Supplementary materials

Paper title: Modified LSHADE-SPACMA with new mutation strategy and external archive mechanism for numerical optimization and point cloud registration

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Table S1 Review the CEC 2014 test suite.

Type	ID	Description	Dim	f_{min}
Unimodal	CEC2014-F1	Rotated High Conditioned Elliptic Function	10/30/50/100	100
	CEC2014-F2	Rotated Bent Cigar Function	10/30/50/100	200
	CEC2014-F3	Rotated Discus Function	10/30/50/100	300
Multimodal	CEC2014-F4	Shifted and Rotated Rosenbrock's Function	10/30/50/100	400
	CEC2014-F5	Shifted and Rotated Ackley's Function	10/30/50/100	500
	CEC2014-F6	Shifted and Rotated Weierstrass Function	10/30/50/100	600
	CEC2014-F7	Shifted and Rotated Griewank's Function	10/30/50/100	700
	CEC2014-F8	Shifted Rastrigin's Function	10/30/50/100	800
	CEC2014-F9	Shifted and Rotated Rastrigin's Function	10/30/50/100	900
	CEC2014-F10	Shifted Schwefel's Function	10/30/50/100	1000
	CEC2014-F11	Shifted Schwefel's Function	10/30/50/100	1100
	CEC2014-F12	Shifted and Rotated Katsuura Function	10/30/50/100	1200
	CEC2014-F13	Shifted and Rotated HappyCat Function	10/30/50/100	1300
	CEC2014-F14	Shifted and Rotated HappyCat Function	10/30/50/100	1400
	CEC2014-F15	Shifted and Rotated Expanded Griewank's plus Rosenbrock's Function	10/30/50/100	1500
	CEC2014-F16	Shifted and Rotated Expanded Scaffer's F6 Function	10/30/50/100	1600
Hybrid	CEC2014-F17	Hybrid Function 1 (N=3)	10/30/50/100	1700
	CEC2014-F18	Hybrid Function 2 (N=3)	10/30/50/100	1800
	CEC2014-F19	Hybrid Function 2 (N=3)	10/30/50/100	1900
	CEC2014-F20	Hybrid Function 4 (N=4)	10/30/50/100	2000
	CEC2014-F21	Hybrid Function 5 (N=5)	10/30/50/100	2100
	CEC2014-F22	Hybrid Function 5 (N=5)	10/30/50/100	2200
Composition	CEC2014-F23	Composition Function 1 (N=5)	10/30/50/100	2300
	CEC2014-F24	Composition Function 2 (N=3)	10/30/50/100	2400
	CEC2014-F25	Composition Function 3 (N=3)	10/30/50/100	2500
	CEC2014-F26	Composition Function 4 (N=5)	10/30/50/100	2600
	CEC2014-F27	Composition Function 5 (N=5)	10/30/50/100	2700
	CEC2014-F28	Composition Function 6 (N=5)	10/30/50/100	2800
	CEC2014-F29	Composition Function 7 (N=3)	10/30/50/100	2900
	CEC2014-F30	Composition Function 8 (N=3)	10/30/50/100	3000

Search Range: [-100,100]				

Table S2 Review the CEC 2017 test suite.

Type	ID	Description	Dim	f_{min}
Unimodal	CEC2017-F1	Shifted and Rotated Bent Cigar Function	10/30/50/100	100
	CEC2017-F3	Shifted and Rotated Zakharov Function	10/30/50/100	300
Multimodal	CEC2017-F4	Shifted and Rotated Rosenbrock's Function	10/30/50/100	400
	CEC2017-F5	Shifted and Rotated Rastrigin's Function	10/30/50/100	500
	CEC2017-F6	Shifted and Rotated Expanded Scaffer's F6 Function	10/30/50/100	600
	CEC2017-F7	Shifted and Rotated Lunacek Bi_Rastrigin Function	10/30/50/100	700
	CEC2017-F8	Shifted and Rotated Non-Continuous Rastrigin's Function	10/30/50/100	800
	CEC2017-F9	Shifted and Rotated Levy Function	10/30/50/100	900
	CEC2017-F10	Shifted and Rotated Schwefel's Function	10/30/50/100	1000
Hybrid	CEC2017-F11	Hybrid Function 1 (N=3)	10/30/50/100	1100
	CEC2017-F12	Hybrid Function 2 (N=3)	10/30/50/100	1200
	CEC2017-F13	Hybrid Function 3 (N=3)	10/30/50/100	1300
	CEC2017-F14	Hybrid Function 4 (N=4)	10/30/50/100	1400
	CEC2017-F15	Hybrid Function 5 (N=4)	10/30/50/100	1500
	CEC2017-F16	Hybrid Function 6 (N=4)	10/30/50/100	1600
	CEC2017-F17	Hybrid Function 6 (N=5)	10/30/50/100	1700
	CEC2017-F18	Hybrid Function 6 (N=5)	10/30/50/100	1800
	CEC2017-F19	Hybrid Function 6 (N=5)	10/30/50/100	1900
	CEC2017-F20	Hybrid Function 6 (N=6)	10/30/50/100	2000
Composition	CEC2017-F21	Composition Function 1 (N=5)	10/30/50/100	2100
	CEC2017-F22	Composition Function 2 (N=5)	10/30/50/100	2200
	CEC2017-F23	Composition Function 3 (N=5)	10/30/50/100	2300
	CEC2017-F24	Composition Function 4 (N=5)	10/30/50/100	2400
	CEC2017-F25	Composition Function 5 (N=3)	10/30/50/100	2500
	CEC2017-F26	Composition Function 6 (N=3)	10/30/50/100	2600
	CEC2017-F27	Composition Function 7 (N=5)	10/30/50/100	2700
	CEC2017-F28	Composition Function 8 (N=5)	10/30/50/100	2800
	CEC2017-F29	Composition Function 9 (N=5)	10/30/50/100	2900
	CEC2017-F30	Composition Function 10 (N=3)	10/30/50/100	3000
Search Range: [-100,100]				

Table S3 Results of ablation experiment in CEC2014 (Dim=10).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2014-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F2	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**

CEC2014-F4	Ave	3.2819E+01	3.1455E+01	3.2052E+01	3.2137E+01	3.4098E+01	**3.1370E+01**	**3.1370E+01**	**3.1370E+01**
	Std	7.9374E+00	1.0200E+01	9.4437E+00	9.1648E+00	**4.8702E+00**	1.0445E+01	1.0445E+01	1.0445E+01
CEC2014-F5	Ave	1.1591E+01	1.4182E+01	1.2325E+01	1.4406E+01	**1.0434E+01**	1.4426E+01	1.2121E+01	1.3455E+01
	Std	9.3901E+00	8.6662E+00	8.8786E+00	8.4516E+00	9.4881E+00	**8.3465E+00**	9.1822E+00	8.9099E+00
CEC2014-F6	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F7	Ave	1.8360E-03	2.0370E-03	1.4555E-03	1.0636E-03	2.3311E-03	**4.3508E-04**	1.2087E-03	1.4036E-03
	Std	4.1766E-03	7.0163E-03	4.6935E-03	2.7123E-03	4.9651E-03	**1.7576E-03**	3.1320E-03	3.0903E-03
CEC2014-F8	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F9	Ave	9.5663E-01	1.1910E+00	1.1715E+00	1.1324E+00	8.9820E-01	**6.0650E-01**	8.9883E-01	1.0545E+00
	Std	7.7009E-01	8.2142E-01	8.1350E-01	8.4544E-01	9.3929E-01	**6.6145E-01**	7.2526E-01	9.6331E-01
CEC2014-F10	Ave	7.3476E-03	8.5722E-03	8.5722E-03	**2.4492E-03**	1.3471E-02	6.1230E-03	1.1021E-02	7.3476E-03
	Std	2.3854E-02	2.5043E-02	2.1705E-02	**1.2244E-02**	2.8793E-02	1.8757E-02	2.4046E-02	2.0322E-02
CEC2014-F11	Ave	1.9295E+01	**1.1280E+01**	3.4050E+01	1.8751E+01	1.9207E+01	2.0051E+01	1.8597E+01	2.0002E+01
	Std	2.2621E+01	**7.3571E+00**	5.5614E+01	2.4137E+01	2.3918E+01	2.5847E+01	2.3777E+01	3.5359E+01
CEC2014-F12	Ave	**6.1921E-02**	7.4678E-02	6.7920E-02	7.6663E-02	7.3712E-02	7.2041E-02	7.6531E-02	7.2894E-02
	Std	1.9663E-02	1.9411E-02	**1.8333E-02**	2.2448E-02	2.2875E-02	1.9521E-02	2.0857E-02	2.0839E-02
CEC2014-F13	Ave	4.0022E-02	3.5209E-02	3.4994E-02	4.0297E-02	3.5151E-02	3.9031E-02	3.6926E-02	**3.3767E-02**
	Std	1.4813E-02	1.4886E-02	1.5645E-02	**1.3955E-02**	1.4242E-02	1.7304E-02	1.7005E-02	1.5950E-02
CEC2014-F14	Ave	9.0677E-02	7.6190E-02	**6.5216E-02**	9.4737E-02	7.2530E-02	1.0107E-01	9.5669E-02	9.6530E-02
	Std	3.6931E-02	3.2943E-02	2.8952E-02	3.8749E-02	**2.6808E-02**	3.6268E-02	3.5512E-02	5.8080E-02
CEC2014-F15	Ave	3.6238E-01	3.8231E-01	3.6476E-01	**3.3893E-01**	3.7820E-01	3.7446E-01	3.6184E-01	3.7691E-01
	Std	9.7455E-02	9.1872E-02	8.2030E-02	6.5653E-02	8.1622E-02	8.2366E-02	8.3356E-02	**6.3660E-02**
CEC2014-F16	Ave	6.2689E-01	5.0543E-01	6.9285E-01	6.6873E-01	5.0729E-01	**4.4165E-01**	5.7709E-01	5.4986E-01
	Std	4.5680E-01	4.2520E-01	4.5013E-01	4.3494E-01	4.2918E-01	**3.7995E-01**	4.2435E-01	3.9335E-01
CEC2014-F17	Ave	7.5553E+01	7.9540E+01	5.5108E+01	**3.0149E+01**	6.9026E+01	5.3731E+01	3.3353E+01	3.6185E+01
	Std	5.8635E+01	5.8561E+01	5.6830E+01	**4.0644E+01**	5.6063E+01	5.7674E+01	4.4948E+01	4.4155E+01
CEC2014-F18	Ave	1.6448E+00	1.9187E+00	8.9713E-01	5.6406E-01	1.5162E+00	1.4662E+00	**3.1462E-01**	5.6172E-01
	Std	1.4481E+00	1.6293E+00	1.0288E+00	6.4826E-01	1.0710E+00	1.2471E+00	**4.1458E-01**	5.5317E-01
CEC2014-F19	Ave	2.3098E-01	4.7959E-01	3.7633E-01	2.8776E-01	4.3675E-01	2.9900E-01	2.9378E-01	**2.1330E-01**
	Std	**3.6738E-01**	4.9580E-01	4.9250E-01	4.1908E-01	5.0201E-01	4.2692E-01	4.3781E-01	3.8010E-01
CEC2014-F20	Ave	**4.9683E-01**	6.2350E-01	6.2366E-01	5.4679E-01	5.6321E-01	5.1990E-01	5.3240E-01	5.7175E-01
	Std	1.8744E-01	3.0442E-01	**1.7620E-01**	1.9967E-01	2.8564E-01	2.0930E-01	2.0428E-01	1.9133E-01
CEC2014-F21	Ave	2.8687E+00	5.4998E-01	8.3055E-01	**4.8921E-01**	5.3638E-01	7.9242E-01	7.9094E-01	1.7190E+00
	Std	5.7407E+00	3.0555E-01	2.2921E+00	3.6135E-01	**3.0195E-01**	2.3053E+00	2.3040E+00	4.4995E+00
CEC2014-F22	Ave	1.2704E+00	1.6985E-01	5.7707E-01	8.7851E-02	4.7300E-01	5.0148E-01	7.5103E-02	**6.1013E-02**
	Std	4.7676E+00	5.1692E-01	2.8770E+00	**4.4215E-02**	2.8046E+00	2.8022E+00	6.3333E-02	4.4503E-02
CEC2014-F23	Ave	2.5838E+02	2.6854E+02	2.4823E+02	2.6600E+02	2.7361E+02	**2.2792E+02**	2.6600E+02	2.6092E+02
	Std	6.5058E+01	6.5260E+01	6.3213E+01	6.5360E+01	6.4754E+01	**5.3775E+01**	6.5360E+01	6.5260E+01
CEC2014-F24	Ave	1.0606E+02	1.0565E+02	1.0643E+02	1.0451E+02	1.0585E+02	**1.0405E+02**	1.0439E+02	1.0427E+02
	Std	2.3010E+00	2.9018E+00	**1.9302E+00**	3.2061E+00	2.9874E+00	3.2721E+00	3.3193E+00	3.2061E+00
CEC2014-F25	Ave	1.2795E+02	1.2286E+02	1.3067E+02	**1.2187E+02**	1.2994E+02	1.2623E+02	1.2728E+02	1.2539E+02
	Std	1.4738E+01	1.1220E+01	2.4828E+01	**9.9804E+00**	1.7438E+01	1.8941E+01	1.6578E+01	1.5168E+01
CEC2014-F26	Ave	1.0003E+02	1.0004E+02	**1.0003E+02**	1.0004E+02	1.0003E+02	1.0004E+02	1.0004E+02	1.0003E+02
	Std	1.6064E-02	1.6446E-02	**1.2933E-02**	1.8171E-02	1.6331E-02	1.6557E-02	1.7534E-02	1.6196E-02
CEC2014-F27	Ave	1.1583E+00	**1.0514E+00**	1.1723E+00	1.0520E+00	6.9815E+00	2.4553E+01	8.9265E+00	1.2800E+01

	Std	4.4217E-01	3.7958E-01	3.1660E-01	**2.9896E-01**	4.1855E+01	9.4829E+01	5.5876E+01	5.8602E+01
CEC2014-F28	Ave	**3.4010E+02**	3.5795E+02	3.6802E+02	3.4650E+02	3.6884E+02	3.5299E+02	3.5357E+02	3.8620E+02
	Std	7.1274E+01	**4.6674E+01**	4.9519E+01	6.5348E+01	5.0304E+01	7.8808E+01	6.6223E+01	7.2465E+01
CEC2014-F29	Ave	2.2285E+02	2.2216E+02	2.2209E+02	2.2226E+02	**2.2079E+02**	2.2208E+02	2.2206E+02	2.2130E+02
	Std	1.3012E+00	7.3606E-01	**4.6820E-01**	7.7599E-01	1.0954E+01	7.0933E-01	4.9692E-01	4.8847E+00
CEC2014-F30	Ave	4.7053E+02	4.7128E+02	4.6669E+02	4.7475E+02	4.6938E+02	**4.6660E+02**	4.7276E+02	4.7034E+02
	Std	1.8360E+01	1.8802E+01	**1.2043E+01**	2.1875E+01	1.9815E+01	1.2858E+01	2.0016E+01	1.8002E+01

Table S4 Results of ablation experiment in CEC2014 (Dim=30).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2014-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F2	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F4	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F5	Ave	**2.0120E+01**	2.0126E+01	2.0125E+01	2.0130E+01	2.0128E+01	2.0129E+01	2.0121E+01	2.0132E+01
	Std	2.5806E-02	3.2833E-02	2.9908E-02	**2.3591E-02**	2.6663E-02	2.7224E-02	3.3524E-02	4.2321E-02
CEC2014-F6	Ave	**0.0000E+00**	9.0055E-03	**0.0000E+00**	**0.0000E+00**	3.8417E-02	**0.0000E+00**	9.0055E-03	**0.0000E+00**
	Std	**0.0000E+00**	6.4312E-02	**0.0000E+00**	**0.0000E+00**	2.1843E-01	**0.0000E+00**	6.4312E-02	**0.0000E+00**
CEC2014-F7	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F8	Ave	**2.6750E-14**	6.0187E-14	3.1208E-14	4.4583E-14	4.9041E-14	2.8979E-14	5.5729E-14	3.7896E-14
	Std	6.2634E-14	7.3160E-14	**5.1240E-14**	6.8509E-14	9.1671E-14	5.4962E-14	7.9978E-14	8.7077E-14
CEC2014-F9	Ave	3.1214E+00	**3.0434E+00**	3.8433E+00	4.5656E+00	3.3751E+00	3.9018E+00	4.4895E+00	3.7652E+00
	Std	**1.6169E+00**	1.7955E+00	1.8985E+00	1.8261E+00	1.6298E+00	2.1602E+00	1.7582E+00	1.9930E+00
CEC2014-F10	Ave	7.3480E-03	1.1430E-02	8.1644E-03	**6.1233E-03**	1.8080E-02	1.5512E-02	7.3480E-03	1.3879E-02
	Std	1.3699E-02	1.6294E-02	1.2546E-02	1.3993E-02	2.0441E-02	1.6042E-02	**1.1647E-02**	1.4819E-02
CEC2014-F11	Ave	1.1929E+03	1.0869E+03	1.0991E+03	1.1253E+03	1.1435E+03	1.1802E+03	**1.0812E+03**	1.0977E+03
	Std	**1.8465E+02**	2.0758E+02	2.2859E+02	2.1033E+02	2.5178E+02	2.1433E+02	1.8916E+02	2.1476E+02
CEC2014-F12	Ave	1.6509E-01	1.6197E-01	1.6298E-01	**1.6063E-01**	1.6877E-01	1.7121E-01	1.6592E-01	1.6446E-01
	Std	**2.3027E-02**	2.8745E-02	3.0242E-02	2.6233E-02	3.2072E-02	2.4916E-02	2.8713E-02	3.0447E-02
CEC2014-F13	Ave	**1.0559E-01**	1.1963E-01	1.1805E-01	1.2790E-01	1.1778E-01	1.1827E-01	1.2379E-01	1.1991E-01
	Std	**2.0083E-02**	3.0416E-02	2.8494E-02	2.2792E-02	2.7853E-02	2.3780E-02	2.3121E-02	2.4957E-02
CEC2014-F14	Ave	1.9299E-01	**1.5073E-01**	1.6393E-01	1.9581E-01	1.5385E-01	1.9993E-01	1.9185E-01	1.8926E-01
	Std	2.5924E-02	**1.8935E-02**	2.8968E-02	2.4332E-02	2.3166E-02	2.2592E-02	3.0606E-02	2.8328E-02
CEC2014-F15	Ave	**2.0404E+00**	2.2446E+00	2.1974E+00	2.1738E+00	2.2364E+00	2.2811E+00	2.2099E+00	2.1236E+00
	Std	**3.1500E-01**	4.3495E-01	4.6333E-01	4.0809E-01	4.3811E-01	4.8403E-01	4.9925E-01	3.5679E-01
CEC2014-F16	Ave	8.2568E+00	7.1400E+00	8.1163E+00	8.3852E+00	**7.1361E+00**	7.5037E+00	8.4792E+00	7.8538E+00
	Std	6.6315E-01	7.2651E-01	6.2836E-01	**5.3164E-01**	7.1749E-01	6.3764E-01	6.2873E-01	6.2392E-01
CEC2014-F17	Ave	2.8809E+02	1.8054E+02	1.7637E+02	1.5618E+02	**1.5423E+02**	1.7955E+02	1.9291E+02	1.6897E+02
	Std	2.1286E+02	1.3851E+02	1.3921E+02	**1.0694E+02**	1.1528E+02	1.3121E+02	1.1149E+02	1.2975E+02
CEC2014-F18	Ave	1.0403E+01	**3.3225E+00**	3.3860E+00	3.5514E+00	3.8867E+00	3.6397E+00	4.1200E+00	3.6915E+00

	Std	4.3399E+00	**1.4270E+00**	2.0290E+00	1.5199E+00	1.7784E+00	1.6059E+00	1.6142E+00	1.7750E+00
CEC2014-F19	Ave	2.5816E+00	2.3762E+00	2.2730E+00	2.1760E+00	2.5031E+00	2.3723E+00	2.1476E+00	**2.0273E+00**
	Std	6.7381E-01	7.1588E-01	7.0250E-01	**6.4383E-01**	7.6138E-01	6.6149E-01	6.9890E-01	6.4444E-01
CEC2014-F20	Ave	2.8072E+00	**2.1129E+00**	2.3304E+00	2.5279E+00	2.4618E+00	2.6721E+00	2.2350E+00	2.5584E+00
	Std	1.3581E+00	**9.7608E-01**	1.1048E+00	1.1040E+00	1.0259E+00	1.2064E+00	9.8687E-01	1.2072E+00
CEC2014-F21	Ave	1.3657E+02	6.0260E+01	**4.2615E+01**	6.4554E+01	6.1588E+01	7.0360E+01	5.6890E+01	6.2290E+01
	Std	8.5750E+01	6.4851E+01	**5.9426E+01**	8.3191E+01	7.4078E+01	7.8493E+01	6.4233E+01	8.2941E+01
CEC2014-F22	Ave	6.4224E+01	4.1845E+01	4.2386E+01	**2.7837E+01**	3.5067E+01	4.0031E+01	3.4564E+01	3.2185E+01
	Std	5.3034E+01	4.1003E+01	4.1479E+01	**2.3232E+01**	3.3484E+01	4.1066E+01	3.2301E+01	3.2525E+01
CEC2014-F23	Ave	3.1298E+02	3.1524E+02	3.1524E+02	3.1524E+02	3.1524E+02	3.1524E+02	**3.1298E+02**	3.1524E+02
	Std	1.6137E+01	**6.4311E-14**	1.1139E-13	1.1226E-13	9.0949E-14	1.2862E-13	1.6137E+01	1.8524E-13
CEC2014-F24	Ave	2.0682E+02	2.0000E+02	2.0041E+02	2.0211E+02	**2.0000E+02**	2.0000E+02	2.0213E+02	2.0000E+02
	Std	1.0192E+01	1.2347E-07	2.9608E+00	6.4532E+00	1.0517E-07	**8.1325E-08**	6.5272E+00	1.0608E-07
CEC2014-F25	Ave	2.0257E+02	2.0233E+02	2.0258E+02	2.0257E+02	2.0258E+02	**2.0223E+02**	2.0258E+02	2.0252E+02
	Std	3.4802E-02	7.7531E-01	3.9060E-02	**3.2019E-02**	3.8262E-02	8.9896E-01	4.0719E-02	3.6079E-01
CEC2014-F26	Ave	1.0009E+02	1.0009E+02	**1.0009E+02**	1.0010E+02	1.0009E+02	1.0010E+02	1.0010E+02	1.0010E+02
	Std	1.9420E-02	2.1913E-02	2.5316E-02	2.1677E-02	**1.7362E-02**	1.7800E-02	2.7128E-02	2.6600E-02
CEC2014-F27	Ave	3.0197E+02	3.0981E+02	3.0589E+02	3.1179E+02	**3.0196E+02**	3.0664E+02	3.0392E+02	**3.0196E+02**
	Std	1.4061E+01	3.0057E+01	2.3797E+01	3.2607E+01	1.4003E+01	2.4249E+01	1.9604E+01	**1.4003E+01**
CEC2014-F28	Ave	8.4454E+02	8.2837E+02	8.2699E+02	8.2127E+02	8.3044E+02	8.2029E+02	8.2334E+02	**8.1992E+02**
	Std	1.8015E+01	1.8868E+01	**1.6576E+01**	1.7008E+01	1.7351E+01	1.9843E+01	1.7819E+01	1.8652E+01
CEC2014-F29	Ave	7.1975E+02	7.1593E+02	7.1569E+02	7.1664E+02	7.1652E+02	7.1666E+02	**7.1281E+02**	7.1616E+02
	Std	6.4839E+00	2.3663E+00	**1.6463E+00**	4.3142E+00	3.7428E+00	3.4708E+00	3.3443E+01	2.7107E+00
CEC2014-F30	Ave	1.3949E+03	1.2290E+03	1.2621E+03	5.6762E+02	1.3388E+03	5.4653E+02	**5.2864E+02**	6.4975E+02
	Std	6.0754E+02	4.3060E+02	5.0300E+02	2.0060E+02	6.2111E+02	1.4806E+02	**1.0493E+02**	2.2365E+02

Table S5 Results of ablation experiment in CEC2014 (Dim=50).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2014-F1	Ave	1.5325E-14	4.1797E-15	5.2942E-15	**3.9010E-15**	5.0156E-15	6.9661E-15	8.6380E-15	8.3593E-15
	Std	1.3283E-14	6.5395E-15	6.9391E-15	**6.4049E-15**	6.8587E-15	7.7172E-15	8.0782E-15	9.9177E-15
CEC2014-F2	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F4	Ave	5.3872E+01	6.3484E+01	5.1937E+01	**2.1165E+01**	6.7337E+01	4.6166E+01	3.6548E+01	4.8090E+01
	Std	4.9312E+01	4.7353E+01	4.9454E+01	**4.0762E+01**	4.5981E+01	4.9454E+01	4.7903E+01	4.9530E+01
CEC2014-F5	Ave	2.0260E+01	2.0260E+01	2.0261E+01	2.0243E+01	2.0249E+01	2.0248E+01	2.0243E+01	**2.0241E+01**
	Std	2.8963E-02	**2.8933E-02**	5.2281E-02	7.0621E-02	5.8317E-02	6.0843E-02	6.4174E-02	7.5061E-02
CEC2014-F6	Ave	**0.0000E+00**	**0.0000E+00**	3.5054E-02	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.4704E-02	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	1.4410E-01	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.0501E-01	**0.0000E+00**
CEC2014-F7	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F8	Ave	7.1021E-12	6.3598E-12	2.0283E-11	6.3798E-12	1.0577E-11	**2.5390E-12**	6.6964E-12	9.6433E-12
	Std	8.4416E-12	1.5261E-11	4.2191E-11	1.2093E-11	1.7569E-11	**3.4100E-12**	8.9119E-12	2.0521E-11
CEC2014-F9	Ave	5.0333E+00	4.9943E+00	**4.7602E+00**	6.5355E+00	5.8332E+00	6.6331E+00	7.2769E+00	5.4040E+00

	Std	2.1378E+00	2.0631E+00	1.8163E+00	2.0512E+00	2.2339E+00	2.3685E+00	2.2203E+00	**1.8157E+00**
CEC2014-F10	Ave	1.1545E-01	1.5355E-01	1.3337E-01	**8.7179E-02**	1.6297E-01	1.3619E-01	9.9526E-02	1.2625E-01
	Std	**2.9626E-02**	3.8917E-02	3.7021E-02	3.2853E-02	3.6626E-02	3.5587E-02	3.1351E-02	3.9503E-02
CEC2014-F11	Ave	**3.1187E+03**	3.3860E+03	3.3157E+03	3.1781E+03	3.1571E+03	3.2576E+03	3.3274E+03	3.2256E+03
	Std	3.7918E+02	4.1155E+02	5.8520E+02	4.3298E+02	4.6170E+02	**3.0520E+02**	5.3564E+02	4.5676E+02
CEC2014-F12	Ave	2.1841E-01	2.1584E-01	2.2112E-01	2.1985E-01	2.2320E-01	2.2130E-01	**2.1464E-01**	2.1691E-01
	Std	2.5148E-02	**2.1496E-02**	2.2775E-02	3.0934E-02	3.0304E-02	2.5974E-02	3.2080E-02	3.2399E-02
CEC2014-F13	Ave	**1.9027E-01**	2.2930E-01	2.3243E-01	2.3941E-01	2.2742E-01	2.3883E-01	2.4328E-01	2.3487E-01
	Std	**2.0420E-02**	2.6586E-02	3.4581E-02	2.3060E-02	2.9517E-02	2.7058E-02	2.6971E-02	2.4690E-02
CEC2014-F14	Ave	1.8802E-01	1.5714E-01	**1.5335E-01**	1.8586E-01	1.5964E-01	1.8790E-01	1.9216E-01	1.8252E-01
	Std	2.5941E-02	2.1772E-02	2.0896E-02	**1.7329E-02**	3.9274E-02	1.9957E-02	2.0039E-02	2.0311E-02
CEC2014-F15	Ave	**4.6753E+00**	5.0546E+00	4.9693E+00	5.2547E+00	5.1049E+00	5.2451E+00	5.3531E+00	4.9723E+00
	Std	5.4501E-01	5.3401E-01	**5.2660E-01**	8.1968E-01	6.9804E-01	7.2377E-01	8.1397E-01	8.0900E-01
CEC2014-F16	Ave	1.6345E+01	1.5824E+01	1.6182E+01	1.6324E+01	**1.5711E+01**	1.6255E+01	1.6497E+01	1.6090E+01
	Std	5.1043E-01	6.5080E-01	5.0029E-01	5.6646E-01	5.3592E-01	6.2931E-01	**4.2204E-01**	6.1100E-01
CEC2014-F17	Ave	6.6760E+02	5.1128E+02	5.7221E+02	**4.3209E+02**	5.2049E+02	5.1512E+02	5.2098E+02	5.1084E+02
	Std	3.2731E+02	2.3520E+02	3.3486E+02	**2.2214E+02**	2.9870E+02	2.6897E+02	3.0440E+02	3.2257E+02
CEC2014-F18	Ave	2.8378E+01	**7.5538E+00**	8.5501E+00	9.5378E+00	8.8378E+00	9.2294E+00	1.0041E+01	8.6198E+00
	Std	9.3532E+00	**2.3653E+00**	2.8271E+00	3.0592E+00	3.0269E+00	2.4340E+00	3.1549E+00	3.0776E+00
CEC2014-F19	Ave	5.6609E+00	5.3440E+00	5.3062E+00	5.2221E+00	4.8789E+00	5.0521E+00	**4.8268E+00**	5.2691E+00
	Std	9.6363E-01	1.6534E+00	1.8089E+00	1.4525E+00	1.5072E+00	1.4498E+00	**7.0066E-01**	1.6544E+00
CEC2014-F20	Ave	7.2367E+00	**4.3077E+00**	4.8640E+00	4.7338E+00	4.5098E+00	5.4032E+00	5.2873E+00	5.0659E+00
	Std	2.2256E+00	1.5458E+00	1.7135E+00	1.7036E+00	**1.4491E+00**	1.8394E+00	1.5866E+00	1.9024E+00
CEC2014-F21	Ave	5.1420E+02	4.6168E+02	4.6981E+02	4.2381E+02	4.7700E+02	4.0683E+02	4.2744E+02	**3.8222E+02**
	Std	1.9345E+02	1.9998E+02	2.2796E+02	**1.6023E+02**	1.8825E+02	1.7950E+02	1.7938E+02	1.6870E+02
CEC2014-F22	Ave	1.2529E+02	1.0884E+02	1.3180E+02	1.3661E+02	1.4974E+02	1.2843E+02	1.3220E+02	**1.0655E+02**
	Std	9.0200E+01	**6.3542E+01**	1.0173E+02	6.7916E+01	8.8268E+01	6.6131E+01	8.8737E+01	8.4828E+01
CEC2014-F23	Ave	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**	**3.4400E+02**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F24	Ave	2.6832E+02	**2.6346E+02**	2.6654E+02	2.6717E+02	2.6480E+02	2.6461E+02	2.6722E+02	2.6507E+02
	Std	1.7222E+00	4.5071E+00	1.7337E+00	**1.0811E+00**	3.5634E+00	9.7907E+00	1.2328E+00	9.4540E+00
CEC2014-F25	Ave	2.0494E+02	**2.0428E+02**	2.0497E+02	2.0499E+02	2.0456E+02	2.0465E+02	2.0498E+02	2.0493E+02
	Std	1.5182E-01	1.7307E+00	**1.5097E-01**	1.6374E-01	1.3520E+00	1.1794E+00	1.8041E-01	1.6922E-01
CEC2014-F26	Ave	**1.0018E+02**	1.0413E+02	1.0022E+02	1.0022E+02	1.0217E+02	1.0413E+02	1.0022E+02	1.0021E+02
	Std	2.6921E-02	1.9562E+01	2.9150E-02	2.4873E-02	1.3972E+01	1.9561E+01	**2.0449E-02**	2.6176E-02
CEC2014-F27	Ave	3.1553E+02	3.1787E+02	3.1490E+02	**3.0065E+02**	3.1129E+02	3.1584E+02	3.0154E+02	3.0631E+02
	Std	2.2318E+01	2.1064E+01	1.9912E+01	**4.6758E+00**	1.8763E+01	2.1833E+01	7.8789E+00	1.4961E+01
CEC2014-F28	Ave	1.1602E+03	1.1188E+03	1.1141E+03	1.1022E+03	1.1238E+03	**1.0859E+03**	1.0906E+03	1.0963E+03
	Std	3.1322E+01	2.9005E+01	3.0259E+01	2.9450E+01	3.4753E+01	**2.3250E+01**	3.1037E+01	2.6794E+01
CEC2014-F29	Ave	**8.0374E+02**	8.0618E+02	8.0852E+02	8.0451E+02	8.0785E+02	8.1264E+02	8.0629E+02	8.1529E+02
	Std	**3.2566E+01**	4.2174E+01	4.3601E+01	4.6126E+01	4.3902E+01	5.1210E+01	4.5566E+01	4.8637E+01
CEC2014-F30	Ave	8.5050E+03	8.4273E+03	**8.4219E+03**	8.4960E+03	8.4670E+03	8.4240E+03	8.5701E+03	8.5188E+03
	Std	3.2775E+02	3.8763E+02	**3.2728E+02**	6.1120E+02	4.2559E+02	5.4285E+02	6.2743E+02	4.0572E+02

Table S6 Results of ablation experiment in CEC2014 (Dim=100).

