

## Supplementary materials

**Table S.1** CEC2013 test suite.

Type	No.	Functions	Search Range	$F_{min}$
Unimodal functions	1	Sphere Function	[-100,100]	-1400
	2	Rotated High Conditioned Elliptic Function	[-100,100]	-1300
	3	Rotated Bent Cigar Function	[-100,100]	-1200
	4	Rotated Discus Function	[-100,100]	-1100
	5	Different Powers Function	[-100,100]	-1000
Basic multimodal functions	6	Rotated Rosenbrock's Function	[-100,100]	-900
	7	Rotated Schaffers F7 Function	[-100,100]	-800
	8	Rotated Ackley's Function	[-100,100]	-700
	9	Rotated Weierstrass Function	[-100,100]	-600
	10	Rotated Griewank's Function	[-100,100]	-500
	11	Rastrigin's Function	[-100,100]	-400
	12	Rotated Rastrigin's Function	[-100,100]	-300
	13	Non-Continuous Rotated Rastrigin's Function	[-100,100]	-200
	14	Schwefel's Function	[-100,100]	-100
	15	Rotated Schwefel's Function	[-100,100]	100
	16	Rotated Katsuura Function	[-100,100]	200
	17	Lunacek Bi Rastrigin Function	[-100,100]	300
	18	Rotated Lunacek Bi rastrigin Function	[-100,100]	400
	19	Expanded Griewank's plus Rosenbrock's Function	[-100,100]	500
	20	Expanded Scaffer's F6 Function	[-100,100]	600
Composition functions	21	Composition Function 1 ( $n = 5$ , Rotated)	[-100,100]	700
	22	Composition Function 2 ( $n = 3$ , Unrotated)	[-100,100]	800
	23	Composition Function 3 ( $n = 3$ , Rotated)	[-100,100]	900
	24	Composition Function 4 ( $n = 3$ , Rotated)	[-100,100]	1000
	25	Composition Function 5 ( $n = 3$ , Rotated)	[-100,100]	1100
	26	Composition Function 6 ( $n = 5$ , Rotated)	[-100,100]	1200
	27	Composition Function 7 ( $n = 5$ , Rotated)	[-100,100]	1300
	28	Composition Function 8 ( $n = 5$ , Rotated)	[-100,100]	1400

**Table S.2** CEC2017 test suite.

	No.	Functions	Search Range	$F_{min}$
Unimodal functions	1	Shifted and Rotated Bent Cigar Function	[-100,100]	100
	3	Shifted and Rotated Zakharov Function	[-100,100]	300
	4	Shifted and Rotated Rosenbrock's Function	[-100,100]	400
Multimodal functions	5	Shifted and Rotated Rastrigin's Function	[-100,100]	500
	6	Shifted and Rotated Expanded Scaffer's F6 Function	[-100,100]	600
	7	Shifted and Rotated Lunacek Bi-Rastrigin Function	[-100,100]	700
	8	Shifted and Rotated Non-Continuous Rastrigin's Function	[-100,100]	800
	9	Shifted and Rotated Levy Function	[-100,100]	900
	10	Shifted and Rotated Schwefel's Function	[-100,100]	1000
	11	Hybrid Function 1 ( $N=3$ )	[-100,100]	1100
	12	Hybrid Function 2 ( $N=3$ )	[-100,100]	1200
Hybrid functions	13	Hybrid Function 3 ( $N=3$ )	[-100,100]	1300
	14	Hybrid Function 4 ( $N=4$ )	[-100,100]	1400
	15	Hybrid Function 5 ( $N=4$ )	[-100,100]	1500
	16	Hybrid Function 6 ( $N=4$ )	[-100,100]	1600
	17	Hybrid Function 6 ( $N=5$ )	[-100,100]	1700
	18	Hybrid Function 6 ( $N=5$ )	[-100,100]	1800
	19	Hybrid Function 6 ( $N=5$ )	[-100,100]	1900
	20	Hybrid Function 6 ( $N=6$ )	[-100,100]	2000
Composition functions	21	Composition Function 1 ( $N=3$ )	[-100,100]	2100
	22	Composition Function 2 ( $N=3$ )	[-100,100]	2200
	23	Composition Function 3 ( $N=4$ )	[-100,100]	2300
	24	Composition Function 4 ( $N=4$ )	[-100,100]	2400
	25	Composition Function 5 ( $N=5$ )	[-100,100]	2500
	26	Composition Function 6 ( $N=5$ )	[-100,100]	2600
	27	Composition Function 7 ( $N=6$ )	[-100,100]	2700
	28	Composition Function 8 ( $N=6$ )	[-100,100]	2800
	29	Composition Function 9 ( $N=3$ )	[-100,100]	2900
	30	Composition Function 10 ( $N=3$ )	[-100,100]	3000

**Table S.3.** Comparison of time usage (s)

	PSO	CLPSO	DMS-PSO	HCLPSO	EPSO	TAPSO	APSO-SL
F1	3.88	11.77	8.26	4.42	10.98	15.46	12.11
F2	4.19	10.68	9.15	4.26	13.54	14.65	12.87
F3	5.01	12.55	8.31	5.65	15.21	14.52	14.32
F4	3.77	10.94	7.55	4.68	13.02	14.75	13.76
F5	3.89	10.72	5.88	4.54	16.11	13.35	15.40
F6	4.23	9.66	7.66	4.73	11.34	13.26	12.11
F7	6.88	14.21	9.58	7.82	19.00	17.98	17.75
F8	6.65	13.95	12.55	6.88	16.01	16.54	15.90
F9	24.51	38.16	28.78	26.15	47.15	44.62	42.87
F10	4.77	12.20	9.12	5.46	14.13	14.65	12.98
F11	5.53	13.11	10.23	6.34	16.31	15.32	14.22
F12	6.19	13.88	12.35	7.66	14.62	15.64	16.84
F13	6.20	12.95	11.25	7.98	17.62	16.65	14.87
F14	5.60	12.61	11.87	6.78	15.32	15.32	13.86
F15	5.75	12.12	12.35	6.58	15.64	16.96	14.33
F16	9.11	16.21	17.65	10.99	18.88	23.64	21.87
F17	4.69	12.10	8.45	5.69	14.33	14.34	12.67
F18	5.55	11.67	8.98	6.76	13.52	15.67	13.09
F19	4.31	9.30	7.75	4.88	11.77	16.32	12.76
F20	5.19	10.11	10.23	6.59	14.33	15.97	14.98
F21	9.70	17.65	14.65	9.69	27.22	21.56	15.11
F22	10.41	16.23	18.95	10.44	25.11	23.31	15.67
F23	11.55	17.65	22.65	11.55	40.26	26.89	14.87
F24	31.91	43.55	34.61	28.61	61.84	51.64	36.78
F25	30.90	45.62	37.65	29.89	75.55	54.68	34.87
F26	30.22	48.65	40.21	31.23	33.44	58.67	35.87
F27	31.40	48.61	41.26	30.56	51.24	51.32	35.89
F28	14.37	26.15	21.98	14.81	25.56	28.64	18.45
Avg.	10.32	19.04	16.06	11.13	23.89	23.95	17.46