0.9)	**2.6**(0.3)	**2.5**(0.3)	**2.6**(0.3)	**2.7**(0.3)	15/15
CMAm	9.3(5)	9.0(1)	4.4(0.6)	3.9(0.4)	3.9(0.4)	3.8(0.4)	15/15
CMAma	6.2(3)	5.4(1)	**2.8**(0.5)	**2.6**(0.3)	**2.6**(0.3)	**2.6**(0.3)	15/15
CMAmah	10(3)	8.2(1)	4.2(0.3)	3.7(0.4)	3.6(0.3)	3.5(0.3)	15/15
CMAmh	13(7)	12(3)	5.8(1)	5.0(0.8)	4.8(0.7)	4.6(0.7)	15/15
DBRCGA	7.4(4)	39(60)	43(52)	93(128)	147(199)	256(372)	12/15
DE	11(6)	13(9)	8.1(5)	10(4)	13(4)	15(5)	15/15
DE-AUTO	**1.1**(0.1)	3.4(0.1)	**1.6**(0.0)	**1.4**(0.0)	**1.3**(0.0)	**1.6**(3)	15/15
DE-BFGS	**1.1**(0.1)	**0.72**(0.1)	**0.37**(0.0)$_{\downarrow 3}$	**0.34**(0.0)$_{\downarrow 4}$	**0.34**(0.0)$_{\downarrow 4}$	**0.44**(0.2)$_{\downarrow 3}$	15/15
DE-ROLL	73(78)	148(122)	116(39)	157(66)	218(67)	1746(1839)	2/15
DE-SIMPLEX	3.6(3)	3.1(2)	**1.8**(0.8)	**1.6**(0.6)	**1.5**(0.6)	**1.5**(0.6)	15/15
DEctpb	10(8)	13(6)	8.1(4)	11(4)	14(3)	16(4)	15/15
IPOPsaACM	**2.2**(0.8)	**1.8**(0.3)	**0.91**(0.1)	**0.85**(0.1)	**0.90**(0.1)	**0.91**(0.1)	15/15
JADEb	8.3(8)	8.2(8)	4.9(5)	4.8(4)	5.2(3)	5.5(3)	15/15
JADEctpb	7.0(3)	6.4(2)	4.0(1)	4.3(0.9)	5.0(1.0)	5.6(0.9)	15/15
MVDE	21(15)	34(17)	26(12)	48(13)	67(12)	79(15)	15/15
NBIPOPaCMA	6.2(3)	5.1(1)	**2.7**(0.5)	**2.6**(0.4)	**2.7**(0.3)	**2.8**(0.4)	15/15
NIPOPaCMA	5.6(3)	5.2(2)	**2.7**(0.8)	**2.5**(0.5)	**2.7**(0.6)	**2.8**(0.5)	15/15
PSO-BFGS	**1.2**(0.3)	**0.84**(0.2)	**0.42**(0.1)	**0.38**(0.1)$_{\downarrow 4}$	**0.38**(0.1)$_{\downarrow 4}$	**0.41**(0.1)$_{\downarrow 4}$	15/15
SNES	152(213)	2283(2544)	6036(6608)	∞	∞	∞ *3e5*	0/15
xNES	4.4(3)	4.6(4)	**2.5**(2)	**2.7**(2)	3.5(2)	4.6(1)	15/15
xNESas	4.8(3)	6.6(2)	6.9(2)	6.4(4)	6.2(4)	6.2(3)	15/15

Table 13: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{12}, 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
f12	65	168	338	445	696	790	15/15
ACOR	151(98)	1639(3363)	1936(2490)	5413(5407)	1.0e4(1e4)	3.7e4(4e4)	2/15
BIPOPaCMA	7.3(6)	5.6(5)	3.8(3)	3.8(3)	3.0(2)	3.1(2)	15/15
BIPOPsaACM	**2.9**(2)	**2.5**(2)	**2.0**(2)	4.4(6)	5.2(9)	28(74)	15/15
CMA	11(18)	9.1(12)	6.5(7)	6.2(7)	4.8(5)	4.8(5)	15/15
CMAES	10(11)	7.2(6)	5.5(4)	5.4(4)	4.7(3)	4.8(3)	15/15
CMAa	10(11)	7.6(8)	5.1(5)	5.0(4)	4.2(3)	4.3(2)	15/15
CMAm	9.1(11)	9.3(8)	7.1(5)	6.9(5)	5.4(4)	5.5(4)	15/15
CMAma	7.9(8)	6.5(6)	4.7(4)	4.5(3)	3.6(3)	3.6(3)	15/15
CMAmah	10(12)	8.7(8)	6.0(3)	5.8(4)	4.5(3)	4.4(3)	15/15
CMAmh	16(19)	12(14)	9.0(8)	8.5(7)	6.6(5)	6.6(5)	15/15
DBRCGA	122(158)	182(196)	166(163)	191(177)	169(183)	204(173)	13/15
DE	42(72)	34(44)	26(26)	26(22)	21(16)	22(15)	15/15
DE-AUTO	4.6(8)	**2.4**(3)	**1.4**(1)	**1.5**(1)	**1.2**(0.8)	**1.2**(0.8)	15/15
DE-BFGS	**2.1**(2)	**1.1**(1)	**0.73**(0.6)	**0.75**(0.5)	**0.59**(0.4)	**0.59**(0.4)	15/15
DE-ROLL	80(31)	55(32)	53(45)	104(89)	136(87)	670(642)	2/15
DE-SIMPLEX	**2.5**(1)	**2.0**(2)	**1.4**(1)	**1.4**(1.0)	**1.1**(0.7)	**1.1**(0.7)	15/15
DEctpb	22(11)	18(10)	16(10)	21(15)	19(13)	20(12)	15/15
IPOPsaACM	4.4(4)	3.1(3)	**2.1**(3)	**2.2**(3)	**1.8**(2)	**1.8**(2)	15/15
JADEb	9.1(7)	10(8)	7.5(6)	7.4(5)	5.7(4)	5.7(3)	15/15
JADEctpb	11(4)	8.7(6)	6.1(4)	6.2(3)	5.0(2)	5.0(2)	15/15
MVDE	75(49)	101(92)	97(139)	118(111)	109(85)	116(86)	15/15
NBIPOPaCMA	6.0(3)	5.3(4)	4.2(4)	4.4(4)	3.3(3)	3.6(4)	15/15
NIPOPaCMA	8.5(7)	6.0(6)	4.4(3)	4.3(3)	3.4(2)	3.4(2)	15/15
PSO-BFGS	**1.8**(0.8)	**0.95**(0.6)	**0.57**(0.4)	**0.57**(0.3)	**0.53**(0.3)	**0.66**(0.6)	15/15
SNES	20(24)	82(65)	221(411)	2441(2377)	6448(6471)	∞ *3e5*	0/15