ID	Metric	LSHADE	mLSHADE	mLSHADE	mLSHADE	mLSHADE	mLSHADE	mLSHADE	mLSHADE

		-SPACMA	-SPACMA1	-SPACMA2	-SPACMA3	-SPACMA12	-SPACMA13	-SPACMA23	-SPACMA
CEC2014-F1	Ave	5.4739E+03	**3.5489E-03**	1.2777E-02	2.0202E+01	9.9758E-03	6.5968E+00	1.0558E+02	1.1921E+04
	Std	4.7139E+03	**8.5958E-03**	5.5692E-02	1.0076E+02	3.1739E-02	3.8376E+01	4.2841E+02	1.0503E+04
CEC2014-F2	Ave	**2.2292E-15**	1.7276E-14	1.3932E-14	1.1703E-14	1.6719E-14	9.4739E-15	1.2260E-14	1.1536E-13
	Std	**7.7172E-15**	1.4014E-14	1.4350E-14	1.4127E-14	1.4127E-14	1.3531E-14	1.4216E-14	2.6303E-14
CEC2014-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F4	Ave	1.8158E+02	1.8892E+02	1.8522E+02	1.5776E+02	1.8713E+02	1.6145E+02	**1.4929E+02**	1.5188E+02
	Std	3.2433E+01	2.7099E+01	2.9543E+01	2.4128E+01	2.8325E+01	2.6473E+01	**1.6347E+01**	1.9162E+01
CEC2014-F5	Ave	2.0548E+01	2.0559E+01	2.0560E+01	2.0529E+01	2.0512E+01	2.0557E+01	2.0515E+01	**2.0468E+01**
	Std	**3.5021E-02**	4.4175E-02	5.5628E-02	1.0731E-01	1.5157E-01	5.2501E-02	1.3022E-01	1.9656E-01
CEC2014-F6	Ave	**1.9292E-01**	3.6337E-01	4.0028E-01	5.2373E-01	5.8228E-01	5.8990E-01	8.3238E-01	4.6325E-01
	Std	**4.6284E-01**	7.2453E-01	6.7971E-01	7.5662E-01	8.2482E-01	7.7415E-01	9.4197E-01	7.0276E-01
CEC2014-F7	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F8	Ave	4.6822E+00	**1.6388E+00**	4.3700E+00	1.6036E+01	2.0484E+00	4.0189E+00	1.7636E+01	4.8187E+00
	Std	1.7831E+00	**1.2075E+00**	1.7357E+00	2.9154E+00	1.7050E+00	1.8979E+00	3.3539E+00	1.9636E+00
CEC2014-F9	Ave	1.0086E+01	**8.9936E+00**	9.5984E+00	1.6739E+01	1.0145E+01	1.3793E+01	1.8124E+01	1.1315E+01
	Std	**2.2864E+00**	2.7498E+00	2.9637E+00	2.5148E+00	3.5094E+00	3.4121E+00	3.6384E+00	3.0567E+00
CEC2014-F10	Ave	1.6904E+01	2.1033E+01	2.0186E+01	**1.4146E+01**	2.4383E+01	1.6227E+01	1.5933E+01	1.7415E+01
	Std	3.7026E+00	4.5927E+00	5.2124E+00	**3.0784E+00**	6.1865E+00	3.4275E+00	3.6202E+00	3.6582E+00
CEC2014-F11	Ave	8.3007E+03	8.2681E+03	8.2476E+03	8.3736E+03	8.2017E+03	8.3107E+03	8.4289E+03	**8.0833E+03**
	Std	**7.4019E+02**	7.9626E+02	9.0793E+02	8.0946E+02	7.8129E+02	8.7053E+02	8.6737E+02	8.3191E+02
CEC2014-F12	Ave	4.1918E-01	4.3316E-01	4.2680E-01	4.2656E-01	4.3280E-01	4.1958E-01	**4.0953E-01**	4.1977E-01
	Std	3.7834E-02	4.0163E-02	**3.7657E-02**	4.5448E-02	4.5525E-02	3.9071E-02	4.3373E-02	3.9351E-02
CEC2014-F13	Ave	**3.2320E-01**	3.8762E-01	3.8966E-01	3.9511E-01	3.8813E-01	3.9372E-01	3.9675E-01	3.8498E-01
	Std	**2.0224E-02**	3.2151E-02	3.0604E-02	2.2324E-02	3.0448E-02	2.4793E-02	2.6363E-02	2.8407E-02
CEC2014-F14	Ave	2.2804E-01	1.9813E-01	1.9907E-01	2.1435E-01	**1.9355E-01**	2.1536E-01	2.1556E-01	2.0973E-01
	Std	1.6413E-02	1.3901E-02	**1.1658E-02**	1.4579E-02	1.3913E-02	1.7029E-02	1.6122E-02	1.7334E-02
CEC2014-F15	Ave	1.5346E+01	1.4809E+01	1.4070E+01	1.4301E+01	1.4716E+01	1.4604E+01	**1.3545E+01**	1.4770E+01
	Std	**1.0569E+00**	1.7648E+00	1.8809E+00	2.0510E+00	1.8021E+00	2.1227E+00	1.9575E+00	2.2295E+00
CEC2014-F16	Ave	3.8978E+01	3.8897E+01	3.8990E+01	3.9148E+01	3.8849E+01	3.9041E+01	3.9220E+01	**3.8606E+01**
	Std	5.9040E-01	6.7964E-01	**4.5683E-01**	5.9205E-01	6.4143E-01	6.2028E-01	6.0438E-01	6.7992E-01
CEC2014-F17	Ave	2.8991E+03	3.4005E+03	3.3309E+03	2.8848E+03	3.3147E+03	2.8720E+03	2.8702E+03	**2.5438E+03**
	Std	5.6127E+02	7.3676E+02	6.8826E+02	5.5661E+02	5.6485E+02	5.8890E+02	**5.2750E+02**	6.3111E+02
CEC2014-F18	Ave	1.5906E+02	1.8265E+02	1.9710E+02	9.3413E+01	1.9879E+02	9.0401E+01	9.5960E+01	**6.3239E+01**
	Std	2.3689E+01	3.5912E+01	3.0541E+01	2.2755E+01	2.4958E+01	2.4427E+01	2.2279E+01	**1.6130E+01**
CEC2014-F19	Ave	9.0247E+01	9.0544E+01	9.0598E+01	8.9994E+01	9.0490E+01	8.9782E+01	8.9728E+01	**8.8968E+01**
	Std	1.0377E+00	**8.5674E-01**	1.0396E+00	9.7051E-01	1.0495E+00	1.0352E+00	1.0897E+00	9.2514E-01
CEC2014-F20	Ave	3.1859E+01	3.6999E+01	3.8133E+01	2.9009E+01	3.7522E+01	2.9256E+01	2.9368E+01	**2.2724E+01**
	Std	7.9145E+00	1.0025E+01	1.2952E+01	6.7899E+00	1.0930E+01	6.7887E+00	6.8361E+00	**5.6756E+00**
CEC2014-F21	Ave	1.2432E+03	1.3746E+03	1.4339E+03	1.1717E+03	1.3955E+03	1.1607E+03	1.2001E+03	**1.0930E+03**
	Std	4.7187E+02	5.4279E+02	4.5475E+02	4.0957E+02	4.4005E+02	3.7323E+02	4.4822E+02	**3.6688E+02**
CEC2014-F22	Ave	1.0042E+03	**9.5503E+02**	1.0141E+03	1.0405E+03	9.7291E+02	1.0217E+03	9.8265E+02	9.5631E+02
	Std	2.3833E+02	2.8390E+02	**1.8064E+02**	2.3167E+02	2.5900E+02	2.5654E+02	2.5835E+02	2.7022E+02
CEC2014-F23	Ave	**3.4823E+02**	**3.4823E+02**	**3.4823E+02**	3.4823E+02	3.4823E+02	**3.4823E+02**	**3.4823E+02**	**3.4823E+02**
	Std	**5.7409E-14**	1.1677E-13	1.1677E-13	1.4801E-13	1.1226E-13	1.1677E-13	1.5484E-13	1.3713E-13

CEC2014-F24	Ave	3.7489E+02	3.6940E+02	3.7039E+02	3.6921E+02	**3.6235E+02**	3.6474E+02	3.6984E+02	3.6769E+02
	Std	3.5546E+00	1.6207E+00	**1.5770E+00**	2.0188E+00	3.3156E+01	2.3579E+01	2.7428E+00	1.7374E+00
CEC2014-F25	Ave	2.1555E+02	2.1194E+02	2.1569E+02	2.1678E+02	2.1258E+02	**2.1035E+02**	2.1680E+02	2.1601E+02
	Std	6.7339E-01	6.7197E+00	**5.6025E-01**	8.7972E-01	6.3213E+00	8.0988E+00	1.1600E+00	8.2719E-01
CEC2014-F26	Ave	2.0000E+02	2.0000E+02	2.0000E+02	2.0000E+02	2.0000E+02	**2.0000E+02**	2.0000E+02	2.0000E+02
	Std	2.4153E-13	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.6747E-13	6.6655E-14	**0.0000E+00**	**0.0000E+00**
CEC2014-F27	Ave	**3.0152E+02**	3.0570E+02	3.0454E+02	3.0643E+02	3.0639E+02	3.0619E+02	3.0835E+02	3.0392E+02
	Std	4.6973E+00	2.9719E+00	4.7111E+00	3.5239E+00	3.5554E+00	**1.7653E+00**	5.3076E+00	3.9925E+00
CEC2014-F28	Ave	2.2945E+03	2.1890E+03	2.2062E+03	2.1053E+03	2.1993E+03	2.1071E+03	**2.0951E+03**	2.1013E+03
	Std	7.4070E+01	5.3597E+01	6.7761E+01	6.4364E+01	7.8612E+01	6.5669E+01	**5.1324E+01**	6.9393E+01
CEC2014-F29	Ave	7.2342E+02	**7.1952E+02**	7.2526E+02	7.2846E+02	7.3255E+02	7.2925E+02	7.3527E+02	7.2216E+02
	Std	**2.1242E+01**	2.5481E+01	2.7282E+01	3.1523E+01	3.0734E+01	3.1726E+01	2.9888E+01	2.8465E+01
CEC2014-F30	Ave	8.1814E+03	6.3790E+03	6.6623E+03	**3.4473E+03**	6.6832E+03	3.6227E+03	3.6252E+03	3.8798E+03
	Std	7.7314E+02	1.1263E+03	1.2189E+03	**7.4100E+02**	1.0535E+03	7.8016E+02	9.2992E+02	7.6751E+02

Table S7 Results of ablation experiment in CEC2017 (Dim=10).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2017-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F4	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F5	Ave	1.6212E+00	1.7396E+00	1.9536E+00	**1.4850E+00**	2.0106E+00	1.7768E+00	1.6792E+00	1.6609E+00
	Std	8.2031E-01	8.1812E-01	**7.1625E-01**	8.7589E-01	7.8338E-01	7.7891E-01	7.8380E-01	7.8752E-01
CEC2017-F6	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F7	Ave	1.0877E+01	1.0868E+01	**1.0855E+01**	1.0951E+01	1.0898E+01	1.0934E+01	1.0880E+01	1.1051E+01
	Std	3.0105E-01	3.2767E-01	3.3113E-01	3.7122E-01	3.0663E-01	**2.9834E-01**	3.4291E-01	3.5443E-01
CEC2017-F8	Ave	9.9588E-01	1.0158E+00	9.7727E-01	1.1135E+00	9.9621E-01	**8.6038E-01**	9.3800E-01	8.8060E-01
	Std	8.9055E-01	9.0116E-01	8.3292E-01	7.3516E-01	8.2092E-01	**6.9089E-01**	7.5553E-01	7.6242E-01
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	2.7819E+01	9.8166E+00	2.1376E+01	1.9877E+01	**9.1674E+00**	1.8965E+01	3.2067E+01	1.6675E+01
	Std	4.8797E+01	**1.7738E+01**	3.8886E+01	3.7941E+01	1.7752E+01	3.5800E+01	4.7884E+01	3.8346E+01
CEC2017-F11	Ave	**0.0000E+00**	1.9509E-02	**0.0000E+00**	**0.0000E+00**	3.9018E-02	**0.0000E+00**	1.9509E-02	1.9509E-02
	Std	**0.0000E+00**	1.3932E-01	**0.0000E+00**	**0.0000E+00**	1.9505E-01	**0.0000E+00**	1.3932E-01	1.3932E-01
CEC2017-F12	Ave	1.0987E+02	7.4914E+01	8.6656E+01	**6.3512E+01**	6.7171E+01	7.0747E+01	6.5655E+01	6.6383E+01
	Std	7.9864E+01	7.6173E+01	8.3514E+01	6.6852E+01	6.5551E+01	6.8034E+01	6.6399E+01	**6.4962E+01**
CEC2017-F13	Ave	**3.2475E+00**	3.9847E+00	4.4630E+00	3.8306E+00	4.5691E+00	4.1525E+00	3.4443E+00	3.5135E+00
	Std	2.5967E+00	2.7640E+00	2.3376E+00	2.3989E+00	2.4240E+00	**2.2335E+00**	2.8566E+00	2.5544E+00
CEC2017-F14	Ave	1.5241E-01	8.7536E-01	5.9346E-01	**1.1705E-01**	5.2872E-01	1.7570E-01	1.9509E-01	8.6245E-01
	Std	3.5737E-01	3.9199E+00	2.8084E+00	**3.2376E-01**	2.8024E+00	3.8302E-01	3.9896E-01	3.9197E+00
CEC2017-F15	Ave	3.2196E-01	4.1089E-01	3.9460E-01	3.2405E-01	4.3872E-01	4.0413E-01	3.4007E-01	**2.9983E-01**
	Std	2.0928E-01	4.2389E-01	2.9114E-01	**1.9651E-01**	2.8245E-01	2.8504E-01	2.1194E-01	2.0515E-01

CEC2017-F16	Ave	7.4149E-01	6.8625E-01	7.6138E-01	7.3587E-01	7.2913E-01	7.4857E-01	6.6228E-01	**6.4450E-01**
	Std	3.3610E-01	2.6208E-01	2.9848E-01	3.6293E-01	3.3447E-01	2.5650E-01	2.5011E-01	**2.3641E-01**
CEC2017-F17	Ave	1.3886E-01	5.0149E-01	**1.1145E-01**	1.1580E-01	5.1997E-01	1.3662E-01	1.4328E-01	1.3859E-01
	Std	1.4694E-01	2.7962E+00	**1.2779E-01**	1.2989E-01	2.9307E+00	1.5338E-01	2.0385E-01	1.8676E-01
CEC2017-F18	Ave	4.3149E+00	1.9172E+00	1.5915E+00	2.3362E+00	3.1167E+00	2.7210E+00	**1.5687E+00**	1.9101E+00
	Std	8.0705E+00	5.4509E+00	**4.7611E+00**	5.9834E+00	6.9932E+00	6.5180E+00	4.7810E+00	5.4589E+00
CEC2017-F19	Ave	2.9913E-01	2.1655E-01	1.5478E-01	5.9809E-02	1.4859E-01	1.0451E-01	9.4864E-02	**4.0570E-02**
	Std	4.2086E-01	3.4306E-01	2.8457E-01	4.9569E-02	2.7403E-01	1.9164E-01	1.9116E-01	**4.7223E-02**
CEC2017-F20	Ave	3.0720E-01	3.1217E-01	3.1217E-01	2.9993E-01	3.1332E-01	2.9381E-01	**2.6933E-01**	3.2442E-01
	Std	2.5176E-01	1.0814E-01	1.0814E-01	**1.0743E-01**	1.9323E-01	1.3114E-01	1.3988E-01	1.2426E-01
CEC2017-F21	Ave	1.0421E+02	1.0284E+02	1.0199E+02	1.0895E+02	1.0329E+02	1.0093E+02	**1.0062E+02**	1.0287E+02
	Std	1.4965E+01	1.4793E+01	5.3324E+00	2.7816E+01	1.4618E+01	3.7986E+00	**2.5578E+00**	1.4617E+01
CEC2017-F22	Ave	1.0003E+02	1.0007E+02	1.0007E+02	1.0003E+02	1.0008E+02	1.0003E+02	**1.0003E+02**	1.0004E+02
	Std	1.0470E-01	1.3196E-01	1.2929E-01	1.0161E-01	1.3907E-01	9.7808E-02	**9.0080E-02**	1.1253E-01
CEC2017-F23	Ave	3.0241E+02	3.0300E+02	3.0286E+02	3.0155E+02	3.0294E+02	3.0239E+02	3.0257E+02	**2.9642E+02**
	Std	1.5072E+00	**1.3026E+00**	1.6641E+00	1.4698E+00	1.6276E+00	1.6231E+00	1.4086E+00	4.0825E+01
CEC2017-F24	Ave	2.9833E+02	3.0659E+02	2.9510E+02	**2.7116E+02**	2.9540E+02	3.0713E+02	2.9584E+02	3.1198E+02
	Std	7.5674E+01	6.6556E+01	8.3349E+01	9.6811E+01	8.2671E+01	7.1271E+01	7.7689E+01	**6.2347E+01**
CEC2017-F25	Ave	4.2574E+02	4.1583E+02	4.1860E+02	4.2478E+02	**4.1327E+02**	4.2736E+02	4.2199E+02	4.2033E+02
	Std	2.2455E+01	2.2536E+01	2.2971E+01	2.2736E+01	**2.1809E+01**	2.1982E+01	2.2895E+01	2.3099E+01
CEC2017-F26	Ave	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**	**3.0000E+02**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F27	Ave	3.8945E+02	**3.8945E+02**	3.8951E+02	3.8989E+02	3.8947E+02	3.9010E+02	3.9080E+02	3.9051E+02
	Std	1.8149E-01	2.7121E-01	**7.1759E-02**	1.2541E+00	1.5391E-01	1.7390E+00	2.2351E+00	2.0683E+00
CEC2017-F28	Ave	3.2446E+02	3.2899E+02	**3.0227E+02**	3.0232E+02	3.2131E+02	3.3229E+02	3.1357E+02	3.3785E+02
	Std	8.4667E+01	8.6353E+01	**1.6205E+01**	1.6600E+01	6.7065E+01	9.2699E+01	5.9611E+01	9.9022E+01
CEC2017-F29	Ave	**2.3133E+02**	2.3202E+02	2.3197E+02	2.3243E+02	2.3183E+02	2.3151E+02	2.3279E+02	2.3141E+02
	Std	2.7273E+00	3.0052E+00	3.2931E+00	3.8968E+00	2.8074E+00	**2.5956E+00**	4.5045E+00	3.3890E+00
CEC2017-F30	Ave	5.6960E+04	1.6451E+04	3.2467E+04	4.8474E+04	4.3101E+02	**4.0934E+02**	4.1197E+02	3.2462E+04
	Std	2.3370E+05	1.1442E+05	1.6019E+05	1.9419E+05	2.6798E+01	**2.1168E+01**	2.4469E+01	1.6020E+05

Table S8 Results of ablation experiment in CEC2017 (Dim=30).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2017-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F4	Ave	**5.8562E+01**	**5.8562E+01**	**5.8562E+01**	5.8997E+01	**5.8562E+01**	5.8670E+01	5.8888E+01	**5.8562E+01**
	Std	8.0389E-15	8.0389E-15	1.1369E-14	1.5085E+00	**0.0000E+00**	7.7797E-01	1.3203E+00	**0.0000E+00**
CEC2017-F5	Ave	3.8742E+00	3.5344E+00	**3.4027E+00**	4.6934E+00	3.9499E+00	4.4408E+00	5.0531E+00	4.2666E+00
	Std	2.4722E+00	2.1884E+00	1.9112E+00	1.9612E+00	2.3721E+00	**1.7004E+00**	2.0866E+00	2.8843E+00
CEC2017-F6	Ave	6.7098E-10	2.6750E-14	2.2292E-14	3.1208E-14	5.1271E-14	2.6750E-14	**6.6875E-15**	2.8979E-14
	Std	4.7915E-09	4.8704E-14	4.5586E-14	5.1240E-14	5.7132E-14	4.8704E-14	**2.7016E-14**	5.0038E-14
CEC2017-F7	Ave	**3.3923E+01**	3.4022E+01	3.4469E+01	3.3925E+01	3.4010E+01	3.4101E+01	3.4004E+01	3.4013E+01
	Std	**7.7158E-01**	8.9273E-01	1.1550E+00	8.2718E-01	9.5667E-01	9.4549E-01	7.9274E-01	8.6510E-01

CEC2017-F8	Ave	3.7067E+00	3.7402E+00	**3.5793E+00**	4.0969E+00	3.9018E+00	4.0189E+00	4.6627E+00	3.9408E+00
	Std	1.8028E+00	2.6153E+00	1.7448E+00	2.0161E+00	1.8437E+00	1.7229E+00	**1.6825E+00**	1.9695E+00
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	**1.3842E+03**	1.4182E+03	1.4271E+03	1.4652E+03	1.4492E+03	1.4417E+03	1.4193E+03	1.4052E+03
	Std	2.8991E+02	2.7051E+02	2.6446E+02	2.5501E+02	2.7332E+02	**1.9204E+02**	2.5183E+02	2.1190E+02
CEC2017-F11	Ave	1.7665E+01	1.8022E+01	1.1337E+01	1.0316E+01	1.4728E+01	**6.5338E+00**	9.9641E+00	1.0336E+01
	Std	2.5265E+01	2.5661E+01	2.0183E+01	1.8853E+01	2.3159E+01	**1.4468E+01**	1.9297E+01	1.8951E+01
CEC2017-F12	Ave	5.0527E+02	3.1564E+02	3.4017E+02	**1.9550E+02**	3.7641E+02	2.2626E+02	2.9107E+02	2.0121E+02
	Std	2.4450E+02	2.2337E+02	2.1955E+02	1.4528E+02	2.4437E+02	1.8812E+02	1.9475E+02	**1.4070E+02**
CEC2017-F13	Ave	1.3243E+01	1.5222E+01	1.4171E+01	**1.1392E+01**	1.4306E+01	1.3983E+01	1.2801E+01	1.4693E+01
	Std	6.0670E+00	**2.1775E+00**	4.3590E+00	6.6211E+00	4.0744E+00	5.3530E+00	5.7296E+00	4.0401E+00
CEC2017-F14	Ave	2.1628E+01	2.1117E+01	**2.0706E+01**	2.2029E+01	2.1020E+01	2.1916E+01	2.1481E+01	2.1444E+01
	Std	4.5880E+00	3.1396E+00	2.9521E+00	**1.1301E+00**	2.9178E+00	1.2352E+00	3.2079E+00	1.1879E+00
CEC2017-F15	Ave	4.3940E+00	2.3625E+00	2.1445E+00	**1.9147E+00**	2.4817E+00	2.1132E+00	2.3911E+00	2.0524E+00
	Std	2.4306E+00	1.5376E+00	1.0761E+00	1.5263E+00	1.3798E+00	**9.3067E-01**	1.2830E+00	1.0561E+00
CEC2017-F16	Ave	4.5937E+01	3.9064E+01	**3.1845E+01**	4.7344E+01	3.9788E+01	4.6104E+01	5.1868E+01	3.5168E+01
	Std	5.6079E+01	5.2480E+01	**2.6483E+01**	6.0636E+01	5.3051E+01	5.7802E+01	7.7448E+01	3.5898E+01
CEC2017-F17	Ave	**2.8795E+01**	3.0243E+01	3.0248E+01	3.1357E+01	3.0204E+01	3.1220E+01	3.0364E+01	2.9062E+01
	Std	7.9684E+00	**7.3646E+00**	9.1131E+00	9.9048E+00	9.6869E+00	1.0237E+01	9.2475E+00	9.3891E+00
CEC2017-F18	Ave	2.4045E+01	2.1507E+01	2.1426E+01	2.1502E+01	2.1416E+01	2.1676E+01	2.1896E+01	**2.1260E+01**
	Std	2.6738E+00	1.3452E+00	1.0356E+00	1.1272E+00	**8.3299E-01**	9.6978E-01	1.0979E+00	8.7267E-01
CEC2017-F19	Ave	9.8996E+00	7.6909E+00	7.8604E+00	6.8027E+00	7.3813E+00	6.8478E+00	6.9004E+00	**6.0807E+00**
	Std	2.0425E+00	2.1583E+00	**1.4824E+00**	1.5079E+00	2.4530E+00	1.7681E+00	1.6845E+00	1.9976E+00
CEC2017-F20	Ave	7.9965E+01	8.9978E+01	6.2659E+01	**5.8608E+01**	8.3573E+01	7.3168E+01	7.4435E+01	7.5621E+01
	Std	5.6387E+01	6.2082E+01	4.3778E+01	**4.2494E+01**	5.8950E+01	5.3607E+01	5.1731E+01	5.2914E+01
CEC2017-F21	Ave	2.0824E+02	2.0836E+02	2.0797E+02	2.0712E+02	2.0713E+02	2.0818E+02	**2.0630E+02**	2.0848E+02
	Std	3.9258E+00	4.7327E+00	4.6582E+00	4.4449E+00	**3.5917E+00**	4.5384E+00	4.0075E+00	4.3819E+00
CEC2017-F22	Ave	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	**1.0000E+02**	1.0000E+02	1.0000E+02
	Std	1.6702E-13	1.5828E-13	1.6702E-13	1.6702E-13	1.7533E-13	**1.4801E-13**	1.5828E-13	1.8955E-13
CEC2017-F23	Ave	3.5503E+02	3.5616E+02	3.5683E+02	**3.5379E+02**	3.5792E+02	3.5635E+02	3.5527E+02	3.5538E+02
	Std	3.5489E+00	4.3271E+00	4.0381E+00	3.9858E+00	3.8533E+00	3.7356E+00	**3.3412E+00**	3.5332E+00
CEC2017-F24	Ave	4.3008E+02	4.3002E+02	4.2999E+02	4.2856E+02	4.2952E+02	4.2953E+02	**4.2780E+02**	4.2880E+02
	Std	**2.2773E+00**	3.3177E+00	3.8295E+00	3.6289E+00	3.2275E+00	2.8479E+00	3.5481E+00	2.8118E+00
CEC2017-F25	Ave	3.8670E+02	3.8670E+02	3.8670E+02	3.8670E+02	3.8671E+02	3.8670E+02	3.8670E+02	**3.8670E+02**
	Std	9.7919E-03	1.0539E-02	1.1242E-02	1.0073E-02	1.5198E-02	1.0147E-02	1.1824E-02	**9.5251E-03**
CEC2017-F26	Ave	9.5648E+02	9.8584E+02	9.6620E+02	9.2756E+02	9.7048E+02	9.6182E+02	**9.1483E+02**	9.3674E+02
	Std	5.1510E+01	5.6170E+01	**4.0217E+01**	4.8062E+01	5.8899E+01	5.1654E+01	4.9600E+01	4.6556E+01
CEC2017-F27	Ave	5.0543E+02	5.0530E+02	5.0232E+02	4.9831E+02	5.0415E+02	5.0176E+02	**4.9734E+02**	5.0168E+02
	Std	6.2248E+00	5.9668E+00	**5.4296E+00**	6.7532E+00	5.5854E+00	6.8915E+00	6.6106E+00	6.5814E+00
CEC2017-F28	Ave	3.2821E+02	3.1075E+02	3.1278E+02	3.1075E+02	3.1543E+02	3.1257E+02	3.1034E+02	**3.0426E+02**
	Std	4.8783E+01	3.2987E+01	3.5396E+01	3.2987E+01	3.9105E+01	3.4812E+01	3.1690E+01	**2.1323E+01**
CEC2017-F29	Ave	4.4832E+02	4.4698E+02	4.4265E+02	4.4649E+02	4.4708E+02	4.4497E+02	4.4812E+02	**4.4202E+02**
	Std	1.4499E+01	1.4495E+01	1.3311E+01	**1.1666E+01**	1.4660E+01	1.5693E+01	1.2396E+01	1.2177E+01
CEC2017-F30	Ave	1.9811E+03	1.9737E+03	**1.9719E+03**	1.9761E+03	1.9723E+03	1.9756E+03	1.9749E+03	1.9736E+03
	Std	4.4874E+01	3.1078E+01	2.6224E+01	**2.4790E+01**	2.5681E+01	3.2070E+01	2.6203E+01	2.9146E+01

Table S9 Results of ablation experiment in CEC2017 (Dim=50).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2017-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F4	Ave	**3.4087E+01**	5.2694E+01	5.1746E+01	4.0337E+01	4.4912E+01	5.0154E+01	3.6461E+01	4.0034E+01
	Std	4.2296E+01	4.4598E+01	4.4866E+01	**3.0845E+01**	4.5977E+01	4.3764E+01	3.0950E+01	3.5339E+01
CEC2017-F5	Ave	5.6186E+00	6.3404E+00	**5.3845E+00**	9.3448E+00	5.7161E+00	7.7646E+00	9.2278E+00	6.6721E+00
	Std	1.7555E+00	2.1336E+00	**1.5436E+00**	2.7363E+00	2.6612E+00	2.3462E+00	2.7579E+00	2.3903E+00
CEC2017-F6	Ave	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F7	Ave	5.7028E+01	5.6904E+01	5.7144E+01	5.6909E+01	5.7451E+01	**5.6696E+01**	5.7144E+01	5.7351E+01
	Std	1.0533E+00	1.1181E+00	1.2437E+00	1.1034E+00	1.4508E+00	**1.0041E+00**	1.1939E+00	1.3225E+00
CEC2017-F8	Ave	**5.3260E+00**	6.1258E+00	5.9893E+00	8.7010E+00	5.5796E+00	7.6670E+00	9.1302E+00	6.8086E+00
	Std	**1.8542E+00**	2.4320E+00	2.0727E+00	2.2935E+00	2.1254E+00	2.3903E+00	2.3096E+00	2.6725E+00
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	3.5296E+03	**3.3837E+03**	3.6575E+03	3.4829E+03	3.5637E+03	3.5189E+03	3.5916E+03	3.4663E+03
	Std	6.8921E+02	**5.8188E+02**	6.6503E+02	6.1200E+02	6.2965E+02	7.3184E+02	6.4620E+02	6.0609E+02
CEC2017-F11	Ave	3.2397E+01	2.9565E+01	3.1276E+01	3.0961E+01	2.9551E+01	3.0205E+01	3.0285E+01	**2.8627E+01**
	Std	4.4512E+00	4.6444E+00	**3.9475E+00**	3.9731E+00	4.2340E+00	4.2011E+00	4.2124E+00	4.5326E+00
CEC2017-F12	Ave	1.5919E+03	1.5096E+03	1.5573E+03	1.2974E+03	1.6235E+03	1.3796E+03	1.2661E+03	**1.1954E+03**
	Std	4.2537E+02	4.2433E+02	4.1182E+02	3.9884E+02	4.2830E+02	3.8620E+02	4.4064E+02	**3.5836E+02**
CEC2017-F13	Ave	3.7967E+01	2.6049E+01	1.9794E+01	**1.8920E+01**	2.1668E+01	2.3748E+01	2.0829E+01	2.3030E+01
	Std	2.2056E+01	1.7323E+01	**1.6874E+01**	1.7024E+01	1.7138E+01	1.7620E+01	1.7424E+01	1.7207E+01
CEC2017-F14	Ave	2.9296E+01	2.2938E+01	**2.2761E+01**	2.4479E+01	2.2977E+01	2.4347E+01	2.4518E+01	2.4288E+01
	Std	3.2016E+00	**1.4406E+00**	1.5477E+00	2.0054E+00	1.7646E+00	1.6041E+00	1.7718E+00	1.8581E+00
CEC2017-F15	Ave	3.0538E+01	**2.1902E+01**	2.2130E+01	2.2509E+01	2.2458E+01	2.2888E+01	2.3172E+01	2.2186E+01
	Std	5.8734E+00	2.3210E+00	2.1147E+00	2.3314E+00	2.3048E+00	**2.0166E+00**	2.1804E+00	2.7812E+00
CEC2017-F16	Ave	4.5201E+02	4.1955E+02	4.1565E+02	4.2580E+02	**4.1390E+02**	4.8659E+02	4.4166E+02	4.6250E+02
	Std	2.6032E+02	2.3106E+02	2.3028E+02	2.3515E+02	2.1373E+02	2.3494E+02	2.5157E+02	**2.1073E+02**
CEC2017-F17	Ave	3.0575E+02	**2.2983E+02**	2.5675E+02	2.6523E+02	2.9943E+02	3.0327E+02	2.8636E+02	2.8592E+02
	Std	1.2353E+02	8.5555E+01	1.0298E+02	**8.4773E+01**	1.1624E+02	1.2684E+02	9.7598E+01	9.8750E+01
CEC2017-F18	Ave	3.2013E+01	2.8787E+01	2.7457E+01	2.3685E+01	2.7844E+01	2.5342E+01	2.4639E+01	**2.3377E+01**
	Std	5.2230E+00	6.0446E+00	3.4601E+00	**1.6738E+00**	4.7234E+00	2.6283E+00	2.4098E+00	1.8401E+00
CEC2017-F19	Ave	2.1029E+01	1.3631E+01	1.4290E+01	1.3881E+01	1.3778E+01	1.3787E+01	1.4389E+01	**1.3388E+01**
	Std	3.5589E+00	2.6004E+00	2.2425E+00	2.7801E+00	**2.1461E+00**	2.1753E+00	2.6494E+00	2.6137E+00
CEC2017-F20	Ave	1.7035E+02	1.5555E+02	1.5180E+02	1.9080E+02	1.6274E+02	1.7092E+02	1.9524E+02	**1.3479E+02**
	Std	1.0308E+02	9.4112E+01	9.9824E+01	1.1347E+02	9.7696E+01	1.0240E+02	1.0812E+02	**6.2719E+01**
CEC2017-F21	Ave	2.1578E+02	2.1477E+02	**2.1395E+02**	2.1527E+02	2.1610E+02	2.1440E+02	2.1519E+02	2.1849E+02
	Std	1.1118E+01	1.1072E+01	1.1180E+01	1.0444E+01	1.1088E+01	9.8844E+00	**8.7926E+00**	1.2269E+01
CEC2017-F22	Ave	**1.4233E+03**	1.8295E+03	2.1292E+03	2.4000E+03	1.6967E+03	2.2961E+03	2.3824E+03	2.0543E+03
	Std	**1.9090E+03**	2.0541E+03	2.0098E+03	2.0669E+03	2.0403E+03	1.9914E+03	2.0763E+03	1.9504E+03
CEC2017-F23	Ave	**4.4061E+02**	4.4595E+02	4.4324E+02	4.4198E+02	4.4573E+02	4.4470E+02	4.4070E+02	4.4460E+02

	Std	**5.9574E+00**	8.3265E+00	8.5103E+00	7.9369E+00	7.5736E+00	8.3220E+00	7.9632E+00	7.7182E+00
CEC2017-F24	Ave	5.1254E+02	5.1488E+02	5.1314E+02	5.1136E+02	5.1708E+02	5.1458E+02	**5.0999E+02**	5.1457E+02
	Std	**6.2566E+00**	8.0501E+00	8.3504E+00	6.5254E+00	9.1817E+00	6.6956E+00	7.7414E+00	9.0478E+00
CEC2017-F25	Ave	4.8088E+02	**4.8046E+02**	4.8086E+02	4.8344E+02	4.8046E+02	4.8064E+02	4.8274E+02	4.8115E+02
	Std	2.7970E+00	1.6268E+00	2.8017E+00	1.1991E+01	**1.6266E+00**	2.3229E+00	4.8240E+00	3.1520E+00
CEC2017-F26	Ave	1.1393E+03	1.1855E+03	1.1533E+03	1.1156E+03	1.1739E+03	1.1672E+03	**1.1082E+03**	1.1333E+03
	Std	5.7028E+01	5.1123E+01	5.6434E+01	5.8285E+01	**4.9950E+01**	5.9592E+01	5.7035E+01	5.3313E+01
CEC2017-F27	Ave	5.3141E+02	5.2400E+02	5.2440E+02	5.1074E+02	5.2569E+02	5.1650E+02	**5.0978E+02**	5.1457E+02
	Std	1.4988E+01	9.7809E+00	1.4247E+01	1.0096E+01	1.4002E+01	8.1053E+00	1.1002E+01	**6.5736E+00**
CEC2017-F28	Ave	4.5964E+02	4.5885E+02	4.5885E+02	4.5885E+02	**4.5885E+02**	4.6172E+02	4.5885E+02	4.5885E+02
	Std	5.6822E+00	2.0886E-13	2.1254E-13	**2.0257E-13**	2.1330E-13	1.1608E+01	2.0511E-13	2.2666E-13
CEC2017-F29	Ave	3.7814E+02	4.0231E+02	3.8692E+02	3.8670E+02	3.8910E+02	3.8851E+02	3.9236E+02	**3.7149E+02**
	Std	4.5293E+01	7.0526E+01	5.1111E+01	3.8819E+01	5.3799E+01	3.3045E+01	6.4524E+01	**1.7216E+01**
CEC2017-F30	Ave	6.4516E+05	6.2435E+05	6.2744E+05	6.1335E+05	6.3505E+05	**6.0892E+05**	6.2297E+05	6.1425E+05
	Std	5.7424E+04	5.3906E+04	4.7947E+04	**3.2243E+04**	6.8565E+04	4.6553E+04	4.1367E+04	4.5174E+04

Table S10 Results of ablation experiment in CEC2017 (Dim=100).

ID	Metric	LSHADE -SPACMA	mLSHADE -SPACMA1	mLSHADE -SPACMA2	mLSHADE -SPACMA3	mLSHADE -SPACMA12	mLSHADE -SPACMA13	mLSHADE -SPACMA23	mLSHADE -SPACMA
CEC2017-F1	Ave	**5.8515E-15**	1.3375E-14	1.0867E-14	7.2447E-15	1.3096E-14	6.6875E-15	1.1146E-14	6.2138E-14
	Std	7.0635E-15	**3.3770E-15**	6.7187E-15	7.1748E-15	5.5718E-15	7.1637E-15	5.9030E-15	1.6563E-14
CEC2017-F3	Ave	2.2292E-15	1.1146E-15	**0.0000E+00**	1.1146E-15	**0.0000E+00**	3.3437E-15	4.4583E-15	3.3437E-15
	Std	1.1144E-14	7.9597E-15	**0.0000E+00**	7.9597E-15	**0.0000E+00**	1.3508E-14	1.5434E-14	1.3508E-14
CEC2017-F4	Ave	2.0289E+02	2.0679E+02	2.0613E+02	2.0340E+02	2.0522E+02	2.0132E+02	2.0218E+02	**2.0013E+02**
	Std	1.0085E+01	**9.6098E+00**	1.0872E+01	1.0143E+01	1.0207E+01	1.0223E+01	9.9347E+00	1.2213E+01
CEC2017-F5	Ave	1.1666E+01	**1.0652E+01**	1.1023E+01	2.1206E+01	1.0886E+01	1.6973E+01	2.1850E+01	1.3793E+01
	Std	3.5210E+00	2.8373E+00	**2.4521E+00**	3.5624E+00	2.7888E+00	3.6226E+00	2.9646E+00	3.2334E+00
CEC2017-F6	Ave	**1.1369E-13**	**1.1369E-13**	2.7740E-10	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**	**1.1369E-13**
	Std	**0.0000E+00**	**0.0000E+00**	1.9802E-09	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F7	Ave	**1.1204E+02**	1.1234E+02	1.1276E+02	1.1266E+02	1.1278E+02	1.1341E+02	1.1262E+02	1.1268E+02
	Std	1.5326E+00	1.7130E+00	1.7943E+00	1.5538E+00	1.4436E+00	1.8089E+00	1.4365E+00	**1.3407E+00**
CEC2017-F8	Ave	**1.0652E+01**	1.0827E+01	1.1179E+01	1.8397E+01	1.1881E+01	1.5529E+01	1.9002E+01	1.3793E+01
	Std	2.6867E+00	3.1504E+00	**2.4093E+00**	3.8502E+00	2.5515E+00	3.5768E+00	3.3194E+00	2.9982E+00
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	9.9559E+03	1.0126E+04	1.0119E+04	9.9772E+03	1.0014E+04	1.0138E+04	1.0228E+04	**9.8782E+03**
	Std	1.0020E+03	**7.6286E+02**	1.0118E+03	1.1309E+03	1.0262E+03	9.9162E+02	8.0985E+02	9.9902E+02
CEC2017-F11	Ave	4.7444E+01	3.0288E+01	3.0567E+01	3.4639E+01	**2.8643E+01**	3.5908E+01	3.4073E+01	3.8560E+01
	Std	2.1497E+01	1.3763E+01	1.5025E+01	1.1781E+01	**5.2400E+00**	1.5394E+01	7.2314E+00	1.7746E+01
CEC2017-F12	Ave	4.5533E+03	4.6360E+03	4.6628E+03	4.5750E+03	4.6535E+03	4.6715E+03	**4.4788E+03**	4.4788E+03
	Std	7.3772E+02	7.6983E+02	6.3787E+02	7.6415E+02	8.1419E+02	7.4541E+02	**6.2676E+02**	6.9447E+02
CEC2017-F13	Ave	1.2761E+02	9.7213E+01	1.0021E+02	1.1334E+02	1.0248E+02	1.1910E+02	1.1400E+02	**7.9579E+01**
	Std	3.9084E+01	**2.8389E+01**	3.3154E+01	3.9389E+01	3.0896E+01	3.8337E+01	4.1948E+01	3.4902E+01
CEC2017-F14	Ave	7.4646E+01	3.7385E+01	3.9999E+01	4.0837E+01	3.8556E+01	3.8635E+01	4.1385E+01	**3.7152E+01**
	Std	1.2501E+01	4.8221E+00	5.0272E+00	5.0400E+00	5.1040E+00	4.2686E+00	5.8534E+00	**4.0083E+00**
CEC2017-F15	Ave	1.1213E+02	9.2584E+01	8.9018E+01	7.3487E+01	9.2085E+01	7.6149E+01	7.2383E+01	**6.0257E+01**

	Std	3.1253E+01	**3.0417E+01**	3.2333E+01	3.2654E+01	3.3071E+01	3.5144E+01	3.3316E+01	3.1421E+01
CEC2017-F16	Ave	1.3615E+03	1.5699E+03	1.4887E+03	1.6068E+03	1.4844E+03	1.5806E+03	1.5478E+03	**1.3375E+03**
	Std	5.0140E+02	5.1174E+02	4.3658E+02	5.2456E+02	4.8089E+02	**3.8498E+02**	4.3817E+02	5.3675E+02
CEC2017-F17	Ave	**9.3146E+02**	9.8988E+02	9.9108E+02	1.1029E+03	1.0035E+03	1.1825E+03	1.1303E+03	1.0442E+03
	Std	3.6355E+02	3.7971E+02	3.3255E+02	4.0690E+02	3.2957E+02	**3.0667E+02**	3.2284E+02	4.2441E+02
CEC2017-F18	Ave	1.3267E+02	1.6084E+02	1.6171E+02	1.0973E+02	1.6436E+02	1.0357E+02	1.1142E+02	**7.2828E+01**
	Std	4.0644E+01	2.9751E+01	2.9278E+01	2.4588E+01	2.6809E+01	2.3139E+01	2.8621E+01	**1.7172E+01**
CEC2017-F19	Ave	7.3483E+01	4.6932E+01	4.7836E+01	4.4774E+01	4.7916E+01	4.4738E+01	4.4710E+01	**4.1582E+01**
	Std	9.7083E+00	5.2406E+00	5.1641E+00	5.3344E+00	5.5228E+00	4.4982E+00	5.2442E+00	**3.8569E+00**
CEC2017-F20	Ave	1.4396E+03	1.3865E+03	1.4132E+03	1.5864E+03	**1.3297E+03**	1.5450E+03	1.5695E+03	1.5108E+03
	Std	3.4599E+02	3.2771E+02	3.1736E+02	3.1220E+02	3.2818E+02	3.1842E+02	**3.0287E+02**	3.5931E+02
CEC2017-F21	Ave	2.4287E+02	2.4271E+02	**2.4211E+02**	2.4456E+02	2.4277E+02	2.4930E+02	2.4658E+02	2.4283E+02
	Std	9.6035E+00	1.3457E+01	1.2562E+01	4.3431E+00	**3.3925E+00**	1.5264E+01	3.9576E+00	3.9155E+00
CEC2017-F22	Ave	9.9995E+03	1.0327E+04	**9.9402E+03**	1.0186E+04	1.0405E+04	1.0710E+04	1.0412E+04	1.0001E+04
	Std	1.0499E+03	9.5742E+02	9.2971E+02	**8.2603E+02**	8.6414E+02	9.0823E+02	1.0308E+03	9.9449E+02
CEC2017-F23	Ave	**5.8264E+02**	5.8812E+02	5.8791E+02	5.8468E+02	5.9027E+02	5.9411E+02	5.8295E+02	5.9022E+02
	Std	**7.1804E+00**	7.6841E+00	8.9180E+00	1.0607E+01	8.4698E+00	9.6847E+00	7.8498E+00	9.4601E+00
CEC2017-F24	Ave	9.2289E+02	9.0573E+02	8.9991E+02	**8.9715E+02**	9.1027E+02	9.1272E+02	8.9897E+02	9.1139E+02
	Std	2.3880E+01	1.2739E+01	**9.7204E+00**	1.0748E+01	1.8045E+01	1.3306E+01	1.3264E+01	1.8267E+01
CEC2017-F25	Ave	6.9935E+02	6.7271E+02	6.7194E+02	**6.6232E+02**	6.7585E+02	6.8869E+02	6.7569E+02	6.6260E+02
	Std	3.8887E+01	4.6233E+01	3.5530E+01	3.8763E+01	3.9159E+01	**2.7314E+01**	3.2861E+01	3.0188E+01
CEC2017-F26	Ave	3.1367E+03	3.1875E+03	3.1400E+03	3.0223E+03	3.1713E+03	3.2531E+03	**3.0202E+03**	3.1268E+03
	Std	8.7796E+01	1.0128E+02	6.5902E+01	7.8252E+01	7.2538E+01	8.1534E+01	**6.4285E+01**	7.7904E+01
CEC2017-F27	Ave	6.0182E+02	5.9086E+02	5.8475E+02	5.5061E+02	5.8832E+02	5.6391E+02	**5.4932E+02**	5.5657E+02
	Std	1.9789E+01	1.5646E+01	1.6268E+01	1.9103E+01	1.5786E+01	2.0038E+01	**1.5084E+01**	1.6447E+01
CEC2017-F28	Ave	5.1867E+02	5.1201E+02	5.1105E+02	**5.0472E+02**	5.0967E+02	5.1341E+02	5.0499E+02	5.0941E+02
	Std	1.6886E+01	2.4226E+01	2.4827E+01	2.1973E+01	2.1887E+01	**1.6479E+01**	1.8650E+01	1.7973E+01
CEC2017-F29	Ave	1.5142E+03	1.5627E+03	1.6542E+03	1.4403E+03	1.6450E+03	1.4703E+03	1.5012E+03	**1.3789E+03**
	Std	3.0300E+02	3.3134E+02	3.4587E+02	2.9456E+02	3.8649E+02	3.0459E+02	**2.6303E+02**	3.0473E+02
CEC2017-F30	Ave	2.3470E+03	2.2976E+03	2.2998E+03	2.1830E+03	2.2787E+03	2.1826E+03	2.1928E+03	**2.1287E+03**
	Std	1.6231E+02	1.3591E+02	1.3019E+02	1.2521E+02	8.8614E+01	1.1610E+02	1.1353E+02	**7.3653E+01**

Table S11 Error statistics of different algorithms solving CEC2014 (Dim=10).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2014-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	5.5300E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	9.9451E-12	**0.0000E+00**	5.1549E-14	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	4.9739E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.3837E-11	**0.0000E+00**	9.6129E-14	**0.0000E+00**
CEC2014-F2	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	6.4876E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	9.3485E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	7.3497E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	6.8288E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F4	Ave	3.0773E+01	1.2870E+01	2.9410E+01	1.9023E+01	3.4768E+01	3.2734E+01	3.1625E+01	3.1267E-01	**0.0000E+00**	3.0688E+01	2.1830E+01	2.2078E+01	4.5168E+00	3.1370E+01
	Std	1.1096E+01	1.6406E+01	1.2588E+01	1.0511E+01	5.0691E-03	8.2650E+00	9.6875E+00	1.0825E+00	**0.0000E+00**	1.1317E+01	1.4311E+01	1.6677E+01	1.1235E+01	1.0445E+01
CEC2014-F5	Ave	1.6057E+01	1.6215E+01	1.4767E+01	1.5001E+01	1.9129E+01	1.4420E+01	1.3024E+01	1.5791E+01	2.1226E+01	1.6185E+01	1.9809E+01	**1.2726E+01**	1.8470E+01	1.3455E+01
	Std	7.6123E+00	7.7475E+00	7.9263E+00	8.2335E+00	3.9512E+00	8.0501E+00	8.1857E+00	8.2162E+00	1.7053E+01	7.5642E+00	**2.8323E+00**	9.5749E+00	5.4422E+00	8.9099E+00
CEC2014-F6	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	4.6812E-14	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.4310E+01	**0.0000E+00**	2.9091E-01	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**