xNES	17(38)	19(22)	17(46)	23(43)	18(42)	17(38)	15/15
xNESas	17(19)	23(37)	33(66)	30(58)	26(40)	35(51)	15/15

Table 14: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{13}, 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
f13	49	85	108	215	281	365	15/15
ACOR	11(7)	133(141)	1481(2814)	4701(4184)	8.5e4(1e5)	4.0e5(5e5)	1/15
BIPOPaCMA	3.1(1)	3.7(1)	3.8(1)	3.3(1)	3.5(0.7)	**3.4**(0.5)	15/15
BIPOPsaACM	**2.0**(0.4)	**1.8**(0.5)	**1.7**(0.5)	**1.3**(0.2)	**1.3**(0.3)	**1.2**(0.2)	15/15
CMA	3.1(1)	5.3(3)	5.2(2)	4.0(1.0)	4.1(0.9)	4.3(0.6)	15/15
CMAES	3.4(2)	5.3(3)	5.9(2)	4.3(0.6)	4.5(0.7)	4.5(1)	15/15
CMAa	3.0(2)	3.4(0.8)	4.0(0.6)	3.1(0.7)	3.5(0.9)	3.4(0.7)	15/15
CMAm	4.2(2)	4.9(3)	6.4(3)	4.5(2)	4.7(1)	5.0(2)	15/15
CMAma	3.4(2)	4.3(2)	4.8(2)	3.6(0.8)	3.8(0.7)	3.5(0.5)	15/15
CMAmah	4.4(6)	5.0(5)	6.6(4)	5.5(2)	6.6(2)	5.8(1)	15/15
CMAmh	7.7(9)	8.6(6)	9.0(5)	9.3(4)	8.0(2)	8.0(4)	15/15
DBRCGA	8.3(2)	14(9)	18(15)	46(49)	81(46)	572(603)	8/15
DE	9.3(2)	12(4)	14(5)	16(5)	19(5)	22(7)	15/15
DE-AUTO	**1.8**(0.2)	**1.2**(0.2)	**1.1**(0.1)	**0.73**(0.1)	**1.9**(2)	3.6(0.7)	15/15
DE-BFGS	**1.7**(0.3)	**1.2**(0.2)	**1.1**(0.1)	**0.72**(0.1)	5.9(5)	863(1217)	0/15
DE-ROLL	48(77)	51(77)	74(58)	53(33)	55(26)	148(146)	13/15
DE-SIMPLEX	**3.0**(1)	**2.9**(1)	**2.8**(1)	**1.7**(0.3)	**1.6**(0.4)	**1.9**(1)	15/15
DEctpb	9.1(4)	13(4)	17(6)	18(4)	21(5)	22(3)	15/15
IPOPsaACM	**2.4**(1)	**1.8**(0.6)	**1.9**(0.6)	**1.4**(0.5)	**1.4**(0.3)	**1.3**(0.2)	15/15
JADEb	4.8(2)	5.0(2)	6.1(2)	6.4(3)	7.1(2)	6.8(2)	15/15
JADEctpb	5.9(2)	7.2(2)	8.8(2)	7.4(1)	7.3(0.5)	6.7(0.5)	15/15
MVDE	18(11)	31(8)	55(23)	75(20)	98(19)	114(13)	15/15
NBIPOPaCMA	3.8(1)	3.7(1.0)	4.5(1)	3.3(0.7)	3.6(0.6)	3.4(0.4)	15/15
NIPOPaCMA	3.7(1)	3.8(1)	4.3(1)	3.4(1.0)	3.6(0.7)	3.4(0.5)	15/15
PSO-BFGS	**1.7**(0.1)	**1.2**(0.2)	**1.1**(0.1)	**0.72**(0.1)	95(58)	1.2e4(1e4)	0/15
SNES	25(34)	83(86)	228(314)	1779(2017)	1.6e4(2e4)	∞ *3e5*	0/15
xNES	4.7(3)	4.3(2)	4.5(1)	3.5(0.8)	3.7(0.5)	3.6(0.3)	15/15
xNESas	11(2)	8.0(0.9)	7.5(0.9)	4.9(0.9)	4.8(0.5)	4.5(0.4)	15/15

Table 15: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{14}, 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
f14	2.2	17	28	71	110	194	15/15
ACOR	**1.9**(2)	3.7(2)	6.1(2)	7.3(2)	77(62)	1802(1766)	11/15
BIPOPaCMA	**2.9**(4)	**2.8**(2)	3.4(2)	4.0(1.0)	4.9(0.8)	4.1(0.4)	15/15
BIPOPsaACM	**1.8**(2)	**2.3**(2)	3.2(0.7)	**2.5**(0.4)	**2.5**(0.5)	**1.9**(0.3)	15/15
CMA	**2.8**(3)	3.1(2)	4.4(1)	4.1(1)	6.9(1)	5.8(0.8)	15/15
CMAES	**2.6**(3)	**2.8**(2)	3.7(2)	4.6(2)	6.6(0.4)	5.8(0.8)	15/15
CMAa	3.9(4)	**2.7**(3)	4.1(2)	4.2(0.7)	4.8(0.9)	4.2(0.5)	15/15
CMAm	**2.8**(4)	**2.5**(2)	3.4(2)	3.6(1)	6.1(2)	5.7(1)	15/15
CMAma	3.7(3)	3.1(2)	3.8(2)	4.1(1)	5.2(0.9)	4.4(0.9)	15/15
CMAmah	3.5(4)	**2.2**(2)	**2.8**(1)	3.6(2)	6.7(2)	6.1(0.7)	15/15
CMAmh	**2.3**(2)	**2.1**(2)	**2.4**(1)	4.3(1)	7.8(2)	7.6(2)	15/15
DBRCGA	**1.9**(2)	6.0(5)	13(6)	15(3)	45(51)	370(579)	14/15
DE	**2.0**(2)	4.1(3)	6.5(4)	9.1(2)	14(3)	16(4)	15/15
DE-AUTO	**2.3**(3)	3.2(2)	**2.8**(0.5)	**1.4**(0.2)	**1.2**(0.1)	4.9(5)	15/15
DE-BFGS	**1.9**(1)	**1.9**(2)	**2.4**(0.3)	**1.3**(0.2)	**1.1**(0.1)	**2.1**(2)	15/15
DE-ROLL	**2.2**(2)	6.3(2)	7.1(6)	20(18)	195(81)	845(914)	1/15
DE-SIMPLEX	**1.7**(2)	4.9(1)	3.9(1)	**2.3**(0.6)	**2.0**(0.5)	**1.4**(0.3)	15/15
DEctpb	**1.8**(2)	4.1(3)	8.6(2)	10(2)	17(5)	18(5)	15/15
IPOPsaACM	3.4(5)	**2.4**(2)	3.2(0.8)	**2.4**(0.6)	**2.4**(0.4)	**1.8**(0.3)	15/15