	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	8.5610E-14	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	9.3303E+00	**0.0000E+00**	6.1539E-01	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F7	Ave	8.6989E-04	1.8413E-12	1.1113E-03	2.9017E-04	**0.0000E+00**	8.2124E-04	1.1216E-02	6.2803E-03	**0.0000E+00**	3.3830E-04	1.8684E-01	1.1351E-02	7.2460E-02	1.4036E-03
	Std	2.7363E-03	3.4975E-12	3.2052E-03	2.0695E-03	**0.0000E+00**	2.9423E-03	1.1192E-02	6.2172E-03	**0.0000E+00**	1.7090E-03	1.4298E-01	1.1812E-02	3.5027E-02	3.0903E-03
CEC2014-F8	Ave	**0.0000E+00**	**0.0000E+00**	7.8036E-02	**0.0000E+00**	5.4625E-01	3.5385E-01	**0.0000E+00**	**0.0000E+00**	2.6319E-03	**0.0000E+00**	6.9754E+00	**0.0000E+00**	3.2970E+00	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	2.7016E-01	**0.0000E+00**	7.2608E-01	9.2051E-01	**0.0000E+00**	**0.0000E+00**	5.2924E-03	**0.0000E+00**	3.5700E+00	**0.0000E+00**	1.0988E+00	**0.0000E+00**
CEC2014-F9	Ave	2.6358E+00	**5.3277E-13**	2.6765E+00	1.8743E+00	7.8036E-01	2.1364E+00	3.7718E+00	1.0730E+00	4.2920E-01	1.2553E+00	8.8228E+00	5.2091E+00	5.1699E+00	1.0545E+00
	Std	8.6373E-01	**6.7927E-13**	9.3708E-01	7.0749E-01	6.9828E-01	1.1751E+00	2.0368E+00	1.2402E+00	5.7173E-01	7.1355E-01	5.9328E+00	2.4416E+00	1.6046E+00	9.6331E-01
CEC2014-F10	Ave	6.1230E-03	1.2246E-03	5.5983E+00	**1.4267E-13**	8.0310E+01	1.5898E+01	2.4492E-03	9.7968E-03	5.6576E-01	2.8877E-02	7.0513E+01	1.2246E-02	1.0514E+01	7.3476E-03
	Std	1.8757E-02	8.7454E-03	2.0132E+01	**3.3405E-13**	1.1022E+02	3.2856E+01	1.2244E-02	2.2939E-02	7.5131E-01	3.9108E-02	3.4717E+01	2.7985E-02	1.7328E+01	2.0322E-02
CEC2014-F11	Ave	3.8331E+01	3.1946E+01	9.1069E+01	2.5026E+01	3.6454E+01	8.2817E+01	4.0817E+01	2.6391E+01	**2.2709E+00**	2.5667E+01	4.3599E+02	8.9575E+01	9.0700E+01	2.0002E+01
	Std	4.4978E+01	4.1009E+01	1.1329E+02	3.4219E+01	7.2453E+01	7.1330E+01	6.9200E+01	3.4900E+01	**2.8045E+00**	4.1624E+01	3.2527E+02	8.5737E+01	9.9438E+01	3.5359E+01
CEC2014-F12	Ave	6.4787E-02	4.0487E-02	3.0294E-01	7.3158E-02	2.8259E-02	4.1650E-01	1.2880E-01	8.5248E-02	1.1491E+01	1.7441E-01	4.9213E-01	**2.3326E-02**	3.2513E-01	7.2894E-02
	Std	**1.8207E-02**	2.5311E-02	1.5594E-01	2.2194E-02	4.2110E-02	1.6466E-01	3.0896E-02	5.4824E-02	7.5870E+00	6.3798E-02	3.1886E-01	3.7760E-02	2.0444E-01	2.0839E-02
CEC2014-F13	Ave	4.9910E-02	3.0481E-02	7.0466E-02	4.4869E-02	**1.0266E-02**	7.0427E-02	3.2983E-02	6.2260E-02	7.0910E-01	6.3677E-02	1.4031E-01	5.3582E-02	3.1821E-02	3.3767E-02
	Std	1.3656E-02	1.4310E-02	1.3539E-02	1.0636E-02	**5.7267E-03**	1.5735E-02	1.8143E-02	2.0090E-02	4.6998E-01	1.5535E-02	3.7788E-02	2.7029E-02	1.2293E-02	1.5950E-02
CEC2014-F14	Ave	6.6014E-02	1.0613E-01	6.6375E-02	9.3907E-02	3.5077E-01	6.0928E-02	8.3120E-02	7.4160E-02	**5.1973E-02**	5.6473E-02	1.7386E-01	8.9143E-02	5.3029E-02	9.6530E-02
	Std	2.1375E-02	4.1161E-02	2.3113E-02	3.7516E-02	7.2784E-02	**1.4624E-02**	3.1511E-02	2.3658E-02	1.5102E-02	2.6713E-02	4.1493E-02	3.6795E-02	3.0108E-02	5.8080E-02
CEC2014-F15	Ave	3.7482E-01	3.0307E-01	5.5302E-01	3.6716E-01	9.6059E-01	6.0722E-01	5.0138E-01	4.0829E-01	**2.5868E-01**	4.1864E-01	1.6631E+00	4.5279E-01	6.3799E-01	3.7691E-01
	Std	6.6235E-02	9.2257E-02	1.4631E-01	7.2614E-02	2.5689E-01	1.1448E-01	1.8053E-01	9.5478E-02	7.4872E-02	7.5976E-02	5.8297E-01	7.2817E-02	1.4837E-01	**6.3660E-02**
CEC2014-F16	Ave	1.2629E+00	1.1129E+00	1.1683E+00	1.0111E+00	1.4218E+00	1.0409E+00	6.6139E-01	6.7042E-01	7.7119E-01	8.3211E-01	2.7057E+00	1.0722E+00	1.0592E+00	**5.4986E-01**
	Std	3.0964E-01	4.7562E-01	3.3886E-01	3.1007E-01	4.7589E-01	3.0281E-01	4.9797E-01	4.6062E-01	3.2267E-01	**3.0183E-01**	3.6093E-01	4.7479E-01	4.8998E-01	3.9335E-01
CEC2014-F17	Ave	1.1928E+00	2.6594E+01	1.1097E+01	3.3741E+01	6.7247E+01	6.6481E+00	5.0163E+00	1.4285E+00	**7.0576E-01**	7.2664E-01	5.3861E+00	1.0097E+00	1.5332E+00	3.6185E+01
	Std	1.9194E+00	3.2830E+01	9.4968E+00	4.5990E+01	1.5729E+02	8.0729E+00	1.7605E+01	5.3611E+00	**4.8335E-01**	7.2650E-01	5.2557E+00	9.6923E-01	2.7458E+00	4.4155E+01
CEC2014-F18	Ave	2.4252E-01	1.2070E-01	2.1755E-01	2.3752E-01	4.3318E-01	2.7195E-01	1.6437E-01	**1.9483E-02**	2.5268E+00	2.9459E-01	2.2002E+00	1.1142E-01	4.8317E-01	5.6172E-01
	Std	1.8535E-01	2.3832E-01	1.5443E-01	2.4851E-01	4.6357E-01	1.6900E-01	1.4702E-01	**3.5487E-02**	4.2650E+00	1.7979E-01	1.4328E+00	1.8830E-01	4.4362E-01	5.5317E-01
CEC2014-F19	Ave	1.1792E-01	8.7265E-02	2.7798E-01	2.2518E-01	6.1835E-01	1.8649E-01	9.1347E-02	**5.0442E-02**	1.0552E-01	7.2369E-02	6.7233E-01	1.0029E-01	8.2980E-02	2.1330E-01
	Std	1.4534E-01	2.3379E-01	4.0130E-01	3.6873E-01	4.7832E-01	2.4844E-01	1.4101E-01	**3.4329E-02**	1.6533E-01	5.2234E-02	2.4425E-01	7.7810E-02	4.3253E-02	3.8010E-01
CEC2014-F20	Ave	1.1475E-01	1.7131E-01	4.2019E-01	2.7867E-01	8.1989E-01	4.2688E-01	3.4067E-01	4.5348E-02	**3.8289E-02**	2.6773E-01	4.2940E-01	3.1171E-01	2.2194E-01	5.7175E-01
	Std	7.0196E-02	1.1630E-01	1.6686E-01	2.0911E-01	9.0479E-01	1.9984E-01	2.0625E-01	4.4197E-02	**1.9211E-02**	1.9676E-01	3.4236E-01	1.6519E-01	1.9405E-01	1.9133E-01
CEC2014-F21	Ave	3.6992E-01	2.9228E-01	5.4668E-01	2.3133E+00	1.5961E+01	5.0029E-01	3.8518E-01	**5.0165E-02**	3.6016E-01	6.2158E-01	4.5082E-01	2.5434E-01	4.5071E-01	1.7190E+00
	Std	2.5964E-01	2.0078E-01	3.0675E-01	8.6082E+00	4.7427E+01	3.6464E-01	3.2367E-01	**1.0833E-01**	2.4566E-01	2.6970E-01	2.8044E-01	1.8911E-01	2.5630E-01	4.4995E+00
CEC2014-F22	Ave	1.0182E-01	**5.5368E-02**	1.1865E+00	1.4857E+00	2.8133E+01	2.5439E+00	1.0234E-01	8.4908E-02	4.9661E-01	3.9626E-01	1.1696E+00	1.4819E-01	4.9146E-01	6.1013E-02
	Std	**4.4408E-02**	5.2073E-02	3.9194E+00	4.7628E+00	3.8393E+01	6.0652E+00	6.6365E-02	7.4621E-02	3.4030E-01	1.6850E-01	2.1415E+00	1.0873E-01	4.2602E-01	4.4503E-02
CEC2014-F23	Ave	3.2946E+02	3.1930E+02	3.2946E+02	3.2946E+02	3.2946E+02	3.2946E+02	2.7107E+02	3.2946E+02	**1.8013E+00**	3.2946E+02	2.0000E+02	3.2946E+02	3.2946E+02	2.6092E+02
	Std	**0.0000E+00**	3.5151E+01	**0.0000E+00**	**0.0000E+00**	3.9472E-13	**0.0000E+00**	6.5058E+01	**0.0000E+00**	5.2361E+00	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	6.5260E+01
CEC2014-F24	Ave	1.0841E+02	1.0463E+02	1.0841E+02	1.0573E+02	1.0837E+02	1.0768E+02	1.1035E+02	1.0528E+02	3.2946E+02	1.0558E+02	1.1297E+02	1.0868E+02	1.0943E+02	**1.0427E+02**
	Std	1.6888E+00	2.6029E+00	2.1798E+00	2.8257E+00	1.1312E+01	1.6990E+00	2.5290E+00	3.2958E+00	**5.7409E-14**	2.6100E+00	4.0705E+00	2.5590E+00	3.6948E+00	3.2061E+00
CEC2014-F25	Ave	1.5589E+02	1.1748E+02	1.2318E+02	1.3572E+02	1.9952E+02	1.2182E+02	1.1884E+02	1.0873E+02	**1.0367E+02**	1.2504E+02	1.6810E+02	1.2617E+02	1.2452E+02	1.2539E+02
	Std	4.3937E+01	1.2672E+01	1.6477E+01	3.5099E+01	**1.0875E+00**	1.6308E+01	1.2251E+01	8.5756E+00	3.4718E+00	2.9249E+01	3.3353E+01	2.8725E+01	3.7208E+01	1.5168E+01
CEC2014-F26	Ave	1.0005E+02	1.0002E+02	1.0007E+02	1.0004E+02	**1.0001E+02**	1.0007E+02	1.0003E+02	1.0007E+02	1.7540E+02	1.0006E+02	1.0013E+02	1.0004E+02	1.0004E+02	1.0003E+02
	Std	1.7490E-02	1.3599E-02	1.6505E-02	1.3560E-02	**5.0655E-03**	1.1402E-02	1.7306E-02	1.9111E-02	3.9933E+01	1.6768E-02	4.2091E-02	1.6480E-02	1.4832E-02	1.6196E-02
CEC2014-F27	Ave	4.6247E+01	6.9853E+00	1.5264E+02	8.5337E+01	2.5709E+02	1.4661E+01	6.8665E+00	6.9753E+01	1.0005E+02	6.5428E+01	7.9891E+01	3.2689E+01	**1.1235E+00**	1.2800E+01
	Std	1.1500E+02	4.1852E+01	1.6456E+02	1.4721E+02	1.1945E+02	6.9165E+01	4.1869E+01	1.3283E+02	**1.3017E-02**	1.3357E+02	9.7435E+01	1.0826E+02	2.8204E-01	5.8602E+01
CEC2014-F28	Ave	3.8527E+02	3.7154E+02	3.9070E+02	3.7878E+02	3.8550E+02	3.8095E+02	3.5982E+02	3.3458E+02	**1.8280E+02**	3.7906E+02	2.0000E+02	4.2482E+02	3.9532E+02	3.8620E+02
	Std	3.6780E+01	2.7705E+00	3.9294E+01	2.7712E+01	1.1338E+02	2.9030E+01	4.7321E+01	5.6556E+01	1.9637E+02	3.0850E+01	**2.3491E-04**	5.0740E+01	4.5363E+01	7.2465E+01
CEC2014-F29	Ave	2.2217E+02	2.2255E+02	2.2217E+02	2.2259E+02	2.1733E+02	2.2200E+02	2.2204E+02	**2.0232E+02**	4.1373E+02	2.2198E+02	2.2167E+02	2.2180E+02	2.1723E+02	2.2130E+02
	Std	5.3697E-01	9.3706E-01	5.6978E-01	9.5594E-01	2.1295E+01	4.5186E-01	5.2412E-01	1.0524E+01	5.6973E+01	4.4573E-01	3.1603E+00	**1.8629E-01**	2.3924E+01	4.8847E+00

CEC2014-F30	Ave	4.6719E+02	4.7051E+02	4.7793E+02	4.7341E+02	5.5066E+02	4.6932E+02	4.6812E+02	2.5977E+02	**2.1495E+02**	4.6461E+02	4.6872E+02	4.6396E+02	4.6214E+02	4.7034E+02
	Std	1.5933E+01	1.0741E+01	2.4863E+01	2.1532E+01	5.1644E+01	1.4868E+01	1.3310E+01	2.7577E+01	2.4520E+01	9.2028E+00	1.9422E+01	**7.2814E+00**	9.3611E+00	1.8002E+01

Table S12 Error statistics of different algorithms solving CEC2014 (Dim=30).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2014-F1	Ave	1.0310E-14	2.8457E-05	2.4431E+00	4.7370E-15	2.5232E-10	9.2098E-02	1.3932E-15	3.3183E+02	4.0348E-13	1.2818E-14	2.6472E+05	3.6502E-14	1.0372E+04	**0.0000E+00**
	Std	7.0072E-15	3.1166E-05	8.3700E+00	6.7657E-15	2.3797E-10	3.2573E-01	4.2679E-15	2.0006E+03	9.7364E-13	5.8627E-15	1.7794E+05	2.2244E-14	5.6634E+03	**0.0000E+00**
CEC2014-F2	Ave	**0.0000E+00**	1.1146E-15	**0.0000E+00**	**0.0000E+00**	3.2629E-10	5.5729E-16	**0.0000E+00**	**0.0000E+00**	4.0348E-13	**0.0000E+00**	3.0651E-14	**0.0000E+00**	3.9010E-15	**0.0000E+00**
	Std	**0.0000E+00**	5.5718E-15	**0.0000E+00**	**0.0000E+00**	3.3607E-10	3.9798E-15	**0.0000E+00**	**0.0000E+00**	9.7364E-13	**0.0000E+00**	2.5951E-14	**0.0000E+00**	9.8777E-15	**0.0000E+00**
CEC2014-F3	Ave	**0.0000E+00**	1.1146E-15	**0.0000E+00**	**0.0000E+00**	2.9261E-10	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.7864E-15	**0.0000E+00**	5.3500E-14	**0.0000E+00**	5.5729E-15	**0.0000E+00**
	Std	**0.0000E+00**	7.9597E-15	**0.0000E+00**	**0.0000E+00**	4.3071E-10	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	8.5358E-15	**0.0000E+00**	3.4878E-14	**0.0000E+00**	1.7072E-14	**0.0000E+00**
CEC2014-F4	Ave	3.9684E-07	2.8756E-13	8.4343E-05	1.6953E-10	3.1422E-11	5.8655E-03	2.2292E-14	2.7992E+00	**0.0000E+00**	5.3500E-14	2.8816E+00	2.6750E-14	3.9148E-09	**0.0000E+00**
	Std	2.8340E-06	4.1747E-13	2.1645E-04	1.2076E-09	4.3082E-11	4.1049E-02	2.8029E-14	6.5703E+00	**0.0000E+00**	2.8787E-14	1.2307E+01	2.8655E-14	1.7157E-08	**0.0000E+00**
CEC2014-F5	Ave	2.0116E+01	1.9999E+01	2.0811E+01	2.0148E+01	2.0000E+01	2.0858E+01	2.0246E+01	2.0203E+01	**2.2292E-15**	2.0877E+01	2.0633E+01	2.0034E+01	2.0259E+01	2.0132E+01
	Std	2.9104E-02	7.1472E-04	1.4196E-01	2.3496E-02	4.3019E-04	1.3290E-01	3.6506E-02	1.1121E-01	**1.1144E-14**	1.6447E-01	1.6699E-01	7.4844E-02	1.2083E-01	4.2321E-02
CEC2014-F6	Ave	**0.0000E+00**	1.8627E-05	9.0909E-03	**0.0000E+00**	1.0071E+00	9.0057E-03	**0.0000E+00**	4.7387E-01	2.0939E+01	1.3843E-07	3.1630E+00	**0.0000E+00**	1.7524E-01	**0.0000E+00**
	Std	**0.0000E+00**	1.2751E-04	6.4302E-02	**0.0000E+00**	9.8822E-01	6.4312E-02	**0.0000E+00**	9.2693E-01	1.3129E-01	9.8860E-07	3.0716E+00	**0.0000E+00**	4.1154E-01	**0.0000E+00**
CEC2014-F7	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.9148E-12	**0.0000E+00**	**0.0000E+00**	1.9328E-04	5.0019E-07	**0.0000E+00**	1.4502E-04	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	8.2890E-12	**0.0000E+00**	**0.0000E+00**	1.3803E-03	2.2847E-06	**0.0000E+00**	1.0357E-03	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2014-F8	Ave	1.4044E-13	4.4583E-14	3.6872E+00	2.3406E-13	7.0818E+00	2.8442E+00	2.0062E-14	**0.0000E+00**	**0.0000E+00**	1.0321E-12	1.8416E+01	5.8527E-02	1.3832E+01	3.7896E-14
	Std	5.8361E-14	5.6058E-14	5.4740E+00	7.6810E-14	2.0837E+00	4.1171E+00	4.3771E-14	**0.0000E+00**	**0.0000E+00**	8.1088E-13	7.3948E+00	4.1797E-01	3.8135E+00	8.7077E-14
CEC2014-F9	Ave	7.0327E+00	1.5667E+00	1.1500E+01	1.3415E+01	7.1403E+00	1.1754E+01	1.4991E+01	2.7235E+01	**1.5412E+00**	7.5726E+00	3.1001E+01	7.4798E+00	2.3157E+01	3.7652E+00
	Std	1.4371E+00	1.6498E+00	5.2839E+00	2.0393E+00	2.7480E+00	6.5541E+00	7.4142E+00	6.7068E+00	1.1312E+00	1.7138E+00	1.7349E+01	**1.0853E+00**	6.1271E+00	1.9930E+00
CEC2014-F10	Ave	5.7151E-03	2.3269E-02	1.6393E+02	7.6591E-03	4.0046E+02	4.8891E+02	**1.6050E-12**	1.0274E-01	2.4386E+00	3.0856E+00	6.5772E+02	2.8575E-03	4.7937E+02	1.3879E-02
	Std	1.0266E-02	2.1494E-02	4.1531E+02	1.2927E-02	2.7718E+02	7.8596E+02	**5.9189E-13**	1.5678E-01	1.1991E+00	1.6153E+00	3.7173E+02	1.2505E-02	2.9059E+02	1.4819E-02
CEC2014-F11	Ave	1.1844E+03	1.2424E+03	2.6104E+03	1.1897E+03	7.9538E+02	3.1444E+03	1.4864E+03	1.5371E+03	**8.5924E+00**	1.2770E+03	2.4284E+03	1.3091E+03	2.1148E+03	1.0977E+03
	Std	2.0684E+02	1.7751E+02	1.1321E+03	1.6964E+02	3.4740E+02	8.8641E+02	4.7022E+02	2.8458E+02	**2.8210E+01**	2.2542E+02	9.4969E+02	2.5231E+02	4.7722E+02	2.1476E+02
CEC2014-F12	Ave	1.5832E-01	6.3727E-02	1.1077E+00	1.8680E-01	**1.1082E-02**	1.3162E+00	2.5807E-01	1.9208E-01	3.4752E+02	3.0253E-01	8.9924E-01	1.1747E-01	5.2190E-01	1.6446E-01
	Std	2.4307E-02	3.0754E-02	4.0742E-01	2.9705E-02	**1.0792E-02**	2.5838E-01	4.0338E-02	8.0712E-02	2.4607E+02	2.4507E-01	3.6451E-01	5.4771E-02	1.5388E-01	3.0447E-02
CEC2014-F13	Ave	1.2077E-01	1.0208E-01	1.4566E-01	1.3925E-01	**4.3180E-02**	1.3043E-01	1.4349E-01	2.0185E-01	2.3609E+00	1.1200E-01	3.1420E-01	1.3496E-01	1.0762E-01	1.1991E-01
	Std	1.7676E-02	3.0192E-02	2.3560E-02	1.8453E-02	**1.3710E-02**	1.8900E-02	2.8062E-02	4.5369E-02	5.5776E-01	1.7682E-02	5.3465E-02	1.5442E-02	2.6205E-02	2.4957E-02
CEC2014-F14	Ave	2.3102E-01	1.9417E-01	2.5251E-01	1.8292E-01	3.5139E-01	2.5852E-01	2.2601E-01	2.0648E-01	**1.0089E-01**	2.1740E-01	2.9972E-01	2.1602E-01	1.9136E-01	1.8926E-01
	Std	2.9504E-02	**1.9971E-02**	4.6302E-02	2.6259E-02	5.7635E-02	3.2284E-02	3.0069E-02	3.3891E-02	2.0220E-02	3.6530E-02	9.1325E-02	2.7030E-02	2.7355E-02	2.8328E-02
CEC2014-F15	Ave	2.1699E+00	1.8334E+00	3.8871E+00	2.3658E+00	2.8274E+00	4.2345E+00	2.8084E+00	2.4577E+00	**3.0844E-01**	2.4571E+00	7.8531E+00	2.3696E+00	3.1459E+00	2.1236E+00
	Std	2.3982E-01	4.0590E-01	1.4657E+00	2.1574E-01	5.1317E-01	1.1748E+00	5.5784E-01	4.6748E-01	**3.9119E-02**	2.6420E-01	3.6145E+00	2.2425E-01	6.6790E-01	3.5679E-01
CEC2014-F16	Ave	8.3490E+00	8.5205E+00	1.0160E+01	8.4812E+00	9.5572E+00	1.0021E+01	7.5782E+00	8.2934E+00	**6.7128E+00**	8.5855E+00	1.1250E+01	9.0061E+00	8.5743E+00	7.8538E+00
	Std	4.6624E-01	4.8916E-01	4.4189E-01	**4.1072E-01**	7.9850E-01	4.4397E-01	8.2208E-01	7.7431E-01	3.2659E+00	8.0920E-01	6.7527E-01	4.2576E-01	9.7667E-01	6.2392E-01
CEC2014-F17	Ave	2.4337E+02	1.7472E+02	3.7538E+02	1.4291E+02	4.6475E+01	2.2223E+02	7.9461E+01	1.9447E+02	**8.9661E+00**	6.5462E+01	1.3487E+03	6.1195E+01	6.6961E+01	1.6897E+02
	Std	1.0219E+02	1.2658E+02	1.6554E+02	8.0317E+01	8.8547E+01	1.1870E+02	4.6448E+01	1.2409E+02	**1.0214E+00**	2.9476E+01	3.7373E+02	2.5323E+01	5.2775E+01	1.2975E+02
CEC2014-F18	Ave	8.2774E+00	6.2697E+00	1.5971E+01	7.4119E+00	6.2090E+00	6.3870E+00	5.8889E+00	9.9156E+00	1.7602E+01	**2.0003E+00**	5.5120E+01	3.7245E+00	5.2130E+00	3.6915E+00
	Std	3.3347E+00	2.6098E+00	9.7514E+00	4.1553E+00	3.2014E+00	2.7335E+00	2.5261E+00	3.9742E+00	7.9732E+00	**1.0743E+00**	1.0700E+01	1.8585E+00	2.1963E+00	1.7750E+00
CEC2014-F19	Ave	3.8755E+00	2.4463E+00	4.0308E+00	2.6425E+00	2.8138E+00	3.4623E+00	1.8491E+00	2.7240E+00	**9.5717E-01**	2.1337E+00	4.4538E+00	2.4089E+00	1.6072E+00	2.0273E+00
	Std	5.3255E-01	8.3286E-01	5.6781E-01	5.9021E-01	9.3685E-01	**4.1572E-01**	6.5709E-01	6.1409E-01	6.8609E-01	8.3967E-01	7.0859E-01	4.4190E-01	6.3323E-01	6.4444E-01
CEC2014-F20	Ave	3.0406E+00	3.5154E+00	3.7048E+00	2.1460E+00	3.3189E+00	2.1881E+00	2.8467E+00	6.2043E+00	**1.0265E+00**	1.7131E+00	2.2722E+01	2.8087E+00	6.5801E+00	2.5584E+00
	Std	1.4010E+00	1.0711E+00	1.6341E+00	9.9457E-01	5.5180E+00	8.1778E-01	1.3174E+00	2.1032E+00	**6.3681E-01**	6.5767E-01	1.0665E+01	9.1912E-01	3.2101E+00	1.2072E+00

CEC2014-F21	Ave	1.3039E+02	1.0238E+02	1.3702E+02	9.7486E+01	1.6063E+01	1.0163E+02	3.4953E+01	9.1895E+01	**1.2569E+00**	1.7408E+01	3.3961E+02	6.8990E+00	1.7750E+01	6.2290E+01
	Std	8.7313E+01	8.1332E+01	8.6570E+01	7.4704E+01	5.7769E+01	7.1476E+01	4.9455E+01	8.0515E+01	**1.8865E-01**	2.6918E+01	2.3279E+02	6.3169E+00	1.7776E+01	8.2941E+01
CEC2014-F22	Ave	3.2563E+01	4.9644E+01	9.2485E+01	4.7896E+01	1.7685E+02	6.3840E+01	2.7958E+01	4.6905E+01	**1.9303E+00**	4.2926E+01	1.4212E+02	5.4971E+01	3.2849E+01	3.2185E+01
	Std	2.9172E+01	4.6315E+01	5.8121E+01	4.6960E+01	8.1397E+01	5.2285E+01	8.6660E+00	4.7935E+01	**1.7936E+00**	4.0900E+01	1.0011E+02	4.7071E+01	3.9082E+01	3.2525E+01
CEC2014-F23	Ave	3.1524E+02	3.1524E+02	3.1524E+02	3.1493E+02	3.1524E+02	3.1524E+02	3.1524E+02	3.1401E+02	**6.8261E+01**	3.1524E+02	2.0000E+02	3.1524E+02	3.1524E+02	3.1524E+02
	Std	**0.0000E+00**	**0.0000E+00**	9.7466E-14	1.1084E-01	5.6010E-06	**0.0000E+00**	9.0949E-14	1.6586E-05	5.8939E+01	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.8524E-13
CEC2014-F24	Ave	2.2455E+02	2.2172E+02	2.2149E+02	2.0763E+02	2.2434E+02	2.1916E+02	2.1361E+02	2.2371E+02	3.1524E+02	2.0680E+02	2.0000E+02	2.2021E+02	2.1122E+02	**2.0000E+02**
	Std	1.9694E+00	4.5076E+00	4.4859E+00	1.0430E+01	1.0562E+00	7.0651E+00	1.0593E+01	1.5646E+00	**5.7409E-14**	1.0161E+01	5.0123E-05	5.9713E+00	1.0928E+01	1.0608E-07
CEC2014-F25	Ave	2.0261E+02	2.0261E+02	2.0260E+02	2.0253E+02	2.0883E+02	2.0259E+02	2.0257E+02	2.0026E+02	**2.0000E+02**	2.0255E+02	2.0000E+02	2.0260E+02	2.0277E+02	2.0252E+02
	Std	5.9605E-02	5.8383E-02	6.3149E-02	3.2335E-02	1.2626E+00	4.8215E-02	3.3661E-02	4.7503E-02	**0.0000E+00**	1.7819E-02	2.3101E-09	5.8686E-02	1.6333E-01	3.6079E-01
CEC2014-F26	Ave	1.0011E+02	1.0009E+02	1.0013E+02	1.0013E+02	1.2261E+02	1.0013E+02	1.0013E+02	1.0019E+02	2.0256E+02	1.0011E+02	1.0030E+02	1.0014E+02	**1.0009E+02**	1.0010E+02
	Std	1.7158E-02	3.2752E-02	2.1967E-02	**1.6688E-02**	3.6849E+01	2.1742E-02	2.5596E-02	4.5535E-02	2.6500E-02	1.9274E-02	5.6041E-02	1.9630E-02	4.0677E-02	2.6600E-02
CEC2014-F27	Ave	3.0073E+02	3.7462E+02	3.0000E+02	3.0197E+02	3.0161E+02	3.0000E+02	3.0000E+02	3.4774E+02	**1.0010E+02**	3.0000E+02	2.0005E+02	3.0197E+02	3.4415E+02	3.0196E+02
	Std	5.2140E+00	4.4082E+01	5.5878E-05	1.4071E+01	7.7988E+00	1.6766E-13	**9.0949E-14**	5.7681E+01	1.6980E-02	1.2862E-13	2.6668E-01	1.4060E+01	4.9970E+01	1.4003E+01
CEC2014-F28	Ave	8.5003E+02	8.4526E+02	8.6071E+02	8.2836E+02	8.9871E+02	8.5709E+02	8.0270E+02	3.8172E+02	3.2745E+02	8.2316E+02	**2.0000E+02**	8.4102E+02	8.1191E+02	8.1992E+02
	Std	1.4024E+01	2.1535E+01	1.8868E+01	2.0749E+01	2.8767E+01	1.9874E+01	2.1643E+01	5.1939E+01	4.5071E+01	1.8249E+01	**1.9738E-12**	2.3289E+01	2.5196E+01	1.8652E+01
CEC2014-F29	Ave	7.1754E+02	7.1640E+02	7.2097E+02	7.2292E+02	2.6639E+02	7.2005E+02	7.1518E+02	**2.1086E+02**	7.6524E+02	7.1523E+02	6.3198E+02	5.4692E+02	6.1562E+02	7.1616E+02
	Std	4.6123E+00	4.5681E+00	6.6222E+00	1.4381E+01	6.9949E+01	9.8399E+00	**1.1430E+00**	1.1661E+00	3.6591E+01	1.6834E+00	2.0063E+02	2.6576E+02	2.2952E+02	2.7107E+00
CEC2014-F30	Ave	2.3239E+03	7.2260E+02	2.1897E+03	1.2085E+03	1.7345E+03	1.5952E+03	7.1803E+02	5.8062E+02	**1.0000E+02**	8.7524E+02	1.2628E+03	4.0575E+02	4.7095E+02	6.4975E+02
	Std	7.5467E+02	2.6889E+02	9.6409E+02	4.8575E+02	4.2228E+02	7.3706E+02	2.3065E+02	1.9444E+02	**0.0000E+00**	3.0013E+02	8.0878E+02	2.1188E+01	1.0609E+02	2.2365E+02

Table S13 Error statistics of different algorithms solving CEC2014 (Dim=50).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2014-F1	Ave	1.5186E+03	6.2325E-03	2.8106E+04	1.0054E-08	3.7632E-09	2.1747E+04	6.3279E-01	1.0767E+05	3.2724E-03	2.0174E-02	4.8140E+06	1.3525E+02	1.0648E+05	**8.3593E-15**
	Std	1.7438E+03	1.4364E-03	1.6197E+04	7.1708E-08	9.5850E-09	1.0085E+04	2.1757E+00	1.8057E+05	4.1746E-03	8.3471E-02	1.7647E+06	2.5666E+02	6.3799E+04	**9.9177E-15**
CEC2014-F2	Ave	3.7338E-14	2.1244E-12	9.9197E-14	4.0125E-14	2.2995E-09	9.4739E-14	3.1765E-14	1.5938E-13	3.2724E-03	4.6812E-14	3.6864E+05	2.8979E-14	9.1897E-13	**0.0000E+00**
	Std	1.3319E-14	3.9580E-12	3.3808E-14	1.4127E-14	4.6761E-09	3.3948E-14	1.0856E-14	5.4998E-13	4.1746E-03	1.4849E-14	1.5693E+06	3.9798E-15	1.3739E-12	**0.0000E+00**
CEC2014-F3	Ave	5.1271E-14	2.5524E-13	1.2260E-13	5.5729E-14	1.6336E-09	8.3593E-14	**0.0000E+00**	7.8689E-13	1.0808E-11	5.9073E-14	5.4996E+02	5.3500E-14	1.3615E-05	**0.0000E+00**
	Std	1.7072E-14	1.9002E-13	7.0424E-14	7.9597E-15	3.3478E-09	3.2857E-14	**0.0000E+00**	9.9392E-13	3.1493E-11	1.1144E-14	5.0400E+02	1.3508E-14	3.7850E-05	**0.0000E+00**
CEC2014-F4	Ave	6.9318E+01	2.1159E+01	7.8584E+01	4.3415E+01	5.0656E-10	7.2323E+01	3.0513E+01	2.6425E+01	**2.5635E-13**	5.4149E+01	9.6952E+01	3.3339E+01	4.5007E+01	4.8090E+01
	Std	4.3085E+01	4.0751E+01	3.6057E+01	3.7316E+01	6.0366E-10	3.8781E+01	4.4075E+01	1.9716E+01	**2.1492E-13**	4.9005E+01	6.5008E+00	4.4142E+01	3.8985E+01	4.9530E+01
CEC2014-F5	Ave	2.0256E+01	2.0000E+01	2.1020E+01	2.0282E+01	2.0000E+01	2.1038E+01	2.0386E+01	2.0197E+01	**3.7753E+00**	2.1077E+01	2.0770E+01	2.0173E+01	2.0458E+01	2.0241E+01
	Std	3.0529E-02	**1.1450E-04**	8.1626E-02	5.3484E-02	1.2680E-04	9.5655E-02	6.3060E-02	1.6610E-01	1.4311E+00	1.2411E-01	2.0574E-01	1.3887E-01	1.1632E-01	7.5061E-02
CEC2014-F6	Ave	2.0124E-01	1.5294E-02	3.6941E-02	1.0487E-02	3.4787E-05	2.5694E-02	**0.0000E+00**	2.8124E+00	2.1109E+01	2.1428E-02	1.0487E+01	1.7541E-02	8.3187E-01	**0.0000E+00**
	Std	5.1850E-01	1.0523E-01	1.4424E-01	7.2627E-02	8.1954E-05	1.2651E-01	**0.0000E+00**	1.6066E+00	1.0460E-01	1.0176E-01	6.3038E+00	1.2526E-01	1.0972E+00	**0.0000E+00**
CEC2014-F7	Ave	5.7958E-14	1.0923E-13	1.0700E-13	9.8083E-14	5.1473E-09	1.0477E-13	**0.0000E+00**	9.6693E-04	2.1878E-04	1.0700E-13	1.9105E-01	2.2292E-15	5.8008E-04	**0.0000E+00**
	Std	5.7398E-14	2.2287E-14	2.7016E-14	3.9511E-14	3.0393E-08	3.0869E-14	**0.0000E+00**	2.7046E-03	2.4501E-04	2.7016E-14	2.8080E-01	1.5919E-14	2.0082E-03	**0.0000E+00**
CEC2014-F8	Ave	1.0156E-10	1.7164E-12	5.2898E+00	3.5593E-08	4.0384E+00	5.8710E+00	5.3946E-13	**8.6937E-14**	1.1815E-13	1.9514E-08	3.4276E+01	4.5475E-13	2.9127E+01	9.6433E-12
	Std	1.4452E-10	1.6887E-12	7.9289E+00	3.2318E-08	2.2984E+00	5.0566E+00	6.6089E-13	4.8704E-14	**2.2287E-14**	1.6001E-08	7.9546E+00	2.4277E-13	8.0193E+00	2.0521E-11
CEC2014-F9	Ave	1.1205E+01	9.1107E+00	1.7324E+01	2.6493E+01	**2.1460E+00**	1.4465E+01	1.3620E+01	6.9042E+01	3.1019E+00	1.4632E+01	4.5392E+01	1.0148E+01	4.0130E+01	5.4040E+00
	Std	2.2523E+00	3.1800E+00	7.3205E+00	7.5144E+00	1.7840E+00	1.1072E+01	6.5505E+00	1.3219E+01	**1.5368E+00**	2.1943E+00	1.1763E+01	2.0555E+00	1.0387E+01	1.8157E+00
CEC2014-F10	Ave	4.8856E-02	2.4340E-01	2.2483E+02	1.3152E+00	5.8863E+02	6.2922E+02	**9.1662E-03**	2.9734E-01	4.0579E+00	1.7119E+01	1.1255E+03	1.8051E-02	1.8228E+03	1.2625E-01
	Std	2.4694E-02	1.6923E-01	1.0347E+03	6.3183E-01	3.8743E+02	1.4770E+03	**1.2069E-02**	2.5823E-01	1.9683E+00	4.4228E+00	5.7431E+02	1.0233E-01	5.7395E+02	3.9503E-02
CEC2014-F11	Ave	3.2517E+03	3.1259E+03	6.2208E+03	3.3308E+03	8.1869E+02	6.5858E+03	3.8364E+03	4.0589E+03	**4.7032E+01**	3.4166E+03	4.6448E+03	3.3621E+03	5.4543E+03	3.2256E+03
	Std	3.1871E+02	4.8466E+02	2.2986E+03	3.6234E+02	4.0663E+02	1.7956E+03	4.0988E+02	6.1514E+02	**6.2644E+01**	3.4789E+02	1.3061E+03	2.5623E+02	1.0486E+03	4.5676E+02