JADEb	**2.3**(2)	3.0(1)	4.6(2)	5.3(2)	7.1(2)	7.1(2)	15/15
JADEctpb	**2.1**(3)	4.3(3)	5.8(2)	7.1(2)	9.1(1)	7.9(1)	15/15
MVDE	**2.0**(2)	6.1(5)	17(8)	26(7)	56(26)	76(21)	15/15
NBIPOPaCMA	**2.5**(3)	**2.0**(2)	3.1(2)	3.7(0.7)	4.6(0.8)	4.0(0.4)	15/15
NIPOPaCMA	**2.5**(3)	**2.1**(2)	3.3(1)	4.1(0.9)	4.9(0.5)	4.2(0.5)	15/15
PSO-BFGS	**2.2**(2)	3.1(2)	**2.7**(0.4)	**1.4**(0.2)	**1.1**(0.1)	24(47)	10/15
SNES	6.8(6)	3.2(2)	3.6(2)	14(11)	4800(4494)	∞ *3e5*	0/15
xNES	3.7(5)	**2.8**(2)	3.7(2)	4.4(0.8)	5.0(0.8)	3.9(0.3)	15/15
xNESas	4.3(4)	**2.7**(3)	3.4(1)	4.3(1)	7.0(1)	5.3(0.9)	15/15

Table 16: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{15}, 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
f15	121	1372	6285	8429	8787	9041	15/15
ACOR	**1.7**(0.6)	8.1(20)	10(13)	7.5(9)	7.2(9)	7.1(9)	15/15
BIPOPaCMA	**1.4**(0.7)	**1.5**(1)	**1.4**(1)	**1.2**(1)	**1.2**(1)	**1.2**(1)	15/15
BIPOPsaACM	**1.2**(0.8)	**1.2**(1)	**0.97**(0.7)	**0.76**(0.6)	**0.74**(0.6)	**0.73**(0.5)	15/15
CMA	**1.0**(0.6)	**1.7**(1)	**1.1**(1)	**0.92**(1)	**0.92**(1)	**0.92**(1)	15/15
CMAES	**0.96**(0.5)	**2.1**(2)	**1.6**(0.9)	**1.2**(0.7)	**1.2**(0.7)	**1.2**(0.6)	15/15
CMAa	**1.2**(1.0)	**1.3**(1)	**0.97**(0.8)	**0.76**(0.6)	**0.76**(0.6)	**0.77**(0.6)	15/15
CMAm	**0.91**(0.8)	**1.6**(1)	**1.2**(0.7)	**0.93**(0.6)	**0.92**(0.5)	**0.93**(0.5)	15/15
CMAma	**0.96**(0.4)	**1.5**(1.0)	**1.3**(2)	**1.0**(1)	**1.0**(1)	**1.1**(1)	15/15
CMAmah	**2.4**(4)	**2.0**(2)	**0.92**(0.5)	**0.78**(0.4)	**0.78**(0.4)	**0.78**(0.4)	15/15
CMAmh	**2.6**(4)	**1.3**(1)	**0.88**(0.9)	**0.70**(0.7)	**0.70**(0.7)	**0.71**(0.7)	15/15
DBRCGA	**2.8**(1)	3.8(3)	**2.1**(2)	**1.7**(2)	**1.6**(2)	**1.6**(2)	15/15
DE	**2.1**(1)	**2.5**(2)	**1.8**(2)	**1.4**(2)	**1.4**(1)	**1.3**(1)	15/15
DE-AUTO	8.2(12)	5.4(6)	4.0(4)	3.0(3)	**2.9**(3)	**2.8**(3)	15/15
DE-BFGS	**1.3**(0.9)	**1.0**(0.4)	**0.98**(0.9)	**0.73**(0.7)	**0.70**(0.7)	**0.68**(0.6)	15/15
DE-ROLL	6.8(10)	7.5(6)	5.1(6)	3.8(4)	3.6(4)	3.5(4)	15/15
DE-SIMPLEX	5.2(4)	**2.3**(1.0)	**1.8**(2)	**1.4**(1)	**1.3**(1)	**1.3**(1)	15/15
DEctpb	**1.9**(2)	**2.5**(2)	**1.4**(2)	**1.2**(1)	**1.2**(1)	**1.2**(1)	15/15
IPOPsaACM	**0.90**(0.5)	**1.2**(1)	**0.97**(0.8)	**0.79**(0.6)	**0.77**(0.6)	**0.76**(0.6)	15/15
JADEb	**1.4**(0.8)	3.1(5)	3.8(5)	**2.9**(3)	**2.8**(3)	**2.7**(3)	15/15
JADEctpb	**1.8**(0.5)	**1.6**(0.7)	**0.94**(1.0)	**0.80**(0.7)	**0.82**(0.7)	**0.82**(0.7)	15/15
MVDE	**2.8**(1)	56(3)	26(80)	20(59)	19(57)	19(55)	13/15
NBIPOPaCMA	**1.0**(0.5)	**1.8**(2)	**2.8**(2)	**2.2**(2)	**2.2**(2)	**2.3**(2)	15/15
NIPOPaCMA	**0.94**(0.5)	**1.8**(1)	**1.1**(0.7)	**0.91**(0.6)	**0.90**(0.6)	**0.92**(0.6)	15/15
PSO-BFGS	5.0(5)	3.4(3)	**1.9**(2)	**1.4**(1)	**1.4**(1)	**1.3**(1)	15/15
SNES	**1.3**(0.9)	5.5(5)	10(16)	7.8(12)	7.5(12)	7.3(11)	15/15
xNES	**2.8**(2)	10(11)	10(11)	7.6(8)	7.3(8)	7.1(7)	14/15
xNESas	**1.2**(0.6)	5.5(8)	5.1(5)	3.8(4)	3.7(4)	3.6(4)	15/15

Table 17: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{16}, 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
f16	41	319	582	1864	3204	3361	15/15
ACOR	**1.7**(1)	10(8)	63(101)	31(39)	18(23)	17(22)	15/15
BIPOPaCMA	**1.5**(2)	**2.6**(3)	4.1(6)	**1.8**(3)	**1.1**(2)	**1.1**(2)	15/15
BIPOPsaACM	**1.1**(2)	**2.9**(4)	**2.4**(2)	**1.4**(1)	**0.92**(0.7)	**0.94**(0.7)	15/15
CMA	**1.4**(1)	**2.7**(3)	**2.3**(2)	**1.4**(1)	**0.95**(0.9)	**0.96**(0.8)	15/15
CMAES	**1.5**(1)	**2.9**(6)	4.9(5)	3.1(6)	**2.2**(3)	**2.1**(3)	15/15