CEC2014-F12	Ave	2.1287E-01	4.6093E-02	1.7827E+00	2.5687E-01	**1.2023E-03**	1.9805E+00	3.5682E-01	1.9648E-01	7.4546E+02	3.7591E-01	1.0509E+00	2.4819E-01	7.5610E-01	2.1691E-01
	Std	2.5100E-02	1.4486E-02	5.1337E-01	3.3879E-02	**1.9098E-03**	3.4561E-01	7.4220E-02	8.2673E-02	3.8688E+02	3.7314E-01	3.9736E-01	3.0241E-02	2.4332E-01	3.2399E-02
CEC2014-F13	Ave	1.6028E-01	1.8753E-01	1.7409E-01	2.1315E-01	**4.3892E-02**	1.6914E-01	2.2425E-01	2.9566E-01	3.3222E+00	1.7233E-01	4.2563E-01	2.0147E-01	1.7236E-01	2.3487E-01
	Std	1.8180E-02	3.7882E-02	2.4154E-02	2.0745E-02	**9.2229E-03**	2.6738E-02	3.2744E-02	4.4771E-02	2.4660E-01	2.1259E-02	5.9405E-02	1.7713E-02	4.0459E-02	2.4690E-02
CEC2014-F14	Ave	3.1626E-01	2.2689E-01	3.3775E-01	1.9804E-01	3.9352E-01	3.2888E-01	2.4440E-01	2.5791E-01	**1.3485E-01**	2.8143E-01	4.0298E-01	2.7128E-01	4.0297E-01	1.8252E-01
	Std	5.6781E-02	**1.9750E-02**	4.4677E-02	2.3766E-02	3.4126E-02	3.2336E-02	3.3648E-02	3.7297E-02	2.1704E-02	3.8607E-02	1.6130E-01	2.1548E-02	1.9517E-01	2.0311E-02
CEC2014-F15	Ave	5.2346E+00	4.4977E+00	7.9204E+00	5.5782E+00	5.0669E+00	9.1526E+00	5.5082E+00	5.7879E+00	**3.2307E-01**	5.4517E+00	1.5541E+01	5.4112E+00	5.3127E+00	4.9723E+00
	Std	4.5919E-01	9.6114E-01	2.6022E+00	4.5705E-01	9.5343E-01	3.3108E+00	9.1710E-01	1.1504E+00	**3.2905E-02**	5.4909E-01	5.1118E+00	3.5894E-01	8.3180E-01	8.0900E-01
CEC2014-F16	Ave	1.6835E+01	1.7871E+01	1.9462E+01	1.6972E+01	1.5983E+01	1.9491E+01	**1.5743E+01**	1.6725E+01	1.7174E+01	1.6992E+01	2.0090E+01	1.7193E+01	1.7380E+01	1.6090E+01
	Std	**3.9091E-01**	5.4948E-01	4.5466E-01	4.1938E-01	1.1345E+00	4.5520E-01	9.1537E-01	7.4884E-01	7.7403E+00	8.0779E-01	7.2900E-01	5.7194E-01	7.0245E-01	6.1100E-01
CEC2014-F17	Ave	1.6800E+03	7.0405E+02	1.7288E+03	3.5151E+02	1.6050E+03	1.5479E+03	4.4148E+02	1.1955E+03	**1.8173E+01**	3.2342E+02	2.3503E+04	7.2498E+02	2.5101E+03	5.1084E+02
	Std	4.1717E+02	2.2766E+02	5.1405E+02	1.5760E+02	1.2877E+03	3.9688E+02	2.4198E+02	3.4600E+02	**1.4567E+00**	1.5807E+02	1.7646E+04	2.7224E+02	3.2123E+03	3.2257E+02
CEC2014-F18	Ave	1.0745E+02	2.6934E+01	1.1556E+02	2.2409E+01	**9.1009E-01**	9.8114E+01	1.6012E+01	6.9452E+01	5.2189E+01	1.2250E+01	1.4812E+02	2.9841E+01	1.3983E+01	8.6198E+00
	Std	1.7441E+01	7.3828E+00	1.8168E+01	6.2478E+00	**6.1282E-01**	1.5266E+01	5.9240E+00	2.3840E+01	1.4081E+01	4.1061E+00	2.3049E+01	1.1223E+01	3.7002E+00	3.0776E+00
CEC2014-F19	Ave	7.9097E+00	1.0268E+01	7.5919E+00	1.0013E+01	7.3136E+00	8.0971E+00	7.4887E+00	1.3171E+01	**2.2117E+00**	9.1146E+00	1.2582E+01	8.8658E+00	8.3972E+00	5.2691E+00
	Std	1.8323E+00	1.1175E+00	1.4701E+00	**8.3488E-01**	1.7302E+00	1.8879E+00	1.0995E+00	5.2951E+00	1.1692E+00	1.2804E+00	1.2732E+00	1.1064E+00	1.4690E+00	1.6544E+00
CEC2014-F20	Ave	1.3685E+01	1.0972E+01	1.6078E+01	6.0000E+00	**2.8944E+00**	9.6673E+00	6.6512E+00	3.2454E+01	4.5069E+00	5.0108E+00	1.0007E+02	7.2679E+00	1.3658E+01	5.0659E+00
	Std	4.0049E+00	3.3773E+00	4.3605E+00	2.2360E+00	8.9941E-01	2.8483E+00	2.3390E+00	1.4775E+01	**7.2247E-01**	1.9125E+00	3.3473E+01	2.0008E+00	4.2215E+00	1.9024E+00
CEC2014-F21	Ave	6.1235E+02	3.6608E+02	7.4548E+02	3.2135E+02	1.2868E+03	5.2926E+02	2.9311E+02	6.1122E+02	**2.2628E+00**	2.6920E+02	2.8378E+03	3.3136E+02	3.8621E+02	3.8222E+02
	Std	1.6735E+02	1.2675E+02	2.3614E+02	1.1274E+02	5.4386E+02	1.5416E+02	1.0068E+02	2.0290E+02	**5.6402E-01**	9.4892E+01	2.0123E+03	1.1430E+02	1.9159E+02	1.6870E+02
CEC2014-F22	Ave	1.0473E+02	1.3975E+02	1.6494E+02	**9.2021E+01**	1.6151E+02	1.3188E+02	1.5177E+02	3.9776E+02	1.1637E+02	1.0568E+02	6.7070E+02	1.5276E+02	1.5619E+02	1.0655E+02
	Std	6.7056E+01	**5.4622E+01**	7.4203E+01	6.0311E+01	6.5002E+01	5.8204E+01	1.0464E+02	1.1945E+02	6.7751E+01	7.1986E+01	2.1936E+02	5.5468E+01	1.8471E+02	8.4828E+01
CEC2014-F23	Ave	3.4400E+02	3.4400E+02	3.4400E+02	3.4216E+02	3.4400E+02	3.4400E+02	3.4400E+02	3.3708E+02	**3.3017E+01**	3.4400E+02	2.0000E+02	3.4400E+02	3.4400E+02	3.4400E+02
	Std	1.2862E-13	2.1986E-13	1.7831E-13	7.9887E-01	2.1982E-05	1.8402E-13	1.3713E-13	1.5022E-02	3.2194E+01	1.8524E-13	**0.0000E+00**	1.4801E-13	2.0527E-13	**0.0000E+00**
CEC2014-F24	Ave	2.7502E+02	2.6810E+02	2.7371E+02	2.6832E+02	2.6856E+02	2.7364E+02	2.6794E+02	2.6334E+02	3.4401E+02	2.7245E+02	**2.0000E+02**	2.7478E+02	2.7032E+02	2.6507E+02
	Std	6.1722E-01	3.0634E+00	1.2620E+00	1.6060E+00	1.8826E+00	1.5285E+00	1.5514E+00	7.1161E+00	**0.0000E+00**	2.0486E+00	8.8678E-05	1.9078E+00	3.0974E+00	9.4540E+00
CEC2014-F25	Ave	2.0525E+02	2.0503E+02	2.0522E+02	2.0490E+02	2.1673E+02	2.0526E+02	2.0494E+02	2.0190E+02	2.6150E+02	2.0494E+02	**2.0000E+02**	2.0555E+02	2.0570E+02	2.0493E+02
	Std	3.1894E-01	2.1076E-01	2.1477E-01	1.3493E-01	1.5171E+00	2.7720E-01	1.4748E-01	4.4798E+00	5.0173E+00	1.4955E-01	**2.7171E-09**	2.6397E-01	5.3241E-01	1.6922E-01
CEC2014-F26	Ave	**1.0016E+02**	1.0213E+02	1.2958E+02	1.0020E+02	1.2048E+02	1.0804E+02	1.0021E+02	1.0223E+02	2.0489E+02	1.0018E+02	1.0614E+02	1.0369E+02	1.0017E+02	1.0021E+02
	Std	**1.7620E-02**	1.3979E+01	4.5909E+01	2.5847E-02	3.4643E+01	2.7098E+01	3.2293E-02	1.3964E+01	6.9212E-02	2.0818E-02	2.3158E+01	1.7626E+01	4.2079E-02	2.6176E-02
CEC2014-F27	Ave	3.4246E+02	3.0800E+02	3.3101E+02	3.1582E+02	3.0279E+02	3.2046E+02	3.0707E+02	3.9709E+02	**1.0013E+02**	3.1288E+02	2.0000E+02	3.1108E+02	3.8193E+02	3.0631E+02
	Std	2.9285E+01	1.7513E+01	2.4168E+01	2.1829E+01	1.1227E+01	2.7412E+01	1.6639E+01	5.8982E+01	2.7732E-02	2.0406E+01	**6.4692E-13**	2.1717E+01	4.2126E+01	1.4961E+01
CEC2014-F28	Ave	1.1332E+03	1.1339E+03	1.1976E+03	1.1526E+03	1.2246E+03	1.1746E+03	1.0821E+03	3.8577E+02	3.0000E+02	1.0873E+03	**2.0000E+02**	1.1818E+03	1.1027E+03	1.0963E+03
	Std	3.4770E+01	3.9677E+01	5.5523E+01	3.3586E+01	5.2073E+01	4.2487E+01	2.8842E+01	1.3182E+01	2.6987E-03	3.2092E+01	**1.2780E-13**	3.1610E+01	3.7252E+01	2.6794E+01
CEC2014-F29	Ave	8.0199E+02	8.0806E+02	8.6486E+02	8.1089E+02	4.9628E+02	8.3861E+02	7.9663E+02	**3.1456E+02**	1.0485E+03	8.1046E+02	6.5049E+02	4.4292E+02	1.6231E+07	8.1529E+02
	Std	3.3912E+01	4.2729E+01	5.7627E+01	3.4883E+01	**2.6729E+01**	5.3911E+01	4.4956E+01	1.7974E+02	5.5916E+01	4.4165E+01	7.6361E+02	1.0161E+02	1.8090E+07	4.8637E+01
CEC2014-F30	Ave	8.6702E+03	8.6326E+03	8.7164E+03	8.1345E+03	8.7790E+03	8.6210E+03	8.2301E+03	1.2220E+03	**3.3777E+02**	8.3318E+03	6.1496E+02	8.7628E+03	8.1436E+03	8.5188E+03
	Std	3.7241E+02	4.1677E+02	5.0819E+02	5.4666E+02	3.2665E+02	3.7530E+02	2.9352E+02	2.4572E+02	**8.3969E+00**	3.6438E+02	1.5140E+03	6.1265E+02	2.1986E+02	4.0572E+02

Table S14 Error statistics of different algorithms solving CEC2014 (Dim=100).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2014-F1	Ave	1.6645E+05	**5.3181E-03**	5.4266E+05	6.2924E+03	1.2828E-01	4.9554E+05	6.4738E+04	2.9610E+05	6.1181E+04	5.9048E+04	1.0286E+08	2.1113E+05	6.9235E+05	1.1921E+04
	Std	5.7445E+04	**3.4697E-04**	1.6278E+05	5.2009E+03	1.2564E-01	1.7383E+05	3.2126E+04	3.5964E+05	3.4542E+04	2.2929E+04	3.0737E+07	7.5941E+04	1.9108E+05	1.0503E+04
CEC2014-F2	Ave	7.3952E-13	4.5993E-09	9.4786E-10	2.7903E-12	2.2298E-09	4.2409E-10	9.6244E-12	1.3028E-03	6.1181E+04	2.5357E-13	2.9445E+08	2.9166E-08	1.0593E-02	**1.1536E-13**
	Std	9.2915E-13	6.4986E-09	1.9596E-09	4.4517E-12	2.4420E-09	1.1883E-09	9.1349E-12	3.2161E-03	3.4542E+04	2.4243E-13	3.4768E+08	2.5743E-08	4.7182E-02	**2.6303E-14**

CEC2014-F3	Ave	6.3642E-13	2.8871E-07	3.9429E-11	2.8756E-13	9.4230E-09	4.9877E-12	5.9073E-14	4.8902E-07	9.4274E+00	6.3197E-13	1.7886E+04	1.3716E-11	1.0383E+00	**0.0000E+00**
	Std	4.4917E-13	6.1981E-07	1.0397E-10	5.6171E-14	2.5774E-08	5.4456E-12	1.1144E-14	9.3399E-07	1.6827E+01	2.6678E-13	6.3340E+03	2.1723E-11	5.4693E+00	**0.0000E+00**
CEC2014-F4	Ave	1.8431E+02	1.5781E+02	1.7610E+02	1.7591E+02	5.9471E+01	1.7693E+02	1.6551E+02	1.5220E+02	**1.3726E-05**	1.6191E+02	3.6064E+02	1.6440E+02	1.5076E+02	1.5188E+02
	Std	3.0612E+01	2.6314E+01	2.9633E+01	3.1499E+01	6.9089E+01	3.0520E+01	2.9609E+01	6.6045E+01	**2.6702E-05**	3.0832E+01	6.0194E+01	2.5018E+01	4.2232E+01	1.9162E+01
CEC2014-F5	Ave	2.0550E+01	**2.0000E+01**	2.1228E+01	2.0553E+01	2.0000E+01	2.1244E+01	2.0624E+01	2.0083E+01	1.5580E+02	2.1258E+01	2.1092E+01	2.0510E+01	2.0827E+01	2.0468E+01
	Std	3.6474E-02	1.2464E-04	3.0171E-02	8.5870E-02	**1.1031E-04**	3.1438E-02	2.0851E-01	1.8991E-01	2.3702E+01	7.7240E-02	1.6658E-01	1.0723E-01	8.6167E-02	1.9656E-01
CEC2014-F6	Ave	5.5656E+00	1.0302E+00	4.3694E+00	**1.9703E-01**	1.6470E+00	2.4783E+00	3.6513E-01	2.4429E+01	2.1293E+01	2.6039E+00	4.5972E+01	1.4616E+00	2.0125E+01	4.6325E-01
	Std	1.9958E+00	7.9291E-01	1.9974E+00	3.8735E-01	1.0749E+00	1.7967E+00	5.8547E-01	3.4519E+00	**9.4873E-02**	1.5440E+00	1.3028E+01	1.4990E+00	3.5980E+00	7.0276E-01
CEC2014-F7	Ave	1.8725E-13	2.2514E-13	2.8087E-13	2.4075E-13	1.1769E-08	2.3852E-13	5.7958E-14	9.1809E-04	6.0946E-02	2.2069E-13	5.0302E+00	1.1592E-13	1.9328E-04	**0.0000E+00**
	Std	5.4870E-14	3.5880E-14	6.9537E-14	4.3422E-14	3.8456E-08	5.2122E-14	5.7398E-14	2.8720E-03	1.9219E-01	4.1998E-14	6.0115E+00	1.5919E-14	1.3803E-03	**0.0000E+00**
CEC2014-F8	Ave	1.5886E-03	1.5982E-01	1.6603E+01	8.5717E-01	1.3247E+01	1.4887E+01	1.2117E-05	**1.1592E-13**	8.3660E-12	4.3963E-03	1.4919E+02	1.3699E-07	7.8582E+01	4.8187E+00
	Std	9.8960E-04	3.5110E-01	1.1853E+01	6.3882E-01	6.5531E+00	4.5514E+00	1.8959E-05	**1.5919E-14**	7.2189E-12	4.3205E-03	4.0396E+01	1.2804E-07	1.2589E+01	1.9636E+00
CEC2014-F9	Ave	2.5186E+01	2.8542E+01	3.9146E+01	5.3419E+01	**9.4424E+00**	2.3194E+01	1.4476E+01	2.2451E+02	1.0242E+01	4.3783E+01	2.1689E+02	2.4010E+01	8.0944E+01	1.1315E+01
	Std	3.7917E+00	5.1218E+00	1.1065E+01	1.0630E+01	3.4373E+00	5.0380E+00	3.1420E+00	3.9114E+01	**2.4718E+00**	4.9250E+00	9.5832E+01	4.5372E+00	1.4185E+01	3.0567E+00
CEC2014-F10	Ave	1.8459E+01	2.4658E+02	4.2127E+02	1.2650E+02	1.5768E+03	1.1103E+03	9.4640E+00	1.4629E+00	1.3754E+01	1.4163E+02	4.7531E+03	**3.2246E-01**	4.0139E+03	1.7415E+01
	Std	3.7829E+00	2.8090E+02	1.8580E+03	2.6865E+01	1.1707E+03	2.3158E+03	2.5533E+00	8.4304E-01	2.4510E+00	3.4013E+01	1.1509E+03	**1.3290E-01**	1.5433E+03	3.6582E+00
CEC2014-F11	Ave	1.0777E+04	1.0666E+04	1.3580E+04	1.0785E+04	3.1120E+03	1.5968E+04	8.4100E+03	1.1717E+04	**2.7407E+02**	1.0329E+04	1.0426E+04	1.0212E+04	1.3802E+04	8.0833E+03
	Std	5.0236E+02	1.0569E+03	4.1221E+03	5.3395E+02	6.5702E+02	4.3289E+03	1.1486E+03	8.3289E+02	**1.7891E+02**	6.0519E+02	2.9244E+03	3.9023E+02	1.4078E+03	8.3191E+02
CEC2014-F12	Ave	4.3038E-01	5.9376E-02	2.6782E+00	5.1601E-01	**9.3770E-04**	2.7487E+00	6.6041E-01	2.9916E-01	2.4337E+03	5.2520E-01	1.5116E+00	4.3189E-01	1.6764E+00	4.1977E-01
	Std	3.8255E-02	2.5552E-02	4.0466E-01	4.6751E-02	**1.0876E-03**	4.1340E-01	8.1805E-02	8.5195E-02	5.6071E+02	3.2796E-01	5.9984E-01	4.2771E-02	3.0007E-01	3.9351E-02
CEC2014-F13	Ave	2.3668E-01	2.6549E-01	2.6083E-01	3.2002E-01	**5.9063E-02**	2.5665E-01	3.3100E-01	4.0821E-01	3.9782E+00	2.8141E-01	5.0969E-01	2.5275E-01	3.1762E-01	3.8498E-01
	Std	2.1208E-02	5.9986E-02	4.2107E-02	2.7669E-02	**8.7425E-03**	3.0737E-02	4.0217E-02	4.7876E-02	3.1249E-01	5.0944E-02	5.9061E-02	3.2533E-02	4.5429E-02	2.8407E-02
CEC2014-F14	Ave	3.3427E-01	2.5212E-01	3.8252E-01	2.1996E-01	3.7503E-01	3.8573E-01	2.9393E-01	3.0729E-01	**2.0163E-01**	3.2630E-01	3.9481E-01	2.9040E-01	2.7555E-01	2.0973E-01
	Std	1.5676E-02	**1.4249E-02**	2.3785E-02	1.6610E-02	2.9782E-02	2.3763E-02	2.6003E-02	5.6563E-02	2.6044E-02	3.1907E-02	1.2608E-01	1.9530E-02	7.7351E-02	1.7334E-02
CEC2014-F15	Ave	1.6040E+01	1.1661E+01	1.8732E+01	1.7215E+01	1.1741E+01	2.2625E+01	1.2843E+01	1.7062E+01	**1.6448E-01**	1.6062E+01	7.5344E+01	1.5416E+01	1.0336E+01	1.4770E+01
	Std	1.1851E+00	1.2851E+00	1.8919E+00	1.2883E+00	1.7815E+00	7.4631E+00	2.1981E+00	2.2601E+00	**1.5467E-02**	1.3758E+00	9.2486E+00	9.3798E-01	1.2206E+00	2.2295E+00
CEC2014-F16	Ave	3.8892E+01	4.1682E+01	4.3268E+01	3.8999E+01	3.7730E+01	4.3233E+01	3.8110E+01	3.9331E+01	**3.2140E+01**	3.8687E+01	4.4105E+01	3.9063E+01	4.0794E+01	3.8606E+01
	Std	6.2911E-01	1.3082E+00	7.1844E-01	5.0382E-01	1.3142E+00	5.0846E-01	7.3099E-01	9.2225E-01	1.7543E+01	6.2840E-01	1.0222E+00	**3.5911E-01**	1.8343E+00	6.7992E-01
CEC2014-F17	Ave	4.4380E+03	3.7710E+03	8.6234E+03	1.7766E+03	2.4783E+03	6.5661E+03	2.5832E+03	5.9590E+04	**4.1855E+01**	3.5971E+03	1.8300E+06	4.0605E+03	6.4566E+04	2.5438E+03
	Std	7.8973E+02	6.5553E+02	2.6360E+03	5.0522E+02	2.5544E+03	1.9977E+03	5.6132E+02	3.6858E+04	**2.5091E+00**	6.2274E+02	7.5420E+05	5.6223E+02	2.1031E+04	6.3111E+02
CEC2014-F18	Ave	2.2033E+02	2.0471E+02	2.3503E+02	1.1884E+02	**2.8678E+00**	2.3240E+02	1.3311E+02	8.0081E+02	2.3505E+02	2.2760E+02	2.1469E+03	2.3866E+02	8.1210E+02	6.3239E+01
	Std	1.9672E+01	2.7123E+01	2.0582E+01	2.4802E+01	**1.4772E+00**	1.9365E+01	2.7285E+01	7.5845E+02	1.1023E+02	2.8027E+01	2.6379E+03	2.4035E+01	9.6385E+02	1.6130E+01
CEC2014-F19	Ave	9.5176E+01	8.9614E+01	9.4665E+01	5.7994E+01	7.3397E+01	9.4371E+01	8.9346E+01	5.4845E+01	**1.7343E+01**	9.1034E+01	1.0322E+02	9.9018E+01	9.2101E+01	8.8968E+01
	Std	2.0022E+00	1.3290E+00	2.2492E+00	9.7507E+00	2.1373E+01	2.0327E+00	1.1882E+00	1.8173E+01	3.9365E+00	1.1796E+00	7.8599E+00	3.0529E+00	2.9759E+00	**9.2514E-01**
CEC2014-F20	Ave	1.2867E+02	6.3168E+01	1.3437E+02	**2.0357E+01**	3.4369E+02	8.6152E+01	2.5660E+01	1.8639E+02	8.8010E+01	4.1926E+01	3.9184E+03	8.3629E+01	5.0101E+02	2.2724E+01
	Std	3.4356E+01	1.9936E+01	4.3631E+01	3.7025E+00	2.0239E+02	1.5728E+01	4.4378E+00	6.8420E+01	**9.6521E-01**	9.1754E+00	2.1385E+03	2.1505E+01	3.1399E+02	5.6756E+00
CEC2014-F21	Ave	2.3710E+03	1.3726E+03	2.7253E+03	5.6069E+02	3.1502E+03	2.4219E+03	1.1133E+03	1.8063E+04	**7.1670E+00**	8.9367E+02	2.9614E+05	2.0344E+03	1.9940E+04	1.0930E+03
	Std	4.8771E+02	3.4338E+02	6.2727E+02	2.2630E+02	9.0228E+02	6.0505E+02	3.6227E+02	1.4783E+04	**1.5708E+00**	2.9160E+02	2.4742E+05	2.9608E+02	9.8247E+03	3.6688E+02
CEC2014-F22	Ave	1.0385E+03	1.1502E+03	1.2007E+03	7.8315E+02	7.3553E+02	1.2476E+03	1.2657E+03	1.4857E+03	**1.7825E+02**	1.0745E+03	2.0352E+03	9.2021E+02	1.2255E+03	9.5631E+02
	Std	1.6886E+02	2.9243E+02	2.1287E+02	1.9036E+02	3.4946E+02	2.8214E+02	2.8960E+02	2.7244E+02	**3.5309E+01**	1.8726E+02	5.0991E+02	2.7017E+02	3.9443E+02	2.7022E+02
CEC2014-F23	Ave	3.4823E+02	3.4823E+02	3.4823E+02	3.4820E+02	3.4825E+02	3.4823E+02	3.4823E+02	3.4605E+02	**4.8458E+01**	3.4823E+02	2.0000E+02	3.4823E+02	3.4823E+02	3.4823E+02
	Std	9.2009E-14	**5.7409E-14**	2.7801E-13	8.6403E-03	3.9962E-03	1.1677E-13	3.9799E-13	1.1508E-01	3.6483E+01	1.5484E-13	1.9104E-13	3.6804E-13	1.1892E-12	1.3713E-13
CEC2014-F24	Ave	3.9407E+02	3.7743E+02	3.8849E+02	3.7281E+02	3.7635E+02	3.8784E+02	3.7410E+02	3.5210E+02	3.4824E+02	3.8736E+02	**2.0000E+02**	3.8987E+02	3.8934E+02	3.6769E+02
	Std	2.9490E+00	2.6647E+00	2.3511E+00	2.4539E+00	2.8341E+00	2.4430E+00	3.3620E+00	1.0852E+01	**0.0000E+00**	2.1978E+00	**0.0000E+00**	3.4151E+00	6.2142E+00	1.7374E+00
CEC2014-F25	Ave	2.0000E+02	2.1791E+02	2.0000E+02	2.1520E+02	2.0311E+02	2.0000E+02	2.1579E+02	2.1275E+02	3.6461E+02	2.1077E+02	**2.0000E+02**	2.2240E+02	2.2699E+02	2.1601E+02
	Std	3.0674E-13	1.1409E+00	3.5031E-13	5.0974E-01	8.2662E+00	3.9617E-13	8.1683E-01	2.1096E+01	1.2185E+00	8.4552E+00	**0.0000E+00**	6.4223E+00	8.3173E+00	8.2719E-01
CEC2014-F26	Ave	2.0000E+02	2.0008E+02	2.0001E+02	2.0001E+02	2.0003E+02	2.0000E+02	2.0000E+02	2.0007E+02	2.1526E+02	2.0000E+02	**1.8200E+02**	2.0000E+02	1.9424E+02	2.0000E+02