CMAa	**1.7**(2)	**2.8**(3)	**2.7**(4)	**1.6**(1)	**1.1**(1)	**1.2**(1)	15/15
CMAm	**1.7**(2)	3.0(4)	3.1(3)	**1.3**(1)	**1.2**(0.6)	**1.2**(0.6)	15/15
CMAma	4.3(3)	3.6(4)	3.5(3)	**1.6**(2)	**1.1**(1)	**1.1**(1)	15/15
CMAmah	6.8(14)	3.5(3)	3.6(4)	**1.6**(0.7)	**0.98**(0.4)	**0.98**(0.4)	15/15
CMAmh	**1.6**(1)	3.7(3)	5.3(7)	**2.7**(3)	**1.8**(2)	**1.7**(2)	15/15
DBRCGA	**1.7**(2)	5.6(11)	8.3(9)	15(15)	15(18)	15(17)	15/15
DE	**2.2**(2)	4.8(3)	5.1(3)	3.2(4)	**2.1**(2)	**2.1**(2)	15/15
DE-AUTO	11(15)	26(38)	38(29)	37(21)	26(15)	35(34)	14/15
DE-BFGS	**1.5**(2)	3.6(4)	34(27)	13(15)	7.8(9)	54(73)	4/15
DE-ROLL	**0.91**(0.7)	23(31)	69(30)	58(83)	38(47)	74(74)	5/15
DE-SIMPLEX	**2.1**(3)	**2.6**(2)	3.2(3)	**1.7**(1)	**1.9**(0.7)	7.6(5)	15/15
DEctpb	**1.9**(2)	6.3(5)	8.9(4)	7.0(4)	8.8(4)	12(24)	13/15
IPOPsaACM	**2.7**(1)	3.9(7)	**2.8**(4)	**1.1**(1)	**0.81**(0.9)	**0.84**(0.9)	15/15
JADEb	**1.2**(1)	**2.1**(1)	**2.2**(0.5)	**1.8**(3)	**1.3**(1)	**1.4**(1)	15/15
JADEctpb	**1.2**(0.7)	3.5(3)	6.2(5)	4.4(3)	3.0(3)	4.8(3)	15/15
MVDE	**1.0**(0.8)	5.3(4)	15(7)	204(271)	120(158)	115(151)	11/15
NBIPOPaCMA	**1.6**(2)	**2.4**(3)	**2.2**(2)	**1.1**(1)	**0.74**(0.8)	**0.74**(0.7)	15/15
NIPOPaCMA	**1.5**(1)	**2.6**(2)	**2.8**(3)	**0.99**(0.9)	**0.71**(0.6)	**0.72**(0.5)	15/15
PSO-BFGS	3.4(4)	4.4(5)	9.2(7)	14(11)	11(11)	59(59)	6/15
SNES	**1.9**(2)	**3.0**(5)	5.0(5)	11(21)	15(19)	35(47)	12/15
xNES	**1.4**(2)	**2.6**(5)	4.3(4)	**1.8**(3)	**1.2**(2)	**1.1**(2)	15/15
xNESas	**0.92**(1)	**2.8**(4)	3.2(3)	**1.1**(1)	**0.71**(0.6)	**0.73**(0.6)	15/15

Table 18: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{17}, 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
f17	3.6	78	282	1134	2347	3469	15/15
ACOR	**2.4**(2)	**2.0**(0.7)	**1.5**(0.3)	6.0(0.2)	3.2(0.1)	4.6(13)	15/15
BIPOPaCMA	4.2(7)	**1.8**(1)	**1.5**(2)	**0.89**(0.6)	**1.0**(0.8)	**0.81**(0.6)	15/15
BIPOPsaACM	3.4(5)	**1.3**(0.6)	**1.9**(3)	**1.3**(1)	**1.6**(1)	**1.4**(0.9)	15/15
CMA	**2.9**(5)	**2.1**(0.5)	**1.1**(0.3)	**1.00**(0.7)	**0.66**(0.4)	**0.72**(0.7)	15/15
CMAES	4.4(3)	**1.1**(0.5)	**1.6**(2)	**1.1**(0.8)	**2.6**(4)	3.3(4)	15/15
CMAa	4.4(5)	**2.4**(1)	**1.4**(2)	**0.94**(0.9)	**0.96**(0.8)	**0.84**(0.6)	15/15
CMAm	3.6(3)	3.4(7)	**1.3**(2)	**0.88**(0.6)	**1.0**(0.5)	**0.94**(0.5)	15/15
CMAma	4.9(6)	**1.7**(0.7)	**1.7**(2)	**0.98**(0.6)	**0.80**(0.8)	**0.78**(0.6)	15/15
CMAmah	3.7(5)	**2.4**(0.6)	4.0(4)	**2.0**(1)	**1.3**(0.3)	**1.2**(0.4)	15/15
CMAmh	5.3(4)	10(26)	4.7(7)	**2.5**(2)	**1.6**(0.9)	**1.3**(0.6)	15/15
DBRCGA	**2.0**(2)	3.7(1)	3.1(0.8)	3.2(5)	4.4(5)	8.1(13)	15/15
DE	**1.8**(2)	**2.7**(1)	**2.3**(0.8)	**1.4**(0.3)	**1.4**(0.4)	**1.8**(2)	15/15
DE-AUTO	**2.4**(2)	31(41)	22(13)	16(10)	13(6)	16(10)	15/15
DE-BFGS	3.1(2)	5.5(5)	4.0(3)	**2.7**(1)	**2.0**(0.5)	50(65)	3/15
DE-ROLL	19(3)	15(18)	24(16)	19(12)	15(10)	127(121)	5/15
DE-SIMPLEX	**2.7**(3)	8.9(6)	5.8(2)	3.7(0.8)	3.1(0.6)	242(304)	0/15
DEctpb	**1.9**(2)	3.1(2)	**2.5**(0.7)	**1.8**(0.4)	**1.6**(0.3)	**1.6**(0.5)	15/15
IPOPsaACM	**2.4**(3)	**1.2**(0.8)	**1.3**(2)	**1.3**(0.9)	**1.1**(0.9)	**0.97**(0.5)	15/15
JADEb	**2.0**(2)	**1.4**(0.9)	**1.2**(0.4)	**1.3**(2)	**1.4**(1)	3.6(6)	15/15
JADEctpb	**1.9**(2)	**1.7**(0.9)	**1.8**(0.5)	**1.2**(0.3)	**0.99**(0.2)	**0.92**(0.1)	15/15
MVDE	**1.8**(2)	4.7(2)	5.2(2)	4.9(1)	4.5(1)	4.4(1)	15/15
NBIPOPaCMA	3.1(4)	**2.2**(0.6)	**1.3**(2)	**0.99**(0.7)	**1.0**(0.2)	**1.3**(1.0)	15/15