	Std	1.4661E-12	1.6966E-02	1.4923E-02	2.3453E-02	3.9214E-02	8.1892E-03	3.0577E-13	2.5514E-02	4.8256E-01	1.9736E-13	3.8218E+01	7.1120E-03	2.3721E+01	**0.0000E+00**
CEC2014-F27	Ave	3.3733E+02	3.0144E+02	3.5248E+02	3.0220E+02	3.0000E+02	3.2828E+02	3.0106E+02	8.2941E+02	2.0007E+02	3.1968E+02	**2.0000E+02**	3.1276E+02	7.8359E+02	3.0392E+02
	Std	2.6356E+01	4.7205E+00	4.5048E+01	5.9406E+00	2.0644E-05	3.2398E+01	5.5641E-01	1.3934E+02	2.3613E-02	1.8464E+01	**4.0372E-07**	1.8739E+01	8.8956E+01	3.9925E+00
CEC2014-F28	Ave	2.3006E+03	2.2228E+03	2.3227E+03	2.2745E+03	2.3410E+03	2.3298E+03	2.0839E+03	7.0527E+02	3.0157E+02	2.0766E+03	**2.0000E+02**	2.5110E+03	2.1427E+03	2.1013E+03
	Std	5.1765E+01	2.0063E+02	9.8582E+01	7.5026E+01	2.7896E+02	8.8612E+01	6.5098E+01	1.2954E+02	5.3133E+00	1.7872E+02	**0.0000E+00**	3.5420E+02	1.8577E+02	6.9393E+01
CEC2014-F29	Ave	8.9384E+02	1.0295E+03	1.4124E+03	7.3841E+02	7.5025E+02	1.3158E+03	7.3326E+02	3.3931E+02	1.9926E+03	7.3655E+02	**2.0000E+02**	1.2143E+03	2.1399E+07	7.2216E+02
	Std	1.6887E+02	2.0430E+02	1.9281E+02	3.2494E+01	5.6367E+01	2.6112E+02	2.9766E+01	2.4817E+02	4.2781E+02	3.1420E+01	**3.0096E-12**	2.9834E+02	4.7315E+07	2.8465E+01
CEC2014-F30	Ave	9.2022E+03	6.9312E+03	9.0644E+03	7.8500E+03	6.0552E+03	8.9706E+03	4.6168E+03	2.7342E+03	6.6306E+02	6.3285E+03	**2.0000E+02**	7.2252E+03	5.2530E+03	3.8798E+03
	Std	7.7101E+02	9.6324E+02	1.0297E+03	7.3867E+02	1.5161E+03	9.1114E+02	7.6996E+02	5.0151E+02	1.9994E+01	1.0103E+03	**5.2613E-05**	5.6251E+02	8.1537E+02	7.6751E+02

Table S15 Detailed results of the CEC2014 Wilcoxon signed-rank test (Dim=10).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2014-F1	=	=	=	=	+	=	=	=	=	=	+	=	+
CEC2014-F2	=	=	=	=	+	=	=	=	=	=	=	=	=
CEC2014-F3	=	=	=	=	+	=	=	=	=	=	=	=	=
CEC2014-F4	=	-	=	-	-	=	=	-	-	=	-	-	-
CEC2014-F5	=	=	=	=	=	=	=	+	=	+	+	=	+
CEC2014-F6	=	=	=	=	+	=	=	=	+	=	+	=	=
CEC2014-F7	=	-	-	-	-	-	+	+	-	-	+	+	+
CEC2014-F8	=	=	+	=	+	+	=	=	+	=	+	=	+
CEC2014-F9	+	-	+	+	-	+	+	=	-	=	+	+	+
CEC2014-F10	=	-	+	-	+	+	-	=	+	+	+	=	+
CEC2014-F11	+	+	+	=	=	+	+	=	-	=	+	+	+
CEC2014-F12	-	-	+	=	-	+	+	=	+	+	+	-	+
CEC2014-F13	+	=	+	+	-	+	=	+	+	+	+	+	=
CEC2014-F14	-	=	-	=	+	-	=	-	-	-	+	=	-
CEC2014-F15	=	-	+	=	+	+	+	=	-	+	+	+	+
CEC2014-F16	+	+	+	+	+	+	=	=	+	+	+	+	+
CEC2014-F17	-	=	-	=	=	-	-	-	-	-	-	-	-
CEC2014-F18	-	-	-	-	=	-	-	-	+	-	+	-	=
CEC2014-F19	=	-	=	=	+	=	=	-	=	=	+	=	=
CEC2014-F20	-	-	-	-	+	-	-	-	-	-	-	-	-
CEC2014-F21	-	-	=	=	+	=	=	-	=	+	=	-	=
CEC2014-F22	+	=	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F23	+	+	+	+	+	+	=	+	-	+	-	+	+
CEC2014-F24	+	=	+	+	+	+	+	=	+	+	+	+	+
CEC2014-F25	+	-	=	=	+	-	-	-	-	-	+	=	=
CEC2014-F26	+	-	+	+	-	+	=	+	+	+	+	=	=
CEC2014-F27	+	=	+	+	+	=	=	+	+	=	+	+	=
CEC2014-F28	=	=	=	=	=	=	=	-	-	=	-	+	=
CEC2014-F29	+	+	=	+	=	=	=	-	+	=	=	=	=
CEC2014-F30	-	=	=	=	+	-	-	-	-	-	=	-	-

Table S16 Detailed results of the CEC2014 Wilcoxon signed-rank test (Dim=30).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2014-F1	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F2	=	=	=	=	+	=	=	=	+	=	+	=	+
CEC2014-F3	=	=	=	=	+	=	=	=	+	=	+	=	+

CEC2014-F4	+	+	+	+	+	+	+	+	=	+	+	+	+
CEC2014-F5	-	-	+	+	-	+	+	+	-	+	+	-	+
CEC2014-F6	=	=	+	=	+	=	=	+	+	=	+	=	+
CEC2014-F7	=	=	=	=	+	=	=	=	+	=	+	=	=
CEC2014-F8	+	=	+	+	+	+	=	-	-	+	+	+	+
CEC2014-F9	+	-	+	+	+	+	+	+	-	+	+	+	+
CEC2014-F10	-	+	+	=	+	+	-	+	+	+	+	-	+
CEC2014-F11	=	+	+	+	-	+	+	+	-	+	+	+	+
CEC2014-F12	=	-	+	+	-	+	+	+	+	+	+	-	+
CEC2014-F13	=	-	+	+	-	+	+	+	+	-	+	+	-
CEC2014-F14	+	=	+	=	+	+	+	+	-	+	+	+	=
CEC2014-F15	=	-	+	+	+	+	+	+	-	+	+	+	+
CEC2014-F16	+	+	+	+	+	+	=	+	-	+	+	+	+
CEC2014-F17	+	=	+	=	-	+	-	=	-	-	+	-	-
CEC2014-F18	+	+	+	+	+	+	+	+	+	-	+	=	+
CEC2014-F19	+	+	+	+	+	+	=	+	-	=	+	+	-
CEC2014-F20	=	+	+	-	=	=	=	+	-	-	+	=	+
CEC2014-F21	+	+	+	+	-	+	=	+	-	-	+	-	-
CEC2014-F22	+	+	+	+	+	+	+	=	-	+	+	+	=
CEC2014-F23	+	+	+	-	+	+	+	-	-	+	-	+	+
CEC2014-F24	+	+	+	=	+	+	+	+	+	+	+	+	+
CEC2014-F25	+	+	+	-	+	+	=	-	-	-	-	+	+
CEC2014-F26	+	-	+	+	+	+	+	+	+	+	+	+	=
CEC2014-F27	=	+	+	+	=	=	=	+	-	=	-	=	+
CEC2014-F28	+	+	+	+	+	+	-	-	-	=	-	+	=
CEC2014-F29	=	=	+	+	-	+	-	-	+	-	=	=	=
CEC2014-F30	+	=	+	+	+	+	=	=	-	+	+	-	-

Table S17 Detailed results of the CEC2014 Wilcoxon signed-rank test (Dim=50).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2014-F1	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F2	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F3	+	+	+	+	+	+	=	+	+	+	+	+	+
CEC2014-F4	+	-	+	=	-	+	=	-	-	+	+	=	=
CEC2014-F5	=	-	+	+	-	+	+	=	-	+	+	=	+
CEC2014-F6	+	+	+	+	+	+	=	+	+	+	+	=	+
CEC2014-F7	+	+	+	+	+	+	=	+	+	+	+	=	+
CEC2014-F8	+	-	+	+	+	+	-	-	-	+	+	-	+
CEC2014-F9	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2014-F10	-	+	+	+	+	+	-	+	+	+	+	-	+
CEC2014-F11	=	=	+	=	-	+	+	+	-	+	+	=	+
CEC2014-F12	=	-	+	+	-	+	+	=	+	+	+	+	+
CEC2014-F13	-	-	-	-	-	-	=	+	+	-	+	-	-
CEC2014-F14	+	+	+	+	+	+	+	+	-	+	+	+	+
CEC2014-F15	+	-	+	+	=	+	+	+	-	+	+	+	=
CEC2014-F16	+	+	+	+	=	+	-	+	=	+	+	+	+
CEC2014-F17	+	+	+	-	+	+	=	+	-	-	+	+	+
CEC2014-F18	+	+	+	+	-	+	+	+	+	+	+	+	+
CEC2014-F19	+	+	+	+	+	+	+	+	-	+	+	+	+
CEC2014-F20	+	+	+	=	-	+	+	+	=	=	+	+	+
CEC2014-F21	+	=	+	=	+	+	-	+	-	-	+	=	=
CEC2014-F22	=	+	+	=	+	+	+	+	=	=	+	+	=
CEC2014-F23	+	+	+	-	+	+	+	-	-	+	-	+	+
CEC2014-F24	+	+	+	+	+	+	+	-	+	+	-	+	+

CEC2014-F25	+	+	+	=	+	+	=	-	+	=	-	+	+
CEC2014-F26	-	-	+	=	+	=	=	+	+	-	+	-	-
CEC2014-F27	+	+	+	+	+	+	+	+	-	+	-	+	+
CEC2014-F28	+	+	+	+	+	+	-	-	-	=	-	+	=
CEC2014-F29	=	=	+	=	-	+	-	-	+	=	-	-	+
CEC2014-F30	+	=	=	-	+	=	-	-	-	-	-	+	-

Table S18 Detailed results of the CEC2014 Wilcoxon signed-rank test (Dim=100).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2014-F1	+	-	+	-	-	+	+	+	+	+	+	+	+
CEC2014-F2	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F3	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F4	+	=	+	+	-	+	=	=	-	=	+	+	=
CEC2014-F5	=	-	+	=	-	+	+	-	+	+	+	=	+
CEC2014-F6	+	+	+	=	+	+	=	+	+	+	+	+	+
CEC2014-F7	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2014-F8	-	-	+	-	+	+	-	-	-	-	+	-	+
CEC2014-F9	+	+	+	+	-	+	+	+	=	+	+	+	+
CEC2014-F10	=	+	+	+	+	+	-	-	-	+	+	-	+
CEC2014-F11	+	+	+	+	-	+	=	+	-	+	+	+	+
CEC2014-F12	=	-	+	+	-	+	+	-	+	+	+	=	+
CEC2014-F13	-	-	-	-	-	-	-	+	+	-	+	-	-
CEC2014-F14	+	+	+	+	+	+	+	+	=	+	+	+	+
CEC2014-F15	+	-	+	+	-	+	-	+	-	+	+	=	-
CEC2014-F16	=	+	+	+	-	+	-	+	-	=	+	+	+
CEC2014-F17	+	+	+	-	=	+	=	+	-	+	+	+	+
CEC2014-F18	+	+	+	+	-	+	+	+	+	+	+	+	+
CEC2014-F19	+	+	+	-	-	+	=	-	-	+	+	+	+
CEC2014-F20	+	+	+	-	+	+	+	+	+	+	+	+	+
CEC2014-F21	+	+	+	-	+	+	=	+	-	-	+	+	+
CEC2014-F22	=	+	+	-	-	+	+	+	-	+	+	=	+
CEC2014-F23	=	=	+	-	+	=	+	-	-	=	-	+	+
CEC2014-F24	+	+	+	+	+	+	+	-	-	+	-	+	+
CEC2014-F25	-	+	-	-	-	-	=	=	+	-	-	+	+
CEC2014-F26	+	+	+	+	+	+	+	+	+	+	-	+	+
CEC2014-F27	+	-	+	-	-	+	-	+	-	+	-	=	+
CEC2014-F28	+	+	+	+	+	+	=	-	-	=	-	+	+
CEC2014-F29	+	+	+	+	+	+	=	-	+	+	-	+	+
CEC2014-F30	+	+	+	+	+	+	+	-	-	+	-	+	+

Table S19 Error statistics of different algorithms solving CEC2017 (Dim=10).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2017-F1	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	4.1658E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.7864E-16	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	3.8617E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.9899E-15	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F3	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.8885E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.1146E-15	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.3562E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	7.9597E-15	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F4	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.8338E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.0831E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.1775E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	4.9349E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F5	Ave	2.6741E+00	**5.8527E-02**	2.6005E+00	1.6848E+00	7.8036E-01	1.9474E+00	3.7878E+00	1.1900E+00	5.8527E-01	1.4282E+00	1.1268E+01	3.8635E+00	6.9842E+00	1.6609E+00

	Std	8.3200E-01	**2.3644E-01**	9.7116E-01	8.2190E-01	8.7452E-01	8.5605E-01	2.1867E+00	9.5474E-01	6.9438E-01	6.9965E-01	6.5143E+00	1.4835E+00	2.7536E+00	7.8752E-01
CEC2017-F6	Ave	8.9166E-15	**0.0000E+00**	2.2292E-15	**0.0000E+00**	3.8687E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	6.9663E-08	**0.0000E+00**	1.2684E-12	1.1146E-14	**0.0000E+00**	**0.0000E+00**
	Std	3.0869E-14	**0.0000E+00**	1.5919E-14	**0.0000E+00**	6.3709E-11	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.8440E-07	**0.0000E+00**	6.9012E-12	3.4143E-14	**0.0000E+00**	**0.0000E+00**
CEC2017-F7	Ave	1.2170E+01	**1.0555E+01**	1.2548E+01	1.1864E+01	1.1187E+01	1.2342E+01	1.2890E+01	1.1727E+01	1.1184E+01	1.1648E+01	2.5555E+01	1.3517E+01	1.6282E+01	1.1051E+01
	Std	7.0194E-01	**1.8334E-01**	8.9930E-01	5.8429E-01	4.3827E-01	9.8881E-01	1.7584E+00	9.7266E-01	1.6239E+00	4.1717E-01	7.1557E+00	1.4595E+00	3.4890E+00	3.5443E-01
CEC2017-F8	Ave	2.6165E+00	**3.4552E-13**	2.3002E+00	1.7975E+00	6.0478E-01	1.9099E+00	3.4572E+00	1.2486E+00	5.4625E-01	1.6576E+00	9.1058E+00	4.8774E+00	7.4134E+00	8.8060E-01
	Std	9.1065E-01	**3.5876E-13**	1.0687E+00	8.2071E-01	6.9158E-01	9.7429E-01	1.9289E+00	1.1404E+00	8.2800E-01	7.3890E-01	5.9760E+00	2.3055E+00	2.6795E+00	7.6242E-01
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	3.3460E-12	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	9.4974E-12	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	2.0628E+01	2.0609E+01	1.3332E+02	3.3414E+01	1.0246E+02	9.2398E+01	2.5069E+01	4.9517E+01	**8.1852E+00**	2.0027E+01	2.9954E+02	1.1061E+02	1.4306E+02	1.6675E+01
	Std	3.5427E+01	3.2010E+01	1.1153E+02	4.7283E+01	1.4009E+02	1.0162E+02	4.6684E+01	6.8648E+01	**2.3229E+01**	4.4923E+01	1.6959E+02	1.1205E+02	1.4266E+02	3.8346E+01
CEC2017-F11	Ave	4.9025E-01	9.2733E-13	**0.0000E+00**	**0.0000E+00**	8.7210E-01	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.3161E-02	1.1883E+00	1.9509E-02	4.4871E-01	1.9509E-02
	Std	7.2535E-01	3.9896E-12	**0.0000E+00**	**0.0000E+00**	3.4729E+00	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	6.2263E-02	1.8715E+00	1.3932E-01	5.7376E-01	1.3932E-01
CEC2017-F12	Ave	5.4191E+01	9.1496E+01	9.5534E+01	1.0821E+02	1.2351E+01	6.2828E+01	4.0849E+01	7.3666E+00	**2.6936E-01**	9.7299E+00	1.1432E+01	2.6417E+00	3.6732E-01	6.6383E+01
	Std	6.6349E+01	6.1177E+01	6.0226E+01	5.6562E+01	3.3396E+01	6.5955E+01	5.7550E+01	2.9182E+01	**1.6280E-01**	3.2504E+01	2.4832E+01	1.6755E+01	1.6436E-01	6.4962E+01
CEC2017-F13	Ave	4.4742E+00	1.5672E+00	4.2261E+00	3.0691E+00	2.6624E+00	3.9932E+00	3.3171E+00	**4.2213E-01**	1.5927E+00	3.5941E+00	9.7170E+00	2.7014E+00	2.3027E+00	3.5135E+00
	Std	1.6412E+00	2.3712E+00	2.0409E+00	2.5036E+00	2.4318E+00	1.9940E+00	2.3159E+00	**1.3293E+00**	2.4194E+00	2.1620E+00	2.0131E+00	2.5276E+00	2.1197E+00	2.5544E+00
CEC2017-F14	Ave	2.3632E-01	1.3263E-02	1.6297E+00	5.8527E-02	1.2766E+01	3.9018E-02	1.5607E-01	**0.0000E+00**	3.9018E-02	3.9019E-02	3.9546E+00	3.9597E-01	7.3151E-01	8.6245E-01
	Std	4.2236E-01	5.9729E-02	5.4138E+00	2.3644E-01	5.5808E+01	1.9505E-01	3.6544E-01	**0.0000E+00**	1.9505E-01	1.9505E-01	6.6521E+00	6.4783E-01	9.1915E-01	3.9197E+00
CEC2017-F15	Ave	1.5446E-01	1.6708E-01	3.4137E-01	3.1226E-01	4.5132E-01	3.3892E-01	2.8060E-01	**2.5716E-02**	1.8444E-01	2.9830E-01	3.5558E-02	1.0131E-01	2.9513E-01	2.9983E-01
	Std	2.0174E-01	2.1327E-01	2.0171E-01	2.0031E-01	3.2112E-01	2.0514E-01	2.1300E-01	**7.5200E-02**	2.0460E-01	2.2214E-01	1.4330E-01	1.7516E-01	3.3970E-01	2.0515E-01
CEC2017-F16	Ave	3.3290E-01	5.0312E-01	9.7014E-01	6.6899E-01	7.8254E+00	8.3837E-01	6.3034E-01	**2.1154E-01**	5.4543E-01	6.7731E-01	3.8985E+00	4.9641E-01	5.0880E-01	6.4450E-01
	Std	**1.6264E-01**	1.6432E-01	5.0877E-01	2.8059E-01	2.8303E+01	2.9589E-01	2.5778E-01	2.0512E-01	2.9225E-01	2.2399E-01	5.1290E+00	2.1059E-01	2.8879E-01	2.3641E-01
CEC2017-F17	Ave	1.3185E-01	1.4309E-01	1.5379E+00	6.3619E-01	1.6425E+01	2.1595E+00	**1.3156E-01**	2.3355E-01	2.0645E+00	6.2909E-01	1.3830E+01	7.4017E-01	3.0680E+00	1.3859E-01
	Std	**1.3433E-01**	2.2547E-01	4.0762E+00	2.8463E+00	1.1417E+01	4.8678E+00	1.8321E-01	1.9471E-01	4.6334E+00	3.4984E-01	9.9265E+00	1.2501E+00	5.6084E+00	1.8676E-01
CEC2017-F18	Ave	2.2509E-01	2.9090E-01	2.3146E+00	2.3432E+00	4.5682E-01	7.0716E-01	2.4128E-01	1.4033E-01	2.4389E-01	3.1137E-01	**6.9516E-02**	1.6163E-01	2.2576E-01	1.9101E+00
	Std	2.1482E-01	1.6134E-01	6.0083E+00	6.0048E+00	1.8612E-01	2.8314E+00	2.0518E-01	5.6669E-01	2.4040E-01	1.9860E-01	**1.4327E-01**	2.0073E-01	2.2526E-01	5.4589E+00
CEC2017-F19	Ave	1.3653E-02	1.3859E-02	3.2015E-02	4.5111E-02	1.0164E+00	2.9451E-02	1.6587E-02	3.1320E-02	2.4784E-02	**8.4804E-03**	2.7251E-02	2.0033E-02	1.8289E-02	4.0570E-02
	Std	1.1618E-02	1.1347E-02	3.6723E-02	2.0894E-01	2.7158E+00	3.1681E-02	1.4369E-02	1.3796E-01	2.2249E-02	1.2498E-02	8.6541E-02	3.3548E-02	**4.6177E-03**	4.7223E-02
CEC2017-F20	Ave	1.8363E-02	1.2854E-01	1.2836E+00	4.0131E-01	1.1645E+01	8.4015E-01	2.3872E-01	**6.1210E-03**	2.2036E-01	2.8769E-01	1.0597E-01	4.3993E-02	4.0857E-01	3.2442E-01
	Std	7.4183E-02	1.7853E-01	3.8941E+00	3.2946E-01	1.8783E+01	2.7880E+00	1.7199E-01	**4.3713E-02**	1.7981E-01	1.5092E-01	1.6426E-01	1.6007E-01	3.0712E-01	1.2426E-01
CEC2017-F21	Ave	1.3720E+02	1.5188E+02	1.4089E+02	1.4041E+02	1.9424E+02	1.2228E+02	**1.0204E+02**	1.4620E+02	1.6917E+02	1.3616E+02	1.4774E+02	1.1212E+02	1.6909E+02	1.0287E+02
	Std	4.7976E+01	5.1294E+01	5.1419E+01	5.0782E+01	2.7794E+01	4.2920E+01	**1.4604E+01**	5.1494E+01	4.7421E+01	4.9367E+01	5.0960E+01	3.3560E+01	5.1575E+01	1.4617E+01
CEC2017-F22	Ave	1.0001E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0003E+02	9.4123E+01	9.2433E+01	1.0000E+02	8.8789E+01	1.0001E+02	**8.6775E+01**	1.0004E+02
	Std	5.6884E-02	**0.0000E+00**	**0.0000E+00**	6.4311E-14	**0.0000E+00**	6.4311E-14	1.3057E-01	2.3765E+01	2.6420E+01	**0.0000E+00**	3.2754E+01	4.8465E-02	3.4957E+01	1.1253E-01
CEC2017-F23	Ave	3.0360E+02	3.0042E+02	3.0425E+02	3.0178E+02	3.0101E+02	3.0284E+02	3.0420E+02	3.0062E+02	3.0017E+02	3.0083E+02	3.0922E+02	3.0251E+02	3.0653E+02	**2.9642E+02**
	Std	1.4242E+00	1.0838E+00	1.4325E+00	1.4890E+00	1.4645E+00	2.0632E+00	2.2734E+00	1.2961E+00	**6.8487E-01**	1.3052E+00	3.7307E+00	2.3017E+00	3.3792E+00	4.0825E+01
CEC2017-F24	Ave	2.9758E+02	**1.5337E+02**	3.0494E+02	2.5680E+02	3.1515E+02	2.7195E+02	3.0614E+02	2.8060E+02	3.1655E+02	2.8844E+02	3.0892E+02	2.9522E+02	3.1955E+02	3.1198E+02
	Std	8.0691E+01	9.5093E+01	7.5602E+01	1.0708E+02	5.4329E+01	1.0158E+02	7.6073E+01	9.0419E+01	**4.4872E+01**	8.8115E+01	7.7275E+01	7.8960E+01	5.5505E+01	6.2347E+01
CEC2017-F25	Ave	4.0967E+02	4.0886E+02	4.0694E+02	4.2114E+02	4.4646E+02	4.0692E+02	4.1412E+02	4.1046E+02	4.1236E+02	4.0687E+02	4.0609E+02	4.0778E+02	**3.9802E+02**	4.2033E+02
	Std	2.0123E+01	1.9328E+01	1.8285E+01	2.2961E+01	1.0273E+00	1.8174E+01	2.2027E+01	2.0541E+01	2.1590E+01	1.8195E+01	1.7739E+01	1.8844E+01	**4.4408E-02**	2.3099E+01
CEC2017-F26	Ave	3.0000E+02	**2.8101E+02**	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02	3.0000E+02
	Std	**0.0000E+00**	3.8930E+01	**0.0000E+00**	**0.0000E+00**	2.3779E-13	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	2.2666E-13	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F27	Ave	3.8948E+02	3.9155E+02	3.8948E+02	3.8947E+02	3.9707E+02	3.8952E+02	3.8949E+02	**3.7742E+02**	3.9327E+02	3.8949E+02	3.8950E+02	3.9010E+02	3.8895E+02	3.9051E+02
	Std	1.3915E-01	2.2813E+00	1.3915E-01	1.7189E+00	2.2180E+00	**0.0000E+00**	1.2178E-01	8.8005E+00	1.6581E+00	1.2178E-01	3.1869E-01	1.9240E+00	7.3268E-01	2.0683E+00
CEC2017-F28	Ave	3.4115E+02	3.0990E+02	3.9679E+02	3.6388E+02	5.9649E+02	3.6126E+02	3.2673E+02	3.3233E+02	3.2281E+02	3.1724E+02	3.6456E+02	4.0015E+02	**3.0000E+02**	3.3785E+02
	Std	1.0432E+02	4.7092E+01	1.4078E+02	1.0818E+02	2.2573E+01	1.2067E+02	8.5545E+01	4.5866E+01	7.9024E+01	6.9726E+01	9.8775E+01	1.3695E+02	**0.0000E+00**	9.9022E+01

CEC2017-F29	Ave	2.3391E+02	2.3333E+02	2.3882E+02	**2.2887E+02**	2.6340E+02	2.3789E+02	2.3113E+02	2.3184E+02	2.3005E+02	2.3395E+02	2.4344E+02	2.3477E+02	2.3343E+02	2.3141E+02
	Std	2.5456E+00	2.6621E+00	4.8509E+00	**1.6702E+00**	1.1635E+01	3.6202E+00	2.7473E+00	3.0529E+00	2.6047E+00	2.8521E+00	5.3593E+00	3.9758E+00	2.8163E+00	3.3890E+00
CEC2017-F30	Ave	3.2456E+04	4.0138E+02	6.4503E+04	4.5149E+02	4.1242E+02	4.0614E+02	3.2449E+04	**2.0199E+02**	3.2442E+04	3.9451E+02	4.0401E+02	3.9451E+02	4.0558E+02	3.2462E+04
	Std	1.6020E+05	1.7634E+01	2.2188E+05	2.2484E+02	2.4384E+01	2.0583E+01	1.6020E+05	1.4693E+00	1.6020E+05	**6.4392E-03**	1.7710E+01	2.3146E-02	1.1536E+01	1.6020E+05