NIPOPaCMA	3.3(4)	3.1(7)	**1.4**(2)	**0.87**(0.7)	**0.98**(0.5)	**0.92**(0.7)	15/15
PSO-BFGS	**2.1**(3)	11(13)	14(6)	6.6(2)	4.9(0.8)	63(71)	1/15
SNES	6.9(8)	3.9(1.0)	**2.9**(6)	**1.7**(2)	6.3(4)	8.0(9)	14/15
xNES	5.6(6)	**1.6**(1)	**2.4**(5)	**1.9**(3)	3.1(3)	3.0(3)	15/15
xNESas	5.3(5)	3.4(1)	**1.7**(1)	**1.3**(2)	3.3(3)	**2.8**(2)	15/15

Table 19: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{18}, 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
f18	40	145	1289	3523	4738	5527	15/15
ACOR	**2.2**(1)	3.0(1)	23(60)	15(27)	29(38)	31(39)	15/15
BIPOPaCMA	**1.3**(1)	**2.3**(0.3)	**0.95**(2)	**0.69**(0.6)	**0.70**(0.5)	**0.75**(0.5)	15/15
BIPOPsaACM	**1.2**(0.8)	**2.2**(0.8)	**0.97**(0.8)	**0.62**(0.6)	**1.1**(0.4)	**1.0**(0.4)	15/15
CMA	3.6(1)	**2.0**(1)	**1.0**(1)	**0.83**(0.7)	**0.85**(0.4)	**0.86**(0.4)	15/15
CMAES	**1.3**(0.9)	3.1(5)	**2.5**(3)	3.4(3)	6.5(7)	11(14)	13/15
CMAa	**1.3**(1)	**2.5**(1)	**1.0**(1)	**0.93**(0.6)	**0.87**(0.3)	**0.90**(0.3)	15/15
CMAm	**1.5**(0.8)	**2.3**(0.4)	**1.2**(1)	**1.4**(1)	**1.3**(0.8)	**1.3**(0.8)	15/15
CMAma	**1.2**(0.9)	4.3(7)	**1.6**(2)	**0.90**(0.5)	**0.85**(0.4)	**0.83**(0.3)	15/15
CMAmah	6.1(10)	4.8(4)	**1.8**(2)	**1.3**(0.5)	**1.2**(0.4)	**1.2**(0.5)	15/15
CMAmh	**2.8**(1)	5.2(8)	**2.8**(4)	**1.6**(1.0)	**1.4**(0.6)	**1.3**(0.6)	15/15
DBRCGA	**2.7**(2)	3.6(1)	4.1(6)	22(21)	32(37)	60(64)	9/15
DE	**2.7**(2)	3.9(2)	**1.0**(0.5)	**1.2**(1)	**1.7**(1)	3.4(5)	15/15
DE-AUTO	22(24)	37(33)	10(11)	15(5)	16(5)	24(28)	13/15
DE-BFGS	**2.3**(2)	9.0(7)	**2.2**(1)	**2.2**(2)	**2.2**(2)	91(111)	0/15
DE-ROLL	16(36)	34(39)	14(10)	17(8)	23(19)	188(192)	0/15
DE-SIMPLEX	9.4(9)	27(33)	10(13)	5.1(5)	4.7(5)	170(190)	0/15
DEctpb	**2.6**(1)	4.1(2)	**1.2**(0.5)	**1.2**(0.3)	**1.9**(2)	5.8(6)	14/15
IPOPsaACM	**1.4**(1)	4.0(6)	**1.3**(0.9)	**0.91**(0.6)	**1.1**(0.4)	**1.3**(0.6)	15/15
JADEb	**1.3**(1.0)	**1.8**(2)	**1.8**(5)	**2.7**(6)	6.8(9)	13(14)	13/15
JADEctpb	**1.9**(0.7)	**2.8**(1.0)	**0.74**(0.2)	**0.57**(0.1)	**0.65**(0.1)	**0.76**(0.1)	15/15
MVDE	3.4(2)	8.0(2)	3.3(1)	3.9(1)	5.5(1)	6.4(2)	15/15
NBIPOPaCMA	**2.9**(2)	3.0(4)	**1.0**(0.7)	**0.89**(1.0)	**0.91**(0.6)	**1.1**(0.6)	15/15
NIPOPaCMA	**1.5**(1)	5.2(8)	**1.6**(2)	**1.1**(0.5)	**1.0**(0.4)	**0.95**(0.4)	15/15
PSO-BFGS	7.7(8)	24(20)	20(40)	10(15)	12(13)	243(275)	0/15
SNES	**1.7**(1)	3.6(3)	5.5(6)	71(85)	443(507)	390(435)	2/15
xNES	**1.7**(1)	5.9(11)	**1.5**(2)	**1.3**(2)	**2.8**(3)	3.8(3)	15/15
xNESas	**1.1**(0.9)	**2.4**(0.9)	**0.72**(0.8)	**0.61**(0.4)	**1.5**(2)	**2.4**(3)	15/15

Table 20: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{19}, 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
f19	1	1	109	7367	7399	7441	15/15
ACOR	**4.3**(2)	170(119)	31(38)	13(18)	14(19)	15(20)	15/15
BIPOPaCMA	10(11)	**140**(118)	38(46)	3.9(4)	3.9(4)	3.9(4)	15/15
BIPOPsaACM	8.4(16)	424(684)	31(21)	**1.8**(2)	**1.8**(2)	**1.8**(2)	15/15
CMA	7.7(6)	203(364)	132(226)	8.4(9)	8.5(9)	8.5(9)	15/15
CMAES	10(9)	312(638)	50(38)	7.6(10)	7.6(10)	7.6(11)	13/15
CMAa	7.3(7)	**109**(98)	88(140)	4.4(4)	4.5(4)	4.5(4)	15/15
CMAm	10(8)	493(560)	153(289)	8.9(8)	8.9(8)	8.9(8)	15/15
CMAma	**5.7**(4)	382(911)	60(38)	5.6(8)	5.6(8)	5.6(8)	15/15
CMAmah	**5.3**(6)	168(185)	228(385)	6.1(7)	6.2(7)	6.2(7)	15/15
CMAmh	6.4(6)	325(178)	102(160)	4.5(5)	4.5(5)	4.5(5)	15/15
DBRCGA	12(15)	235(140)	38(33)	19(27)	19(25)	19(21)	12/15
DE	14(16)	276(230)	35(37)	5.1(7)	5.2(7)	5.2(7)	14/15
DE-AUTO	**4.1**(4)	1701(1930)	81(75)	15(21)	15(21)	19(22)	12/15
DE-BFGS	18(18)	310(238)	**19**(21)	11(18)	11(17)	18(19)	7/15
DE-ROLL	10(10)	879(1802)	72(83)	22(27)	22(25)	35(43)	6/15
DE-SIMPLEX	12(18)	685(1100)	32(33)	9.4(14)	9.4(14)	9.3(14)	14/15
DEctpb	10(8)	279(250)	**24**(12)	**1.6**(0.5)	**2.1**(1)	**2.2**(1)	15/15
IPOPsaACM	8.1(7)	268(375)	138(141)	5.3(8)	5.4(8)	5.4(8)	15/15
JADEb	12(14)	159(148)	**20**(19)	4.0(10)	4.7(10)	4.7(10)	13/15
JADEctpb	13(16)	166(172)	**27**(21)	**3.0**(2)	**3.2**(1)	**3.3**(1)	14/15
MVDE	10(9)	387(328)	30(28)	70(136)	71(135)	71(134)	10/15
NBIPOPaCMA	9.2(8)	174(152)	41(50)	3.4(4)	3.4(4)	**3.4**(4)	15/15
NIPOPaCMA	11(12)	**114**(86)	110(167)	13(17)	13(18)	13(18)	15/15
PSO-BFGS	8.4(8)	491(938)	41(31)	**2.9**(4)	**2.9**(4)	14(21)	9/15
SNES	9.1(8)	264(399)	27(28)	8.1(7)	16(10)	23(13)	11/15
xNES	7.5(9)	**137**(132)	41(46)	5.5(4)	5.8(5)	5.8(5)	15/15
xNESas	8.3(8)	526(250)	62(79)	10(9)	14(9)	14(9)	14/15

Table 21: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{20}, 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
f20	8.3	385	2291	2481	2573	2776	15/15
ACOR	4.1(4)	**1.5**(0.9)	**2.3**(0.3)	**2.3**(0.4)	**2.3**(0.4)	**2.2**(0.3)	15/15
BIPOPaCMA	**1.4**(1)	5.6(8)	6.0(8)	6.2(7)	6.1(7)	5.8(7)	15/15
BIPOPsaACM	**2.9**(2)	**2.7**(3)	3.7(4)	3.6(4)	3.5(4)	3.3(4)	15/15
CMA	**2.8**(3)	5.5(7)	5.2(4)	5.5(4)	5.5(4)	5.3(4)	15/15
CMAES	**2.5**(3)	7.1(8)	17(19)	16(17)	16(17)	14(15)	15/15
CMAa	**3.0**(2)	6.5(7)	6.7(4)	6.7(4)	6.7(4)	6.4(4)	15/15
CMAm	3.1(4)	7.3(8)	6.0(4)	6.1(4)	6.1(4)	5.8(4)	15/15
CMAma	**1.9**(2)	7.3(6)	6.7(4)	7.1(4)	7.1(4)	6.8(3)	15/15
CMAmah	**1.9**(2)	5.9(7)	6.7(3)	7.0(3)	7.0(3)	6.7(3)	15/15
CMAmh	**2.2**(2)	6.0(7)	7.0(7)	7.2(8)	7.2(8)	6.8(8)	15/15
DBRCGA	5.4(8)	**2.2**(1)	4.5(5)	4.4(4)	4.4(4)	4.2(4)	15/15
DE	4.8(4)	**1.6**(0.7)	**1.5**(2)	**1.6**(2)	**1.6**(2)	**1.6**(2)	15/15
DE-AUTO	**2.8**(3)	6.1(7)	13(16)	12(15)	12(15)	11(14)	15/15
DE-BFGS	5.2(2)	**2.0**(2)	14(12)	12(11)	12(11)	11(10)	15/15
DE-ROLL	4.0(2)	4.3(5)	29(47)	27(28)	26(42)	24(39)	14/15
DE-SIMPLEX	3.4(4)	3.6(4)	41(50)	38(46)	36(45)	34(41)	15/15
DEctpb	**3.0**(5)	**1.7**(0.8)	**1.4**(1)	**1.5**(1)	**1.7**(1)	**1.7**(1)	15/15
IPOPsaACM	**2.2**(2)	3.0(4)	**2.4**(2)	**2.6**(2)	**2.5**(2)	**2.3**(2)	15/15
JADEb	**2.9**(2)	**1.7**(2)	**2.0**(2)	**1.9**(2)	**1.9**(2)	**1.8**(2)	15/15
JADEctpb	**3.0**(3)	**1.1**(0.6)	**1.2**(1)	**1.4**(1)	**1.4**(1)	**1.4**(1)	15/15
MVDE	5.4(5)	**2.2**(1)	110(219)	103(202)	99(195)	93(181)	12/15
NBIPOPaCMA	3.6(3)	3.2(2)	8.0(10)	8.0(10)	7.9(10)	7.6(9)	15/15
NIPOPaCMA	**2.9**(2)	3.4(4)	6.6(9)	6.7(9)	6.6(8)	6.4(8)	15/15
PSO-BFGS	6.0(4)	**2.5**(2)	7.9(11)	7.3(11)	7.1(10)	6.6(9)	15/15
SNES	**1.9**(2)	8.9(11)	10(11)	9.3(10)	9.0(10)	8.4(9)	15/15
xNES	**2.0**(2)	14(16)	19(20)	20(19)	20(18)	18(17)	15/15
xNESas	3.0(3)	7.6(8)	12(13)	14(19)	13(19)	12(17)	15/15

Table 22: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{21}, 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
f21	5.9	184	425	458	469	482	14/15
ACOR	**1.5**(2)	112(143)	57(62)	54(57)	53(56)	52(54)	15/15
BIPOPaCMA	**1.3**(1)	7.9(12)	11(16)	16(21)	16(21)	16(20)	15/15
BIPOPsaACM	**2.3**(2)	3.4(4)	7.2(15)	7.5(17)	7.5(17)	7.4(17)	15/15
CMA	**1.3**(1)	7.3(12)	6.1(8)	6.6(8)	7.0(8)	7.0(8)	15/15
CMAES	**1.8**(3)	9.2(11)	11(13)	10(12)	10(12)	10(12)	15/15
CMAa	**2.4**(2)	4.0(6)	5.5(6)	15(26)	15(27)	15(28)	15/15
CMAm	**1.3**(1)	10(12)	48(14)	46(13)	46(14)	45(14)	14/15