Table S20 Error statistics of different algorithms solving CEC2017 (Dim=30).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2017-F1	Ave	**0.0000E+00**	3.9010E-15	2.2292E-15	2.7864E-16	2.9932E-10	1.6719E-15	**0.0000E+00**	**0.0000E+00**	5.5729E-15	**0.0000E+00**	2.9187E-10	**0.0000E+00**	1.2260E-14	**0.0000E+00**
	Std	**0.0000E+00**	6.4049E-15	5.2195E-15	1.9899E-15	3.5613E-10	4.6242E-15	**0.0000E+00**	**0.0000E+00**	7.0072E-15	**0.0000E+00**	1.0517E-09	**0.0000E+00**	7.5302E-15	**0.0000E+00**
CEC2017-F3	Ave	4.4583E-15	6.3531E-14	5.3500E-14	**0.0000E+00**	2.7926E-10	5.1271E-14	**0.0000E+00**	**0.0000E+00**	4.5698E-14	1.2260E-14	1.3985E+03	**0.0000E+00**	1.7120E-12	**0.0000E+00**
	Std	1.5434E-14	1.8497E-14	1.7655E-14	**0.0000E+00**	3.1633E-10	2.0511E-14	**0.0000E+00**	**0.0000E+00**	2.7893E-14	2.3612E-14	8.6885E+02	**0.0000E+00**	3.8083E-12	**0.0000E+00**
CEC2017-F4	Ave	5.8562E+01	5.9106E+01	5.8562E+01	4.2016E+01	**4.9388E+00**	5.8562E+01	5.8562E+01	2.0693E+01	5.8997E+01	5.8562E+01	5.6348E+01	5.8562E+01	5.9106E+01	5.8562E+01
	Std	2.8897E-14	1.6686E+00	3.3554E-14	3.0147E+00	1.2230E+01	2.8985E-14	8.0389E-15	1.9748E+01	1.5085E+00	2.6261E-14	1.6928E+00	**0.0000E+00**	1.6686E+00	**0.0000E+00**
CEC2017-F5	Ave	6.6855E+00	**2.1944E+00**	1.1747E+01	1.1646E+01	7.5500E+00	8.0709E+00	2.0917E+01	2.8408E+01	2.8483E+00	7.0067E+00	2.9051E+01	7.9088E+00	1.9470E+01	4.2666E+00
	Std	**1.3510E+00**	1.6619E+00	5.0324E+00	1.9744E+00	2.3221E+00	3.1329E+00	7.3082E+00	6.6530E+00	1.6291E+00	1.4408E+00	1.5129E+01	1.4417E+00	5.5656E+00	2.8843E+00
CEC2017-F6	Ave	6.9617E-10	1.1592E-13	1.0791E-07	1.1666E-08	1.0477E-13	2.2800E-08	1.1592E-13	8.5074E-08	6.1659E-08	2.6969E-09	1.2627E-05	1.1369E-13	6.1664E-07	**2.8979E-14**
	Std	4.8050E-09	1.5919E-14	2.3694E-07	3.7306E-08	3.0869E-14	6.2251E-08	2.7756E-14	2.2958E-07	1.8816E-07	1.9164E-08	1.5005E-05	**0.0000E+00**	9.4245E-07	5.0038E-14
CEC2017-F7	Ave	3.7800E+01	**3.3715E+01**	4.6365E+01	4.3453E+01	3.8941E+01	4.5698E+01	3.8800E+01	5.9138E+01	3.5797E+01	3.7648E+01	8.0646E+01	3.7222E+01	4.7990E+01	3.4013E+01
	Std	1.3745E+00	**7.3398E-01**	1.2590E+01	2.3443E+00	4.9659E+00	1.2701E+01	3.0276E+00	6.0451E+00	3.1170E+00	1.3374E+00	3.0401E+01	1.1384E+00	6.0920E+00	8.6510E-01
CEC2017-F8	Ave	7.2788E+00	2.6346E+00	1.0157E+01	1.2700E+01	7.8036E+00	1.0005E+01	1.6253E+01	2.7039E+01	**2.6337E+00**	7.0307E+00	2.6604E+01	7.8390E+00	1.8963E+01	3.9408E+00
	Std	1.6835E+00	**1.5218E+00**	4.1366E+00	2.4171E+00	2.2808E+00	7.1404E+00	6.8968E+00	7.3565E+00	1.8327E+00	1.8575E+00	1.2839E+01	2.2172E+00	4.9285E+00	1.9695E+00
CEC2017-F9	Ave	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	3.5109E-03	**0.0000E+00**	**0.0000E+00**	8.4708E-14	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
	Std	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**	1.7551E-02	**0.0000E+00**	**0.0000E+00**	6.3677E-14	**0.0000E+00**	**0.0000E+00**	**0.0000E+00**
CEC2017-F10	Ave	1.3971E+03	1.4363E+03	3.0702E+03	1.3825E+03	9.9682E+02	3.3673E+03	1.6905E+03	1.8755E+03	**3.3090E+02**	1.4819E+03	2.7614E+03	1.7113E+03	2.3928E+03	1.4052E+03
	Std	2.2314E+02	1.8569E+02	1.0502E+03	2.0505E+02	3.5224E+02	9.4933E+02	5.2839E+02	2.6597E+02	1.9563E+02	1.9852E+02	1.0819E+03	**1.5781E+02**	4.2566E+02	2.1190E+02
CEC2017-F11	Ave	3.4147E+01	6.1720E+00	1.9867E+01	9.9508E+00	1.2846E+01	1.7492E+01	9.2952E+00	1.1172E+01	**1.7976E+00**	1.2034E+01	1.6432E+01	4.9433E+00	7.6408E+00	1.0336E+01
	Std	2.8143E+01	1.1881E+01	2.5352E+01	1.6666E+01	2.0737E+01	2.5124E+01	1.6208E+01	4.9057E+00	**1.9634E+00**	1.9996E+01	1.5906E+01	8.6058E+00	1.1772E+01	1.8951E+01
CEC2017-F12	Ave	1.1378E+03	4.1952E+02	1.1566E+03	3.4029E+02	1.3132E+01	1.0239E+03	2.3966E+02	3.9468E+02	**2.0566E+00**	2.4989E+02	1.1771E+04	4.4600E+02	3.3644E+03	2.0121E+02
	Std	3.5353E+02	1.7248E+02	3.5434E+02	2.0728E+02	5.0574E+01	3.8057E+02	1.5739E+02	2.7272E+02	**2.4262E+00**	1.5104E+02	9.7910E+03	2.0628E+02	3.7496E+03	1.4070E+02
CEC2017-F13	Ave	1.8018E+01	1.6524E+01	2.0789E+01	1.4723E+01	3.6592E+01	2.0854E+01	1.6120E+01	2.2296E+01	9.8602E+00	1.7648E+01	9.3378E+01	**9.4878E+00**	1.7689E+01	1.4693E+01
	Std	5.8598E+00	5.2446E+00	7.8026E+00	6.6227E+00	1.8243E+01	7.3997E+00	4.6285E+00	1.4814E+01	6.5504E+00	5.0899E+00	1.4224E+01	6.9197E+00	5.5257E+00	**4.0401E+00**
CEC2017-F14	Ave	2.1799E+01	2.2975E+01	2.2733E+01	2.2004E+01	2.0462E+01	2.1497E+01	2.2919E+01	1.7001E+01	**6.1864E+00**	2.1014E+01	3.4331E+01	2.0631E+01	2.6579E+01	2.1444E+01
	Std	9.9467E-01	1.2772E+00	1.8526E+00	2.8399E+00	7.0382E+00	1.1170E+00	6.3261E+00	9.8096E+00	9.2155E+00	**8.5972E-01**	1.2749E+01	6.5968E+00	3.8748E+00	1.1879E+00
CEC2017-F15	Ave	3.3232E+00	3.3765E+00	6.1930E+00	2.6137E+00	5.3974E+00	3.4275E+00	1.6641E+00	4.7876E+00	**4.4118E-01**	8.6855E-01	3.1084E+01	1.8194E+00	3.6248E+00	2.0524E+00
	Std	1.6486E+00	1.8568E+00	3.1449E+00	1.7466E+00	4.0746E+00	1.6469E+00	8.8164E-01	2.1041E+00	**1.4677E-01**	7.2022E-01	1.5609E+01	1.0324E+00	1.5413E+00	1.0561E+00
CEC2017-F16	Ave	3.6653E+01	3.5727E+01	9.0448E+01	3.2912E+01	3.0065E+02	5.4268E+01	4.8881E+01	2.8859E+02	**6.6487E+00**	4.9670E+01	4.6084E+02	1.2599E+02	5.8685E+01	3.5168E+01
	Std	2.9705E+01	5.1851E+01	7.6467E+01	5.4014E+01	2.0014E+02	5.6989E+01	5.7421E+01	1.3038E+02	**5.9366E+00**	5.2866E+01	2.4129E+02	1.1220E+02	8.9983E+01	3.5898E+01
CEC2017-F17	Ave	3.2796E+01	2.9895E+01	5.4570E+01	2.7682E+01	6.1254E+01	5.6008E+01	3.0634E+01	2.4986E+01	**2.1805E+01**	3.3063E+01	1.0123E+02	3.1637E+01	3.3179E+01	2.9062E+01
	Std	6.1047E+00	6.5333E+00	2.3499E+01	6.9883E+00	1.0060E+02	1.5287E+01	6.7248E+00	1.1411E+01	**4.4043E+00**	6.2363E+00	8.2258E+01	7.1044E+00	8.0296E+00	9.3891E+00
CEC2017-F18	Ave	2.2747E+01	2.2246E+01	2.5776E+01	2.0969E+01	2.0475E+01	2.3128E+01	2.1215E+01	2.1595E+01	**1.7136E+01**	2.0711E+01	4.0455E+01	2.1000E+01	2.2225E+01	2.1260E+01
	Std	2.2254E+00	1.3282E+00	4.5037E+00	6.5374E-01	3.1860E+00	1.6416E+00	8.9932E-01	2.8905E+00	7.7801E+00	**3.0229E-01**	5.4363E+00	5.4424E-01	5.2456E+00	8.7267E-01
CEC2017-F19	Ave	6.6238E+00	8.4785E+00	1.0956E+01	5.5656E+00	4.7070E+00	6.6355E+00	4.3374E+00	5.2301E+00	**1.9447E+00**	3.2401E+00	1.6115E+01	5.4513E+00	5.2400E+00	6.0807E+00
	Std	2.1612E+00	1.9570E+00	2.0807E+00	1.7480E+00	2.3192E+00	2.1296E+00	1.3979E+00	1.3324E+00	**5.4267E-01**	5.6890E-01	5.1001E+00	1.5699E+00	1.3683E+00	1.9976E+00
CEC2017-F20	Ave	3.1654E+01	3.5119E+01	5.7433E+01	2.9059E+01	1.6723E+02	5.8007E+01	2.6051E+01	2.6578E+01	**1.4884E+01**	2.9753E+01	6.8332E+01	3.2125E+01	2.3022E+01	7.5621E+01
	Std	6.2409E+00	7.4926E+00	2.7478E+01	6.7734E+00	6.3845E+01	1.7819E+01	5.8653E+00	3.7303E+01	3.8576E+01	**5.5474E+00**	8.1951E+01	1.1561E+01	2.2460E+01	5.2914E+01

CEC2017-F21	Ave	2.0834E+02	**2.0155E+02**	2.1208E+02	2.1241E+02	2.0822E+02	2.1203E+02	2.2119E+02	2.2736E+02	2.0236E+02	2.0737E+02	2.2929E+02	2.0807E+02	2.2168E+02	2.0848E+02
	Std	1.7049E+00	1.4558E+01	4.3604E+00	2.7089E+00	2.3355E+00	5.8114E+00	5.2938E+00	6.5754E+00	1.7386E+00	**1.4202E+00**	1.3856E+01	1.8388E+00	6.0982E+00	4.3819E+00
CEC2017-F22	Ave	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	**1.0000E+02**	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02	1.0000E+02
	Std	1.4352E-14	6.3901E-14	1.4352E-14	1.4352E-14	1.4352E-14	1.4352E-14	1.4352E-14	1.4352E-14	**0.0000E+00**	1.4352E-14	1.4547E-12	1.4352E-14	1.4352E-14	1.8955E-13
CEC2017-F23	Ave	3.5418E+02	3.5054E+02	3.6426E+02	3.5486E+02	3.4875E+02	3.6298E+02	3.7008E+02	3.7669E+02	**3.3834E+02**	3.4932E+02	3.8232E+02	3.4771E+02	3.6428E+02	3.5538E+02
	Std	2.9342E+00	3.2174E+00	7.1236E+00	3.0745E+00	8.7232E+00	6.3980E+00	8.5677E+00	7.5667E+00	**2.5891E+00**	2.9414E+00	1.8170E+01	4.9122E+00	6.5091E+00	3.5332E+00
CEC2017-F24	Ave	4.2860E+02	4.1901E+02	4.3606E+02	4.2863E+02	4.1833E+02	4.3244E+02	4.4123E+02	4.4438E+02	**4.1476E+02**	4.2492E+02	4.5479E+02	4.2381E+02	4.3844E+02	4.2880E+02
	Std	2.2057E+00	4.5585E+01	4.6519E+00	2.5442E+00	5.1191E+00	4.2701E+00	6.9841E+00	7.6195E+00	4.7600E+00	**1.5804E+00**	1.2482E+01	2.6151E+00	4.1865E+00	2.8118E+00
CEC2017-F25	Ave	3.8673E+02	3.8544E+02	3.8671E+02	3.8668E+02	3.8675E+02	3.8671E+02	3.8670E+02	**3.7956E+02**	3.8669E+02	3.8670E+02	3.8676E+02	3.8673E+02	3.8676E+02	3.8670E+02
	Std	2.6647E-02	1.5621E+00	1.6786E-02	7.8604E-03	3.1743E-02	1.7634E-02	9.9919E-03	2.4117E+00	**3.3990E-03**	7.4934E-03	3.2374E-02	1.5745E-02	1.8581E-02	9.5251E-03
CEC2017-F26	Ave	9.7607E+02	**6.2232E+02**	1.0976E+03	9.5006E+02	9.3300E+02	1.0183E+03	1.0739E+03	1.1520E+03	6.3008E+02	9.0115E+02	1.2565E+03	8.6685E+02	1.0531E+03	9.3674E+02
	Std	**3.1760E+01**	3.1708E+02	5.1574E+01	4.2884E+01	1.8739E+02	6.0771E+01	9.5001E+01	3.2029E+02	1.4501E+02	3.1898E+01	1.5604E+02	3.7291E+01	7.4102E+01	4.6556E+01
CEC2017-F27	Ave	5.0589E+02	5.0366E+02	5.0748E+02	5.0375E+02	5.2107E+02	5.0628E+02	4.9856E+02	4.8881E+02	**4.7131E+02**	4.9708E+02	4.9780E+02	4.9860E+02	4.8881E+02	5.0168E+02
	Std	4.9988E+00	4.7277E+00	5.1595E+00	5.5168E+00	1.1159E+01	6.4704E+00	6.5994E+00	2.4774E+01	**3.0620E+00**	6.9917E+00	6.7352E+00	7.8275E+00	7.6711E+00	6.5814E+00
CEC2017-F28	Ave	3.3006E+02	3.0426E+02	3.4116E+02	3.1460E+02	3.1620E+02	3.2718E+02	3.0873E+02	3.3408E+02	**3.0000E+02**	3.0447E+02	3.8260E+02	3.2193E+02	3.1522E+02	3.0426E+02
	Std	5.2843E+01	2.1323E+01	5.6894E+01	3.7001E+01	3.7936E+01	4.9852E+01	3.0250E+01	5.4257E+01	**0.0000E+00**	2.2344E+01	1.1834E+02	4.4885E+01	3.8592E+01	2.1323E+01
CEC2017-F29	Ave	4.3601E+02	4.3051E+02	5.0258E+02	4.3286E+02	4.8436E+02	4.8849E+02	4.3547E+02	**4.0030E+02**	4.0234E+02	4.3669E+02	4.7767E+02	4.4278E+02	4.2543E+02	4.4202E+02
	Std	7.3504E+00	8.6874E+00	3.5032E+01	9.8135E+00	7.7646E+01	2.4220E+01	1.2445E+01	5.8133E+01	**5.7599E+00**	1.0731E+01	5.0858E+01	1.5874E+01	2.0508E+01	1.2177E+01
CEC2017-F30	Ave	2.0075E+03	1.9840E+03	2.0345E+03	1.9827E+03	2.0546E+03	1.9987E+03	1.9731E+03	**2.7599E+02**	1.9804E+03	1.9700E+03	2.0390E+03	1.9874E+03	2.0706E+03	1.9736E+03
	Std	6.8278E+01	4.6403E+01	7.3004E+01	4.8094E+01	3.5271E+01	5.5437E+01	2.8616E+01	1.4052E+01	**1.0637E+01**	1.8519E+01	5.0966E+01	1.6800E+01	6.6534E+01	2.9146E+01

Table S21 Error statistics of different algorithms solving CEC2017 (Dim=50).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2017-F1	Ave	2.0341E-14	9.4594E-12	6.0744E-14	1.6719E-14	8.3981E-10	5.3221E-14	1.6161E-14	1.6381E-12	1.0453E-11	2.6193E-14	5.0158E+05	1.5325E-14	5.9518E-13	**0.0000E+00**
	Std	7.1082E-15	1.4031E-11	2.9273E-14	5.4714E-15	7.8169E-10	2.5555E-14	4.9388E-15	6.6038E-12	2.0103E-11	8.7012E-15	1.7147E+06	3.8586E-15	4.7039E-13	**0.0000E+00**
CEC2017-F3	Ave	1.6719E-13	2.9391E-09	7.2225E-13	1.1034E-13	1.6977E-09	5.4503E-13	5.7958E-14	5.6843E-14	4.0448E-12	1.8725E-13	8.1572E+04	9.6968E-14	6.3615E+00	**0.0000E+00**
	Std	4.8782E-14	2.0164E-09	3.6984E-13	3.8405E-14	3.2687E-09	3.1632E-13	1.7940E-14	**0.0000E+00**	1.9268E-12	4.8626E-14	1.2581E+04	2.8522E-14	1.7698E+01	**0.0000E+00**
CEC2017-F4	Ave	7.6348E+01	4.2922E+01	7.2561E+01	4.4809E+01	4.1101E+01	7.1473E+01	4.8214E+01	5.1101E+01	**3.2095E+01**	5.3003E+01	1.4083E+02	5.9708E+01	5.3296E+01	4.0034E+01
	Std	5.3861E+01	3.1415E+01	3.9492E+01	4.0360E+01	4.4745E+01	4.5037E+01	3.7993E+01	4.2276E+01	**1.7948E+01**	4.3822E+01	4.3603E+01	4.9094E+01	4.3284E+01	3.5339E+01
CEC2017-F5	Ave	1.1653E+01	9.6236E+00	1.7530E+01	2.6970E+01	**4.0189E+00**	1.2608E+01	1.5354E+01	6.9608E+01	5.2674E+00	1.3964E+01	4.6346E+01	1.2191E+01	3.5721E+01	6.6721E+00
	Std	2.2981E+00	3.1460E+00	5.8084E+00	6.5331E+00	2.4691E+00	5.0467E+00	6.4886E+00	1.4106E+01	**1.6202E+00**	2.6708E+00	1.1429E+01	1.6712E+00	8.2317E+00	2.3903E+00
CEC2017-F6	Ave	9.3585E-08	6.7289E-08	1.9540E-06	8.6988E-07	9.2887E-07	7.9808E-07	2.3524E-10	2.3984E-06	1.5243E-06	9.4547E-07	6.0617E-02	2.8203E-09	2.4894E-04	**1.1369E-13**
	Std	2.0541E-07	1.1118E-07	2.5897E-06	8.6114E-07	1.0576E-06	1.3970E-06	1.6783E-09	7.6029E-06	2.6140E-06	1.6408E-06	7.9606E-02	1.1393E-08	1.0561E-03	**0.0000E+00**
CEC2017-F7	Ave	6.3803E+01	5.7579E+01	7.2562E+01	7.7763E+01	**5.5485E+01**	8.3273E+01	6.1109E+01	1.2012E+02	6.8650E+01	6.5712E+01	1.0221E+02	6.4063E+01	8.7874E+01	5.7351E+01
	Std	2.0214E+00	1.0567E+00	1.5245E+01	6.4794E+00	**7.9622E-01**	2.4806E+01	3.8584E+00	1.3641E+01	2.6948E+01	2.0657E+00	1.4710E+01	2.2134E+00	9.8914E+00	1.3225E+00
CEC2017-F8	Ave	1.1411E+01	9.9786E+00	1.7546E+01	2.5740E+01	**4.1359E+00**	1.4486E+01	1.8755E+01	6.7969E+01	5.5991E+00	1.4569E+01	4.7673E+01	1.3017E+01	3.5877E+01	6.8086E+00
	Std	2.3326E+00	3.0253E+00	4.5638E+00	6.7509E+00	1.9936E+00	7.5121E+00	7.1341E+00	1.4651E+01	1.8769E+00	2.5846E+00	1.8054E+01	**1.8369E+00**	6.2908E+00	2.6725E+00
CEC2017-F9	Ave	1.5604E-14	8.0250E-14	9.1395E-14	8.9166E-14	**0.0000E+00**	7.1333E-14	**0.0000E+00**	3.4124E-01	1.1146E-13	8.9166E-14	1.9314E+00	6.6875E-15	2.3414E-01	**0.0000E+00**
	Std	3.9511E-14	5.2316E-14	4.5586E-14	4.7224E-14	**0.0000E+00**	5.5513E-14	**0.0000E+00**	4.7660E-01	1.5919E-14	4.7224E-14	3.7437E+00	2.7016E-14	4.6537E-01	**0.0000E+00**
CEC2017-F10	Ave	3.1912E+03	3.1858E+03	5.7939E+03	3.2500E+03	6.3442E+02	6.9085E+03	3.9475E+03	3.7721E+03	**4.0776E+02**	3.2162E+03	4.2853E+03	3.4027E+03	4.8835E+03	3.4663E+03
	Std	2.6213E+02	5.0177E+02	2.2138E+03	2.8749E+02	4.7407E+02	2.0106E+03	6.9400E+02	4.9319E+02	**2.5211E+02**	2.8216E+02	1.3580E+03	3.0871E+02	6.7451E+02	6.0609E+02
CEC2017-F11	Ave	4.9541E+01	2.7433E+01	4.4495E+01	2.1951E+01	2.3217E+01	3.4211E+01	2.6126E+01	5.6609E+01	**1.9182E+01**	2.7992E+01	4.2926E+01	3.4195E+01	3.3754E+01	2.8627E+01
	Std	1.0850E+01	3.3151E+00	9.7888E+00	1.8061E+00	2.0925E+00	5.0203E+00	3.9459E+00	1.4198E+01	**6.8483E-01**	2.5592E+00	7.1842E+00	4.9603E+00	4.6752E+00	4.5326E+00
CEC2017-F12	Ave	2.3583E+03	1.9117E+03	7.3200E+03	1.3530E+03	2.8023E+02	5.3212E+03	1.4420E+03	3.8995E+04	**8.4022E+01**	1.7083E+03	1.3375E+05	2.1499E+03	2.2355E+04	1.1954E+03
	Std	4.8628E+02	7.1817E+02	3.8651E+03	3.8110E+02	1.6737E+02	2.2924E+03	3.5883E+02	6.3665E+04	**7.0357E+01**	4.1597E+02	9.3392E+04	4.7549E+02	1.0161E+04	3.5836E+02

CEC2017-F13	Ave	6.1570E+01	3.9530E+01	8.9702E+01	6.8391E+01	4.8012E+01	6.6688E+01	4.1776E+01	9.2610E+01	**3.8701E+00**	2.9483E+01	9.1727E+02	4.4930E+01	5.2610E+01	2.3030E+01
	Std	2.5074E+01	1.4326E+01	3.3329E+01	3.1906E+01	2.9074E+01	2.9740E+01	1.8796E+01	4.7842E+01	**2.1784E+00**	1.6114E+01	1.1073E+03	2.3650E+01	3.2353E+01	1.7207E+01
CEC2017-F14	Ave	3.1757E+01	3.1670E+01	3.8816E+01	2.6844E+01	2.0714E+01	2.8627E+01	3.0842E+01	5.3236E+01	**2.0426E+01**	2.2843E+01	6.9831E+01	2.6635E+01	3.1389E+01	2.4288E+01
	Std	4.2891E+00	3.5529E+00	5.8104E+00	2.3001E+00	1.8810E+00	2.7180E+00	3.1847E+00	1.4629E+01	5.2431E+00	**1.3819E+00**	3.3543E+01	1.7516E+00	4.3459E+00	1.8581E+00
CEC2017-F15	Ave	4.5698E+01	2.8805E+01	5.6035E+01	2.5930E+01	**1.7139E+01**	3.7328E+01	2.2664E+01	5.4137E+01	1.7617E+01	2.2805E+01	1.0541E+02	2.5790E+01	2.9853E+01	2.2186E+01
	Std	1.2181E+01	3.4754E+00	1.8050E+01	3.2586E+00	2.9142E+00	9.8838E+00	2.1127E+00	1.6176E+01	**5.7805E-01**	2.7739E+00	2.8947E+01	3.5855E+00	7.6319E+00	2.7812E+00
CEC2017-F16	Ave	3.7369E+02	3.4268E+02	4.5441E+02	2.9122E+02	5.1702E+02	4.0020E+02	4.5168E+02	7.0633E+02	**1.2728E+02**	3.9763E+02	1.1024E+03	3.7051E+02	7.1511E+02	4.6250E+02
	Std	1.1913E+02	1.3555E+02	1.6355E+02	1.1178E+02	1.8329E+02	1.3299E+02	1.8869E+02	1.7807E+02	**1.6845E+01**	1.2922E+02	3.9740E+02	9.8194E+01	3.7253E+02	2.1073E+02
CEC2017-F17	Ave	2.5125E+02	3.0260E+02	3.5129E+02	2.1574E+02	3.0230E+02	3.4068E+02	2.3823E+02	4.5920E+02	**9.6974E+01**	2.5490E+02	6.3392E+02	3.1339E+02	3.5555E+02	2.8592E+02
	Std	8.2983E+01	8.2231E+01	9.2822E+01	**5.7132E+01**	1.4868E+02	8.5402E+01	1.1367E+02	1.1606E+02	7.1700E+01	7.9043E+01	2.5622E+02	7.5935E+01	1.9256E+02	9.8750E+01
CEC2017-F18	Ave	5.0618E+01	3.2970E+01	7.2075E+01	2.5170E+01	**2.0605E+01**	5.3932E+01	2.4383E+01	4.8050E+01	2.1018E+01	2.4283E+01	1.5978E+03	2.7260E+01	2.8942E+02	2.3377E+01
	Std	1.7590E+01	5.4628E+00	4.0013E+01	2.7394E+00	2.9809E-01	2.6032E+01	2.1969E+00	1.1346E+01	**2.3624E-01**	2.3855E+00	1.6619E+03	2.8089E+00	3.7437E+02	1.8401E+00
CEC2017-F19	Ave	3.5589E+01	2.7061E+01	5.3110E+01	1.6951E+01	8.0132E+00	2.5824E+01	1.4508E+01	2.4026E+01	**3.9723E+00**	1.2337E+01	3.3791E+01	1.4882E+01	1.3166E+01	1.3388E+01
	Std	1.1747E+01	6.3504E+00	1.2792E+01	2.9698E+00	5.2671E+00	4.5695E+00	2.4593E+00	1.0598E+01	**6.7998E-01**	2.8599E+00	1.3274E+01	1.9329E+00	2.5496E+00	2.6137E+00
CEC2017-F20	Ave	1.6853E+02	2.1205E+02	1.8086E+02	1.0840E+02	4.4913E+01	1.7952E+02	1.0447E+02	2.0521E+02	**2.7863E+01**	1.3547E+02	5.0641E+02	2.5956E+02	3.8121E+02	1.3479E+02
	Std	7.4124E+01	9.4035E+01	6.7458E+01	3.5116E+01	5.8209E+01	5.6809E+01	7.3987E+01	1.2882E+02	**1.0523E+01**	5.3577E+01	2.3264E+02	9.8932E+01	1.7052E+02	6.2719E+01
CEC2017-F21	Ave	2.1436E+02	2.1194E+02	2.2299E+02	2.2927E+02	2.0598E+02	2.1833E+02	2.3962E+02	2.6931E+02	**2.0595E+02**	2.1585E+02	2.4842E+02	2.1497E+02	2.3570E+02	2.1849E+02
	Std	2.6440E+00	3.4507E+00	8.9336E+00	6.9377E+00	**2.1046E+00**	5.9837E+00	9.8673E+00	1.1926E+01	2.3555E+00	2.7775E+00	1.3700E+01	2.4423E+00	7.3882E+00	1.2269E+01
CEC2017-F22	Ave	2.4500E+03	1.5569E+02	2.4532E+03	1.1833E+03	1.0000E+02	2.7098E+03	5.2646E+02	3.2465E+03	**1.0000E+02**	1.9952E+03	3.7260E+03	2.4462E+02	5.1804E+03	2.0543E+03
	Std	1.5449E+03	3.9552E+02	3.1749E+03	1.5495E+03	5.0009E-09	3.4791E+03	1.1880E+03	2.1345E+03	**0.0000E+00**	1.8112E+03	2.4885E+03	7.1952E+02	1.3061E+03	1.9504E+03
CEC2017-F23	Ave	4.3179E+02	4.3348E+02	4.5294E+02	4.3766E+02	4.2997E+02	4.4536E+02	4.6174E+02	4.9255E+02	**4.0252E+02**	4.2909E+02	4.8384E+02	4.3405E+02	4.5483E+02	4.4460E+02
	Std	**3.5003E+00**	5.3461E+00	1.0171E+01	8.4740E+00	8.0987E+00	5.8884E+00	1.1826E+01	1.3640E+01	6.1286E+00	4.7242E+00	1.6875E+01	1.3952E+01	1.0924E+01	7.7182E+00
CEC2017-F24	Ave	5.1062E+02	5.0797E+02	5.2759E+02	5.1168E+02	4.8984E+02	5.2139E+02	5.3578E+02	5.6376E+02	**4.8483E+02**	5.0485E+02	5.9249E+02	5.0131E+02	5.2828E+02	5.1457E+02
	Std	2.8878E+00	**2.6953E+00**	5.8414E+00	5.6339E+00	3.0880E+00	5.5973E+00	1.1519E+01	1.8514E+01	4.3831E+00	3.4586E+00	5.4731E+01	5.1603E+00	1.0087E+01	9.0478E+00
CEC2017-F25	Ave	4.8122E+02	4.9314E+02	4.8050E+02	4.8065E+02	5.4996E+02	4.8192E+02	4.8047E+02	**4.6419E+02**	4.8040E+02	4.8048E+02	5.0751E+02	4.8164E+02	4.9849E+02	4.8115E+02
	Std	3.1373E+00	2.7234E+01	1.6774E+00	2.1735E+00	2.4812E+01	1.1512E+01	**1.6228E+00**	2.4356E+01	1.6651E+00	1.6231E+00	3.0838E+01	3.7787E+00	3.0056E+01	3.1520E+00
CEC2017-F26	Ave	1.1979E+03	6.6406E+02	1.3410E+03	1.2201E+03	6.8856E+02	1.2472E+03	1.3059E+03	1.9118E+03	**5.2237E+02**	1.0878E+03	1.6231E+03	1.0800E+03	1.2954E+03	1.1333E+03
	Std	4.8058E+01	4.0794E+02	7.7661E+01	9.4848E+01	1.5147E+02	6.5919E+01	1.4162E+02	1.8411E+02	1.4261E+02	**4.4045E+01**	1.6819E+02	6.9221E+01	1.0291E+02	5.3313E+01
CEC2017-F27	Ave	5.4006E+02	5.2666E+02	5.4611E+02	5.2982E+02	5.8601E+02	5.3665E+02	5.0949E+02	4.9769E+02	**4.6458E+02**	5.1257E+02	5.0324E+02	5.2452E+02	5.1448E+02	5.1457E+02
	Std	1.7211E+01	7.8181E+00	2.3308E+01	1.0503E+01	1.5822E+01	1.6299E+01	8.9156E+00	1.1615E+01	**5.3311E+00**	8.2800E+00	1.3133E+01	9.4279E+00	1.0891E+01	6.5736E+00
CEC2017-F28	Ave	4.6794E+02	4.7322E+02	4.7305E+02	4.5954E+02	5.0166E+02	4.7098E+02	4.6076E+02	**4.5269E+02**	4.5885E+02	4.5981E+02	4.8912E+02	4.6172E+02	4.5885E+02	4.5885E+02
	Std	1.8669E+01	2.2478E+01	2.2253E+01	1.1531E+01	1.1866E+01	2.0995E+01	9.5757E+00	1.5420E+01	**1.1482E-13**	6.8398E+00	1.9356E+01	1.1608E+01	3.0165E-13	2.2666E-13
CEC2017-F29	Ave	3.4721E+02	3.5979E+02	4.2516E+02	3.5367E+02	5.0000E+02	4.5815E+02	3.6316E+02	4.0522E+02	**3.0316E+02**	3.6471E+02	5.0208E+02	3.6746E+02	3.3417E+02	3.7149E+02
	Std	9.8099E+00	1.7116E+01	5.7420E+01	8.6171E+00	1.8213E+02	5.4368E+01	2.1384E+01	9.8935E+01	**7.4036E+00**	1.1417E+01	1.5959E+02	1.8030E+01	1.3852E+01	1.7216E+01
CEC2017-F30	Ave	6.5478E+05	6.1496E+05	6.6798E+05	6.3640E+05	5.9806E+05	6.4382E+05	6.0061E+05	**1.1054E+03**	5.7969E+05	6.0513E+05	6.4920E+05	6.1964E+05	5.9141E+05	6.1425E+05
	Std	5.3431E+04	3.6474E+04	6.7757E+04	6.4434E+04	1.6530E+04	5.4448E+04	2.9821E+04	**3.4412E+02**	7.9803E+02	3.2960E+04	5.4106E+04	3.3111E+04	2.0730E+04	4.5174E+04

Table S22 Error statistics of different algorithms solving CEC2017 (Dim=100).