CMAma	**1.2**(0.9)	8.3(19)	8.3(12)	12(13)	12(15)	12(15)	15/15
CMAmah	**0.97**(1)	6.0(11)	8.0(9)	7.9(8)	8.8(8)	8.8(8)	15/15
CMAmh	**1.5**(2)	4.7(6)	13(14)	13(15)	14(15)	14(15)	15/15
DBRCGA	**1.4**(0.9)	3.4(6)	4.4(6)	5.1(6)	5.7(6)	**6.1**(5)	15/15
DE	**1.8**(2)	3.5(4)	4.1(6)	**4.3**(5)	**4.7**(5)	**5.1**(5)	15/15
DE-AUTO	**1.8**(2)	30(46)	71(128)	66(119)	65(116)	63(113)	15/15
DE-BFGS	**1.2**(0.8)	**2.7**(3)	8.1(9)	7.6(8)	7.5(8)	17(33)	15/15
DE-ROLL	**1.7**(1)	28(44)	48(57)	45(53)	44(52)	43(51)	15/15
DE-SIMPLEX	**1.3**(1)	11(24)	9.1(20)	8.7(18)	8.5(18)	8.3(17)	15/15
DEctpb	**2.5**(2)	**1.9**(3)	**2.0**(2)	**2.9**(2)	**3.6**(2)	**4.2**(2)	15/15
IPOPsaACM	**1.4**(1)	**3.0**(4)	6.7(5)	38(12)	38(12)	37(12)	15/15
JADEb	**1.8**(2)	8.1(7)	10(16)	9.2(15)	9.2(14)	9.1(14)	15/15
JADEctpb	**1.3**(1)	4.5(9)	**2.7**(4)	**3.2**(3)	**3.6**(4)	**3.8**(3)	15/15
MVDE	**1.2**(1)	4.2(3)	**3.1**(2)	5.9(5)	10(5)	11(5)	15/15
NBIPOPaCMA	**2.1**(2)	11(13)	24(38)	23(35)	22(34)	22(33)	15/15
NIPOPaCMA	**1.8**(2)	21(31)	193(284)	185(264)	182(258)	179(251)	15/15
PSO-BFGS	**1.5**(2)	**2.5**(4)	**3.7**(5)	**3.5**(4)	**3.5**(4)	45(64)	14/15
SNES	**1.9**(2)	20(44)	18(26)	17(24)	16(23)	16(23)	15/15
xNES	**1.5**(2)	16(32)	36(50)	34(46)	33(45)	33(44)	15/15
xNESas	**1.5**(1)	43(84)	41(72)	38(67)	37(66)	36(64)	15/15

Table 23: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{22}, 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
f22	18	170	354	384	401	414	15/15
ACOR	**2.1**(2)	141(297)	175(216)	165(198)	159(189)	156(183)	15/15
BIPOPaCMA	4.5(3)	4.3(3)	32(24)	30(22)	29(21)	28(20)	15/15
BIPOPsaACM	**2.3**(1)	4.1(6)	11(25)	11(23)	11(22)	11(21)	15/15
CMA	**1.6**(1)	**2.8**(3)	47(29)	335(537)	414(620)	481(644)	9/15
CMAES	**0.76**(0.7)	9.5(10)	14(14)	13(13)	13(12)	13(12)	15/15
CMAa	4.6(3)	14(19)	32(53)	315(468)	461(731)	447(626)	9/15
CMAm	4.1(3)	13(12)	60(53)	128(266)	335(380)	325(560)	10/15
CMAma	4.8(5)	12(19)	60(53)	198(303)	406(633)	395(631)	10/15
CMAmah	3.7(3)	11(12)	24(42)	234(340)	288(427)	282(497)	11/15
CMAmh	3.3(2)	3.9(4)	17(26)	57(76)	175(288)	246(374)	11/15
DBRCGA	**1.5**(2)	**1.8**(1)	**3.2**(5)	**4.3**(4)	**5.2**(4)	**6.1**(4)	15/15
DE	**2.0**(2)	**2.1**(1)	4.5(9)	5.2(8)	5.7(8)	**6.2**(8)	15/15
DE-AUTO	**1.2**(1)	16(15)	104(262)	96(242)	93(231)	91(224)	15/15
DE-BFGS	**1.0**(0.7)	3.2(6)	**2.7**(3)	**2.6**(3)	**2.6**(3)	19(29)	15/15
DE-ROLL	**1.5**(1)	11(17)	90(74)	85(68)	87(69)	123(126)	14/15
DE-SIMPLEX	**1.4**(1)	18(25)	20(21)	18(19)	18(18)	17(18)	15/15
DEctpb	**1.7**(2)	**2.2**(2)	6.8(10)	8.0(10)	9.1(9)	10(9)	15/15
IPOPsaACM	**1.4**(1)	5.3(6)	17(29)	101(237)	100(227)	98(222)	15/15
JADEb	15(42)	5.1(7)	5.6(5)	5.5(5)	5.5(5)	**5.7**(4)	15/15
JADEctpb	**1.5**(2)	4.5(9)	4.4(4)	**4.8**(5)	**5.3**(4)	**5.8**(5)	15/15
MVDE	**1.1**(0.9)	**2.0**(2)	**2.5**(3)	6.8(6)	11(5)	16(6)	15/15
NBIPOPaCMA	12(26)	21(35)	16(16)	18(25)	17(24)	17(23)	15/15
NIPOPaCMA	8.0(24)	19(19)	207(209)	210(198)	205(197)	202(198)	15/15
PSO-BFGS	4.5(7)	**2.2**(2)	**2.7**(4)	**2.5**(3)	**2.7**(3)	65(79)	12/15
SNES	13(3)	25(35)	39(45)	50(42)	69(55)	90(68)	15/15
xNES	18(2)	28(43)	36(63)	35(58)	33(56)	33(54)	15/15
xNESas	14(2)	29(31)	68(101)	70(93)	67(89)	65(87)	15/15

Table 24: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{23}, 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
f23	2.6	407	906	2214	2293	2393	15/15
ACOR	4.2(4)	19(15)	2.2e4(2e4)	∞	∞	∞ *1e7*	0/15
BIPOPaCMA	4.7(6)	4.4(7)	5.2(5)	**2.6**(2)	**2.6**(2)	**2.9**(2)	15/15
BIPOPsaACM	7.8(10)	5.9(6)	5.8(4)	4.9(6)	4.8(6)	5.1(5)	15/15
CMA	4.8(5)	8.0(8)	13(17)	5.8(7)	5.8(7)	5.7(7)	15/15
CMAES	**2.7**(2)	7.0(6)	14(14)	6.5(6)	6.8(9)	6.6(8)	15/15
CMAa	**2.4**(3)	8.5(9)	11(12)	4.9(5)	5.0(5)	5.0(5)	15/15
CMAm	4.9(8)	5.9(7)	113(334)	46(137)	45(132)	43(126)	13/15
CMAma	5.8(7)	5.3(7)	7.6(5)	3.3(2)	**3.4**(2)	**3.4**(2)	15/15
CMAmah	4.7(4)	5.0(6)	60(17)	25(7)	24(7)	23(7)	14/15
CMAmh	4.7(6)	13(15)	16(17)	6.9(7)	8.4(10)	8.3(10)	15/15
DBRCGA	4.1(3)	9.3(9)	102(104)	53(47)	52(46)	50(44)	14/15
DE	3.5(3)	20(16)	79(92)	35(38)	42(46)	40(44)	11/15
DE-AUTO	**2.6**(3)	**2.5**(3)	**4.4**(6)	**2.9**(4)	**2.8**(4)	**2.8**(4)	15/15
DE-BFGS	**2.2**(2)	**1.9**(2)	**3.4**(2)	3.1(4)	6.1(7)	280(316)	2/15
DE-ROLL	3.5(2)	3.2(6)	17(22)	32(30)	33(28)	126(127)	1/15
DE-SIMPLEX	**2.1**(2)	**0.66**(0.5)	**1.2**(2)	**0.66**(0.6)	5.9(4)	354(439)	1/15
DEctpb	3.7(4)	21(13)	353(343)	∞	∞	∞ *2e5*	0/15
IPOPsaACM	5.6(5)	7.5(7)	11(10)	4.5(4)	4.5(4)	4.4(4)	15/15
JADEb	3.2(3)	7.3(8)	25(22)	21(21)	21(20)	20(19)	14/15
JADEctpb	**2.8**(2)	10(6)	22(20)	10(9)	10(8)	10(8)	15/15
MVDE	4.1(5)	11(13)	1018(1650)	6370(6889)	6155(6759)	5901(7313)	1/15
NBIPOPaCMA	4.6(5)	4.2(3)	4.6(6)	**2.1**(2)	**2.4**(2)	**3.2**(3)	15/15
NIPOPaCMA	4.3(5)	11(8)	10(10)	4.8(4)	4.9(4)	4.9(4)	15/15
PSO-BFGS	3.6(4)	**1.4**(2)	**4.4**(4)	8.8(13)	88(107)	∞ *3e5*	0/15
SNES	3.7(3)	13(18)	80(159)	380(445)	525(614)	503(588)	3/15
xNES	4.1(5)	16(16)	280(367)	328(332)	318(369)	437(471)	3/15
xNESas	5.0(7)	16(19)	271(296)	186(207)	217(230)	256(223)	0/15

Table 25: 03-D, running time excess ERT/ERT$_{\text{best 2009}}$ on f_{24}, 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
f24	97	10391	1.0e5	3.6e5	3.6e5	3.6e5	2/15
ACOR	**2.9**(2)	341(536)	37(54)	12(16)	12(15)	12(16)	13/15
BIPOPaCMA	**1.6**(2)	3.1(4)	11(9)	4.8(5)	4.8(5)	5.7(6)	12/15
BIPOPsaACM	**1.6**(1)	6.8(10)	7.2(9)	5.6(7)	5.7(7)	5.9(7)	11/15
CMA	**1.5**(1)	117(145)	∞	∞	∞	∞ *6e5*	0/15
CMAES	3.5(1)	3.5(4)	6.1(7)	**2.8**(3)	**2.8**(3)	**2.8**(3)	2/15
CMAa	**1.7**(1)	116(145)	∞	∞	∞	∞ *6e5*	0/15
CMAm	**2.6**(2)	67(88)	38(47)	11(14)	11(13)	11(13)	2/15
CMAma	**2.4**(2)	232(289)	∞	∞	∞	∞ *6e5*	0/15
CMAmah	**1.1**(0.7)	88(116)	38(44)	∞	∞	∞ *6e5*	0/15
CMAmh	**2.9**(5)	160(202)	∞	∞	∞	∞ *6e5*	0/15
DBRCGA	3.9(4)	4.6(5)	5.9(6)	∞	∞	∞ *3e5*	0/15
DE	3.2(3)	5.3(6)	6.6(8)	6.3(6)	6.3(7)	6.3(7)	1/15
DE-AUTO	26(42)	64(77)	6.8(8)	**2.0**(2)	**2.0**(2)	**2.0**(2)	5/15
DE-BFGS	**2.5**(2)	8.4(8)	**0.89**(0.8)	**0.26**(0.2)	**0.26**(0.2)	**0.26**(0.2)	14/15
DE-ROLL	33(56)	62(75)	6.9(8)	**2.0**(2)	**2.0**(2)	**2.6**(3)	4/15
DE-SIMPLEX	3.4(5)	21(29)	**2.2**(3)	**0.65**(0.8)	**0.65**(0.8)	**0.65**(0.8)	10/15
DEctpb	3.0(2)	21(23)	4.6(5)	**2.9**(3)	**3.0**(3)	**3.0**(3)	2/15
IPOPsaACM	**2.3**(2)	402(520)	433(439)	∞	∞	∞ *3e6*	0/15
JADEb	4.5(2)	**1.4**(1)	**2.3**(3)	**3.0**(3)	**3.0**(3)	**3.0**(3)	2/15
JADEctpb	**2.7**(2)	**2.2**(3)	**1.1**(1)	**0.66**(0.7)	**0.66**(0.8)	**0.66**(0.7)	7/15
MVDE	4.4(3)	1348(1540)	137(151)	∞	∞	∞ *1e6*	0/15
NBIPOPaCMA	**1.4**(0.7)	7.1(16)	5.9(7)	4.3(6)	4.3(5)	4.3(5)	12/15
NIPOPaCMA	3.9(4)	35(68)	5.6(7)	3.9(5)	3.9(5)	3.9(5)	12/15
PSO-BFGS	**1.4**(0.9)	**1.3**(2)	**0.44**(0.4)	**0.24**(0.2)	**0.24**(0.2)	**0.24**(0.2)	15/15
SNES	**1.9**(2)	4.0(4)	13(13)	∞	∞	∞ *3e5*	0/15
xNES	**2.6**(2)	**3.0**(3)	7.6(7)	∞	∞	∞ *2e5*	0/15
xNESas	**1.6**(1)	4.7(4)	29(35)	18(21)	18(21)	18(19)	1/15

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