ID	Metric	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE	mLSHADE -SPACMA
CEC2017-F1	Ave	1.1862E-11	2.3333E-08	8.5770E-08	2.9713E-11	3.3204E-09	2.0228E-08	3.9705E-11	1.7633E-01	2.5222E+02	4.2911E-13	2.7943E+08	1.1587E-06	2.8108E-03	**6.2138E-14**
	Std	3.6267E-11	1.0143E-07	1.6020E-07	6.7763E-11	8.5434E-09	7.1204E-08	4.6990E-11	4.9168E-01	1.2045E+03	1.3368E-12	3.4976E+08	1.5430E-06	1.5611E-02	**1.6563E-14**
CEC2017-F3	Ave	5.0089E-06	2.0584E-05	1.1591E-03	7.1002E-11	3.5465E-09	4.9327E-04	3.0041E-07	3.4483E-07	3.6424E-03	3.1044E-09	2.5086E+05	1.5907E-03	1.5357E+04	**3.3437E-15**
	Std	6.6370E-06	8.7258E-06	2.0370E-03	6.1822E-11	5.4519E-09	1.6070E-03	1.1054E-06	4.2130E-07	3.1025E-03	4.0787E-09	2.1738E+04	2.0941E-03	5.4593E+03	**1.3508E-14**
CEC2017-F4	Ave	1.9858E+02	1.9048E+02	2.0053E+02	1.9894E+02	**2.2767E+01**	2.0250E+02	2.0135E+02	1.6097E+02	2.0159E+02	1.9480E+02	3.8143E+02	1.9612E+02	1.6786E+02	2.0013E+02
	Std	6.9266E+00	4.0220E+01	1.3832E+01	8.3085E+00	5.0714E+01	1.8526E+01	8.9040E+00	7.3307E+01	9.2026E+00	2.0293E+01	8.9637E+01	**6.3958E+00**	5.1371E+01	1.2213E+01

CEC2017-F5	Ave	2.7597E+01	3.1234E+01	4.1771E+01	5.5239E+01	**1.1354E+01**	2.7851E+01	1.6973E+01	2.1524E+02	1.6544E+01	4.2650E+01	2.4350E+02	2.8136E+01	8.6763E+01	1.3793E+01
	Std	4.4019E+00	6.0360E+00	9.8116E+00	6.8670E+00	4.6249E+00	7.9338E+00	**3.2296E+00**	3.7386E+01	3.4977E+00	5.2194E+00	1.1611E+02	4.8393E+00	1.6930E+01	3.2334E+00
CEC2017-F6	Ave	1.7118E-03	1.4657E-05	9.4199E-04	5.8640E-05	9.7506E-08	5.2964E-04	4.2529E-09	3.0949E-04	4.4557E-05	2.0782E-04	1.5242E+00	3.3138E-04	5.9837E-02	**1.1369E-13**
	Std	1.2318E-03	4.8004E-06	2.0050E-03	2.0855E-05	4.6720E-08	1.2236E-03	1.0421E-08	2.0517E-04	1.6702E-05	4.2566E-04	1.0747E+00	5.0990E-04	4.9215E-02	**0.0000E+00**
CEC2017-F7	Ave	1.3644E+02	1.2122E+02	1.5049E+02	1.6265E+02	**1.1072E+02**	1.4971E+02	1.1138E+02	3.3561E+02	1.1731E+02	1.4480E+02	5.5749E+02	1.3370E+02	1.9882E+02	1.1268E+02
	Std	4.4697E+00	4.0692E+00	2.4660E+01	6.3726E+00	**1.2023E+00**	1.8000E+01	1.7079E+00	3.1416E+01	1.2725E+01	5.5465E+00	1.5244E+02	3.8325E+00	1.7984E+01	1.3407E+00
CEC2017-F8	Ave	2.6274E+01	2.6435E+01	4.1115E+01	5.4755E+01	**1.0125E+01**	2.6779E+01	1.8026E+01	2.1795E+02	1.5763E+01	4.1999E+01	2.5903E+02	2.5767E+01	8.2310E+01	1.3793E+01
	Std	7.0063E+00	4.1753E+00	8.2565E+00	6.2382E+00	4.0961E+00	8.6885E+00	3.4158E+00	3.1587E+01	3.3733E+00	5.4929E+00	1.3291E+02	5.3872E+00	1.5927E+01	**2.9982E+00**
CEC2017-F9	Ave	1.6821E-01	1.2706E-13	4.2524E-02	1.6050E-13	6.9018E-01	1.7555E-03	6.6875E-15	2.6055E+01	2.2648E-12	1.2288E-02	5.0792E+02	2.1328E-02	2.5606E+01	**0.0000E+00**
	Std	2.4250E-01	3.6993E-14	1.4787E-01	5.6508E-14	1.3065E+00	1.2536E-02	2.7016E-14	1.0494E+02	1.5581E-12	3.1115E-02	3.4478E+02	1.2794E-01	1.4419E+01	**0.0000E+00**
CEC2017-F10	Ave	1.0283E+04	9.6769E+03	1.2759E+04	1.0328E+04	2.3893E+03	1.5012E+04	1.0593E+04	1.1364E+04	**1.6724E+03**	9.9569E+03	1.4466E+04	1.0087E+04	1.2278E+04	9.8782E+03
	Std	4.7214E+02	1.8850E+03	3.6459E+03	4.8446E+02	7.3798E+02	3.9511E+03	1.2245E+03	1.0412E+03	6.6369E+02	4.7375E+02	3.8731E+03	**4.0490E+02**	1.5212E+03	9.9902E+02
CEC2017-F11	Ave	3.8557E+02	6.5799E+01	3.7375E+02	5.3760E+01	**1.7814E+01**	2.3912E+02	6.8491E+01	3.4139E+02	3.3649E+01	9.9395E+01	1.3030E+03	2.3232E+02	6.9562E+01	3.8560E+01
	Std	9.6107E+01	3.2129E+01	1.0136E+02	3.7756E+01	2.5753E+01	5.9611E+01	3.0736E+01	1.0460E+02	2.8000E+01	2.8131E+01	4.2839E+02	4.4102E+01	3.5132E+01	**1.7746E+01**
CEC2017-F12	Ave	2.4079E+04	5.2049E+03	3.5195E+04	4.4357E+03	**1.2045E+03**	4.0498E+04	8.6396E+03	1.3714E+05	2.3548E+03	1.3711E+04	6.8507E+07	3.7152E+04	8.1948E+04	4.4788E+03
	Std	8.6910E+03	4.3818E+03	1.3961E+04	7.3133E+02	**4.4579E+02**	1.4542E+04	4.8189E+03	1.7070E+05	1.6323E+03	5.9661E+03	3.9840E+07	1.7229E+04	4.4106E+04	6.9447E+02
CEC2017-F13	Ave	1.1927E+03	2.8875E+02	3.0688E+03	1.0655E+02	4.6453E+01	2.4800E+03	1.4192E+02	1.9212E+03	**4.5922E+01**	1.4067E+02	6.7140E+03	3.8565E+02	1.8592E+03	7.9579E+01
	Std	7.3633E+02	8.0698E+01	8.9548E+02	3.7344E+01	**8.1357E+00**	6.5522E+02	4.4930E+01	1.9265E+03	1.5379E+01	3.3491E+01	7.3469E+03	1.2900E+02	2.9526E+03	3.4902E+01
CEC2017-F14	Ave	2.6097E+02	1.4675E+02	2.6012E+02	5.0795E+01	**2.2931E+01**	2.4223E+02	4.6694E+01	2.5807E+02	2.6790E+01	6.3416E+01	1.4626E+04	2.2847E+02	6.4362E+02	3.7152E+01
	Std	3.1742E+01	2.5635E+01	3.5391E+01	9.4589E+00	**1.5966E+00**	2.7727E+01	6.1075E+00	8.9891E+01	1.6384E+00	9.0486E+00	1.4186E+04	2.5301E+01	1.0216E+03	4.0083E+00
CEC2017-F15	Ave	2.6363E+02	1.6597E+02	2.5464E+02	1.0300E+02	1.1023E+02	2.4611E+02	1.1665E+02	5.6731E+02	6.2119E+01	1.7863E+02	7.6409E+03	2.8112E+02	1.1646E+03	**6.0257E+01**
	Std	5.8915E+01	3.9107E+01	5.5090E+01	3.9796E+01	**2.0933E+01**	4.7234E+01	3.3851E+01	4.8965E+02	3.0101E+01	4.0706E+01	7.2536E+03	5.8510E+01	2.7578E+03	3.1421E+01
CEC2017-F16	Ave	1.5626E+03	1.8841E+03	1.9408E+03	1.2589E+03	1.1529E+03	1.8163E+03	1.6846E+03	2.5053E+03	**6.9642E+01**	1.8315E+03	2.8898E+03	1.2907E+03	1.3067E+03	1.3375E+03
	Std	2.7102E+02	5.7798E+02	3.3375E+02	2.4672E+02	3.9312E+02	4.1630E+02	4.4199E+02	3.4481E+02	**7.2296E+01**	2.5294E+02	7.9908E+02	3.3688E+02	5.9989E+02	5.3675E+02
CEC2017-F17	Ave	1.1044E+03	1.1591E+03	1.4873E+03	9.4203E+02	7.1536E+02	1.4036E+03	1.1815E+03	1.6989E+03	**7.8577E+01**	1.1926E+03	2.3055E+03	1.0243E+03	1.3790E+03	1.0442E+03
	Std	1.7863E+02	2.8801E+02	2.4554E+02	1.5653E+02	3.3594E+02	2.6193E+02	3.5463E+02	3.1166E+02	**5.5818E+01**	2.2157E+02	5.6654E+02	1.9738E+02	4.8075E+02	4.2441E+02
CEC2017-F18	Ave	2.3216E+02	2.4537E+02	2.2485E+02	7.6696E+01	**1.8978E+01**	2.2105E+02	1.0700E+02	3.6836E+03	2.6651E+01	1.7634E+02	3.7596E+05	2.0135E+02	2.3332E+04	7.2828E+01
	Std	5.2660E+01	5.5098E+01	4.6560E+01	1.5473E+01	6.8594E+00	5.3781E+01	2.5456E+01	3.3315E+03	**1.8147E+00**	3.6688E+01	2.1440E+05	5.4566E+01	9.0855E+03	1.7172E+01
CEC2017-F19	Ave	1.8092E+02	1.1605E+02	1.8689E+02	5.4916E+01	2.7706E+01	1.7057E+02	6.0681E+01	2.0905E+02	**1.4909E+01**	1.2300E+02	8.6615E+03	1.8711E+02	1.6849E+03	4.1582E+01
	Std	2.4315E+01	1.7066E+01	2.3419E+01	7.0643E+00	2.3700E+01	1.7308E+01	9.0979E+00	9.9248E+01	**2.2270E+00**	2.2198E+01	9.5586E+03	2.7857E+01	3.6684E+03	3.8569E+00
CEC2017-F20	Ave	1.5012E+03	1.4390E+03	1.5347E+03	1.1274E+03	6.1957E+02	1.4730E+03	8.5015E+02	1.5096E+03	**1.7328E+02**	1.4291E+03	2.0419E+03	2.0892E+03	1.7570E+03	1.5108E+03
	Std	1.5794E+02	2.5959E+02	1.9388E+02	1.6621E+02	2.7480E+02	2.2757E+02	2.9776E+02	2.4015E+02	**2.9510E+01**	2.2593E+02	5.4476E+02	2.3942E+02	5.0882E+02	3.5931E+02
CEC2017-F21	Ave	2.5651E+02	2.5886E+02	2.6612E+02	2.7704E+02	**2.3328E+02**	2.5559E+02	2.9522E+02	4.4302E+02	2.3681E+02	2.6312E+02	4.5334E+02	2.5334E+02	3.0919E+02	2.4283E+02
	Std	4.4792E+00	5.8310E+00	9.0711E+00	5.4737E+00	5.5896E+00	7.9041E+00	1.8752E+01	3.3010E+01	**3.7956E+00**	5.8648E+00	1.0723E+02	4.8050E+00	1.5230E+01	3.9155E+00
CEC2017-F22	Ave	1.0869E+04	1.0549E+04	1.2833E+04	1.0498E+04	**4.4240E+02**	1.5477E+04	9.4703E+03	1.2353E+04	2.4503E+03	1.0712E+04	1.7437E+04	1.1293E+04	1.2669E+04	1.0001E+04
	Std	5.9666E+02	1.4695E+03	2.9770E+03	5.7080E+02	1.3837E+03	4.2332E+03	1.9820E+03	8.5023E+02	5.6754E+02	**5.3690E+02**	5.5401E+03	5.5051E+02	1.3368E+03	9.9449E+02
CEC2017-F23	Ave	5.6045E+02	5.7830E+02	6.0509E+02	5.9568E+02	5.4924E+02	5.8936E+02	6.0766E+02	6.9733E+02	**5.3784E+02**	5.6511E+02	7.4542E+02	5.9401E+02	6.1481E+02	5.9022E+02
	Std	**6.9686E+00**	1.2984E+01	1.0931E+01	9.3587E+00	1.0064E+01	1.1284E+01	2.0271E+01	2.5561E+01	7.2779E+00	9.4374E+00	6.4816E+01	9.1354E+00	1.4935E+01	9.4601E+00
CEC2017-F24	Ave	9.1669E+02	9.1543E+02	9.5715E+02	9.1402E+02	8.4703E+02	9.3618E+02	9.2627E+02	1.1170E+03	**8.1249E+02**	8.9614E+02	1.2427E+03	9.2146E+02	9.6559E+02	9.1139E+02
	Std	**6.8169E+00**	1.1243E+01	1.0473E+01	9.4629E+00	8.2441E+00	9.8711E+00	1.6690E+01	3.7561E+01	1.1751E+01	7.2692E+00	1.5807E+02	1.0716E+01	2.5211E+01	1.8267E+01
CEC2017-F25	Ave	7.5130E+02	7.2413E+02	7.3317E+02	6.8002E+02	7.4127E+02	7.3498E+02	7.0926E+02	7.1255E+02	**6.3565E+02**	7.3362E+02	9.7817E+02	7.0082E+02	7.2896E+02	6.6260E+02
	Std	**2.6672E+01**	3.6202E+01	4.1557E+01	4.6584E+01	3.7804E+01	4.0588E+01	4.3595E+01	4.3746E+01	3.2823E+01	3.4236E+01	7.7251E+01	5.3711E+01	4.5854E+01	3.0188E+01
CEC2017-F26	Ave	3.3940E+03	2.8467E+03	3.7174E+03	3.0556E+03	2.4311E+03	3.5233E+03	3.2344E+03	5.5293E+03	**2.2492E+03**	3.1603E+03	6.5592E+03	3.1140E+03	3.8988E+03	3.1268E+03
	Std	8.6357E+01	1.0317E+03	1.3782E+02	1.2289E+02	1.6621E+02	1.0772E+02	2.0595E+02	4.1658E+02	1.7577E+02	8.6697E+01	1.4832E+03	9.9221E+01	2.0322E+02	**7.7904E+01**
CEC2017-F27	Ave	6.5378E+02	5.8953E+02	6.4285E+02	5.8627E+02	6.3824E+02	6.2938E+02	5.6348E+02	**4.9982E+02**	5.1702E+02	5.8037E+02	5.2815E+02	6.4576E+02	6.0907E+02	5.5657E+02
	Std	1.5005E+01	1.3223E+01	2.3311E+01	1.4512E+01	1.0116E+01	2.0581E+01	1.7761E+01	**5.1973E+00**	9.7637E+00	1.5391E+01	8.9374E+01	1.8168E+01	1.7089E+01	1.6447E+01
CEC2017-F28	Ave	5.2713E+02	5.2644E+02	5.2431E+02	5.1578E+02	**4.9815E+02**	5.2237E+02	5.2000E+02	5.3323E+02	5.0187E+02	5.3139E+02	6.1467E+02	5.4594E+02	5.3287E+02	5.0941E+02

	Std	2.1519E+01	1.9730E+01	2.5650E+01	1.8958E+01	1.0472E+02	1.8535E+01	**1.5586E+01**	2.2763E+01	1.7925E+01	2.4663E+01	5.4481E+02	3.0929E+01	2.3509E+01	1.7973E+01
CEC2017-F29	Ave	1.4037E+03	1.3549E+03	1.7343E+03	1.1375E+03	1.3345E+03	1.5981E+03	1.2032E+03	1.8616E+03	**6.9608E+02**	1.2618E+03	2.2091E+03	1.3428E+03	1.0321E+03	1.3789E+03
	Std	1.7059E+02	2.2748E+02	2.9109E+02	1.1139E+02	3.3150E+02	2.0389E+02	1.8429E+02	3.3466E+02	**4.0040E+01**	2.0588E+02	4.1037E+02	2.1561E+02	3.0058E+02	3.0473E+02
CEC2017-F30	Ave	2.4348E+03	2.4089E+03	2.4911E+03	2.3550E+03	2.6780E+03	2.4052E+03	2.2347E+03	2.9223E+03	**2.0644E+03**	2.3680E+03	3.5013E+04	2.4831E+03	2.7971E+03	2.1287E+03
	Std	1.5244E+02	1.2298E+02	1.3097E+02	1.7449E+02	1.4867E+02	1.3094E+02	9.0654E+01	2.0635E+03	**1.7584E+01**	1.5792E+02	2.3394E+04	1.9562E+02	5.7897E+02	7.3653E+01

Table S23 Detailed results of the CEC2017 Wilcoxon signed-rank test (Dim=10).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2017-F1	=	=	=	=	+	=	=	=	=	=	=	=	=
CEC2017-F3	=	=	=	=	+	=	=	=	=	=	=	=	=
CEC2017-F4	=	=	=	=	+	=	=	=	=	=	+	=	=
CEC2017-F5	+	-	+	=	-	+	+	-	-	=	+	+	+
CEC2017-F6	+	=	=	=	+	=	=	=	+	=	+	+	=
CEC2017-F7	+	-	+	+	=	+	+	+	+	+	+	+	+
CEC2017-F8	+	-	+	+	-	+	+	=	-	+	+	+	+
CEC2017-F9	=	=	=	=	+	=	=	=	=	=	=	=	=
CEC2017-F10	=	+	+	+	+	+	=	=	-	=	+	+	+
CEC2017-F11	+	+	=	=	+	=	=	=	=	=	+	=	+
CEC2017-F12	=	=	=	+	-	=	-	-	-	-	-	-	-
CEC2017-F13	=	-	=	=	=	=	=	-	-	=	+	=	-
CEC2017-F14	+	=	=	=	+	=	=	-	=	=	+	=	+
CEC2017-F15	-	-	=	=	=	=	=	-	-	=	-	-	=
CEC2017-F16	-	-	+	=	+	+	=	-	=	=	=	-	-
CEC2017-F17	=	=	+	+	+	+	=	+	+	+	+	+	+
CEC2017-F18	-	=	=	=	=	=	-	-	-	=	-	-	-
CEC2017-F19	-	-	=	-	+	=	-	-	-	-	-	-	-
CEC2017-F20	-	-	+	=	+	+	-	-	-	=	-	-	=
CEC2017-F21	+	+	+	+	+	+	=	+	+	+	+	=	+
CEC2017-F22	=	-	-	-	-	-	=	-	=	-	+	=	+
CEC2017-F23	+	-	+	=	-	=	+	-	-	-	+	=	+
CEC2017-F24	=	-	+	-	-	=	+	-	-	-	+	-	+
CEC2017-F25	=	-	-	=	+	-	=	-	=	-	-	-	-
CEC2017-F26	=	-	=	=	+	=	=	=	=	=	+	=	=
CEC2017-F27	-	+	-	-	+	-	-	-	+	-	-	-	-
CEC2017-F28	=	=	+	=	+	=	=	=	=	=	+	=	-
CEC2017-F29	+	+	+	-	+	+	=	=	-	+	+	+	+
CEC2017-F30	=	-	=	=	=	-	-	-	-	-	=	-	=

Table S24 Detailed results of the CEC2017 Wilcoxon signed-rank test (Dim=30).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2017-F1	=	+	+	=	+	+	=	=	+	=	+	=	+
CEC2017-F3	+	+	+	=	+	+	=	=	+	+	+	=	+
CEC2017-F4	+	+	+	-	-	+	=	-	+	+	-	=	+
CEC2017-F5	+	-	+	+	+	+	+	+	-	+	+	+	+
CEC2017-F6	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F7	+	=	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F8	+	-	+	+	+	+	+	+	-	+	+	+	+
CEC2017-F9	=	=	=	=	=	=	=	=	=	=	+	=	=
CEC2017-F10	=	=	+	=	-	+	+	+	-	=	+	+	+

CEC2017-F11	+	=	+	=	=	=	=	+	-	=	+	=	=
CEC2017-F12	+	+	+	+	-	+	=	+	-	=	+	+	+
CEC2017-F13	+	+	+	=	+	+	=	+	-	+	+	-	+
CEC2017-F14	+	+	+	+	-	=	+	-	-	-	+	+	+
CEC2017-F15	+	+	+	=	+	+	-	+	-	-	+	=	+
CEC2017-F16	=	=	+	-	+	=	=	+	-	+	+	+	=
CEC2017-F17	+	=	+	=	=	+	=	=	-	+	+	=	+
CEC2017-F18	+	+	+	=	-	+	=	+	-	-	+	=	+
CEC2017-F19	=	+	+	=	-	=	-	-	-	-	+	=	-
CEC2017-F20	-	-	=	-	+	=	-	-	-	-	=	-	-
CEC2017-F21	=	-	+	+	=	+	+	+	-	=	+	=	+
CEC2017-F22	+	+	+	+	+	+	+	+	-	+	+	+	+
CEC2017-F23	=	-	+	=	-	+	+	+	-	-	+	-	+
CEC2017-F24	=	-	+	=	-	+	+	+	-	-	+	-	+
CEC2017-F25	+	=	+	-	+	+	=	-	-	=	+	+	+
CEC2017-F26	+	-	+	=	=	+	+	+	-	-	+	-	+
CEC2017-F27	+	=	+	=	+	+	-	-	-	-	-	=	-
CEC2017-F28	+	+	+	+	=	+	+	+	=	+	+	+	+
CEC2017-F29	-	-	+	-	+	+	-	-	-	-	+	=	-
CEC2017-F30	+	=	+	=	+	+	=	-	+	=	+	+	+

Table S25 Detailed results of the CEC2017 Wilcoxon signed-rank test (Dim=50).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2017-F1	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F3	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F4	+	+	+	=	=	+	=	=	-	+	+	+	+
CEC2017-F5	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F6	+	+	+	+	+	+	+	+	+	+	+	=	+
CEC2017-F7	+	=	+	+	-	+	+	+	+	+	+	+	+
CEC2017-F8	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F9	+	+	+	+	=	+	=	+	+	+	+	=	+
CEC2017-F10	-	-	+	=	-	+	+	+	-	-	+	=	+
CEC2017-F11	+	=	+	-	-	+	-	+	-	=	+	+	+
CEC2017-F12	+	+	+	=	-	+	+	+	-	+	+	+	+
CEC2017-F13	+	+	+	+	+	+	+	+	-	+	+	+	+
CEC2017-F14	+	+	+	+	-	+	+	+	-	-	+	+	+
CEC2017-F15	+	+	+	+	-	+	=	+	-	=	+	+	+
CEC2017-F16	-	-	=	-	=	=	=	+	-	=	+	-	+
CEC2017-F17	=	=	+	-	=	+	-	+	-	=	+	=	+
CEC2017-F18	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F19	+	+	+	+	-	+	+	+	-	-	+	+	=
CEC2017-F20	+	+	+	-	-	+	-	+	-	=	+	+	+
CEC2017-F21	=	-	=	+	-	=	+	+	-	=	+	=	+
CEC2017-F22	=	-	=	-	-	=	-	+	-	=	+	-	+
CEC2017-F23	-	-	+	-	-	=	+	+	-	-	+	-	+
CEC2017-F24	-	-	+	=	-	+	+	+	-	-	+	-	+
CEC2017-F25	+	+	+	-	+	+	+	-	-	+	+	+	+
CEC2017-F26	+	-	+	+	-	+	+	+	-	-	+	-	+
CEC2017-F27	+	+	+	+	+	+	-	-	-	=	-	+	=
CEC2017-F28	+	+	+	-	+	+	+	-	+	+	+	+	+
CEC2017-F29	-	-	+	-	+	+	-	=	-	-	+	=	-
CEC2017-F30	+	=	+	+	=	+	=	-	-	=	+	=	-

Table S26 Detailed results of the CEC2017 Wilcoxon signed-rank test (Dim=100).

mLSHADE-SPACMA vs	LSHADE	EBOwith CMAR	jSO	LSHADE -cnEpSin	HSES	LSHADE -RSP	ELSHADE -SPACMA	EA4eig	L-SRTDE	APSM-jSO	LensOBLDE	ACD-DE	MIDE
CEC2017-F1	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F3	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F4	=	=	=	=	-	=	=	-	=	=	+	=	-
CEC2017-F5	+	+	+	+	-	+	+	+	+	+	+	+	+
CEC2017-F6	+	+	+	+	+	+	+	+	+	+	+	+	+
CEC2017-F7	+	+	+	+	-	+	-	+	+	+	+	+	+
CEC2017-F8	+	+	+	+	-	+	+	+	+	+	+	+	+
CEC2017-F9	+	+	+	+	+	+	=	+	+	+	+	+	+
CEC2017-F10	+	=	+	+	-	+	+	+	-	=	+	=	+
CEC2017-F11	+	+	+	=	-	+	+	+	-	+	+	+	+
CEC2017-F12	+	=	+	=	-	+	+	+	-	+	+	+	+
CEC2017-F13	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F14	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F15	+	+	+	+	+	+	+	+	=	+	+	+	+
CEC2017-F16	+	+	+	=	=	+	+	+	-	+	+	=	=
CEC2017-F17	=	=	+	=	-	+	=	+	-	+	+	=	+
CEC2017-F18	+	+	+	=	-	+	+	+	-	+	+	+	+
CEC2017-F19	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F20	=	=	=	-	-	=	-	=	-	=	+	+	+
CEC2017-F21	+	+	+	+	-	+	+	+	-	+	+	+	+
CEC2017-F22	+	+	+	+	-	+	=	+	-	+	+	+	+
CEC2017-F23	-	-	+	+	-	=	+	+	-	-	+	+	+
CEC2017-F24	+	+	+	+	-	+	+	+	-	-	+	+	+
CEC2017-F25	+	+	+	+	+	+	+	+	-	+	+	+	+
CEC2017-F26	+	+	+	-	-	+	+	+	-	+	+	=	+
CEC2017-F27	+	+	+	+	+	+	=	-	-	+	-	+	+
CEC2017-F28	+	+	+	=	=	+	+	+	-	+	=	+	+
CEC2017-F29	=	=	+	-	=	+	-	+	-	=	+	=	-
CEC2017-F30	+	+	+	+	+	+	+	=	-	+	+	+	+