SUPPLEMENTARY FILE FOR PAPER

Paper Title: Adaptive Gaining-sharing knowledge-based variant algorithm with Historical Probability Expansion and its application in Escape Maneuver Decision Making

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Table S1. The results of the first seven test algorithms in 10D CEC 2021

CEC 2021		10D						
	No	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	EDA2	AAVS-EDA
0 0 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.51E+01	3.12E-01	5.94E+00
	F3	0.00E+00	7.65E+00	3.26E+00	0.00E+00	1.77E+01	2.76E+01	1.63E+01
	F4	4.60E-02	4.64E-01	3.74E-01	0.00E+00	8.29E-01	1.73E-01	8.89E-01
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.87E+00	3.05E-01	8.34E+00
	F6	2.81E-02	1.13E-01	3.10E-02	0.00E+00	4.10E+00	8.64E-01	4.99E+00
	F7	1.50E-03	1.55E-02	2.45E-03	0.00E+00	2.06E+00	7.87E-01	2.55E+00
	F8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.20E+01	0.00E+00	0.00E+00
	F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F10	3.15E+01	4.80E+01	4.80E+01	6.50E-04	4.84E+01	4.86E+01	4.84E+01
0 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	4.16E-03	5.10E+02	1.22E+00	7.69E+00
	F3	1.09E+01	1.09E+01	1.09E+01	1.09E+01	1.74E+01	2.81E+01	1.67E+01
	F4	3.03E-01	4.52E-01	3.70E-01	2.52E-01	1.28E+00	9.31E-02	9.11E-01
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.97E+01	4.32E+00	3.24E+00
	F6	2.67E-02	1.12E-01	2.63E-02	2.29E-02	2.54E+01	2.38E+00	6.84E+00
	F7	5.99E-02	1.73E-02	2.55E-03	1.73E-03	6.18E+01	7.92E-01	2.40E+00
	F8	8.07E+00	5.09E+01	6.50E+01	5.67E+01	9.74E+01	1.00E+02	1.00E+02
	F9	5.00E+01	1.00E+02	6.67E+01	8.67E+01	2.02E+02	3.26E+02	3.27E+02
	F10	3.27E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02
0 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	2.08E-03	3.25E+02	1.72E+00	1.60E+01
	F3	1.09E+01	1.06E+01	1.09E+01	1.09E+01	1.58E+01	2.84E+01	1.80E+01
	F4	3.29E-01	4.74E-01	3.57E-01	2.56E-01	1.21E+00	1.66E-01	8.91E-01
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.93E+01	4.28E+00	4.48E+00
	F6	2.06E-02	9.29E-02	2.66E-02	2.45E-02	2.73E+01	2.43E+00	8.27E+00
	F7	1.96E-03	1.47E-02	2.33E-03	1.86E-03	2.22E+02	7.53E-01	2.04E+00
	F8	4.05E+00	5.01E+01	8.33E+01	6.67E+01	8.20E+01	1.00E+02	1.00E+02
	F9	4.67E+01	9.67E+01	8.00E+01	9.67E+01	2.02E+02	3.25E+02	3.26E+02
	F10	2.90E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02
1 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.41E+02	0.00E+00	0.00E+00
	F2	8.60E+01	1.52E+02	9.00E+01	1.74E+01	7.29E+02	7.02E-01	1.60E+01
	F3	1.46E+01	1.66E+01	1.54E+01	1.34E+01	1.75E+01	2.82E+01	1.33E+01
	F4	4.71E-01	5.75E-01	5.51E-01	3.74E-01	7.41E-01	1.39E-01	8.88E-01
	F5	1.14E+00	1.48E+01	3.93E+00	5.85E+00	1.76E+03	2.50E-01	6.02E+00
	F6	4.66E-01	1.25E+00	5.32E-01	2.71E-01	2.35E+01	8.56E-01	4.13E+00
	F7	1.71E-01	7.56E-01	3.57E-01	1.04E-01	8.24E+02	7.85E-01	3.27E+00
	F8	2.90E+01	8.44E+01	9.07E+01	8.21E+01	9.49E+01	1.00E+02	1.00E+02
	F9	4.33E+01	9.33E+01	7.67E+01	9.00E+01	2.14E+02	3.18E+02	3.24E+02
	F10	1.20E+02	3.88E+02	3.78E+02	3.88E+02	4.09E+02	4.33E+02	4.22E+02
1 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.17E+02	0.00E+00	0.00E+00
	F2	1.16E+02	1.55E+02	9.58E+01	2.14E+01	4.86E+02	6.88E-01	2.48E+01
	F3	1.45E+01	1.66E+01	1.52E+01	1.32E+01	1.66E+01	2.83E+01	1.46E+01

	F4	4.91E-01	6.02E-01	5.31E-01	4.08E-01	6.55E-01	1.60E-01	9.17E-01
	F5	1.58E+00	1.41E+01	2.84E+00	4.92E+00	2.79E+03	3.05E-01	5.94E+00
	F6	4.04E-01	1.30E+00	4.32E-01	3.55E-01	3.31E+01	8.14E-01	4.37E+00
	F7	1.70E-01	8.52E-01	2.97E-01	1.51E-01	1.47E+03	8.71E-01	4.34E+00
	F8	4.27E+01	8.04E+01	8.53E+01	7.39E+01	9.11E+01	1.00E+02	1.00E+02
	F9	4.00E+01	1.00E+02	6.00E+01	9.67E+01	1.71E+02	3.20E+02	3.24E+02
	F10	1.30E+02	3.78E+02	3.68E+02	3.88E+02	4.09E+02	4.36E+02	4.17E+02

Table S2. The results of the laster seven test algorithms in 10D CEC 2021

CEC 2021		10D						
	No	EBOwithCMAR	LSHADE-SPACMA	HSES	IMODE	MadDE	CJADE	iLSHADE-RSP
0 0 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	3.02E-01	0.00E+00	0.00E+00	0.00E+00	4.16E-03
	F3	3.26E+00	3.26E+00	1.15E+01	0.00E+00	0.00E+00	1.09E+01	1.05E+01
	F4	1.23E-01	1.23E-01	9.54E-01	0.00E+00	0.00E+00	3.23E-01	2.59E-01
	F5	3.50E-01	3.50E-01	5.04E-01	0.00E+00	0.00E+00	0.00E+00	1.39E-02
	F6	2.20E-01	2.20E-01	6.78E-01	0.00E+00	0.00E+00	6.29E-02	1.54E-01
	F7	2.69E-01	2.69E-01	4.44E-01	0.00E+00	0.00E+00	8.43E-03	6.47E-02
	F8	0.00E+00	0.00E+00	3.69E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F10	2.40E+01	2.40E+01	4.81E+01	0.00E+00	0.00E+00	4.80E+01	4.80E+01
0 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	6.25E-03	6.25E-03	7.87E+01	0.00E+00	0.00E+00	0.00E+00	4.16E-03
	F3	1.09E+01	1.09E+01	1.15E+01	1.09E+01	1.09E+01	1.09E+01	1.09E+01
	F4	1.73E-01	1.73E-01	9.00E-01	2.65E-01	1.88E-01	2.98E-01	2.51E-01
	F5	1.31E+01	1.31E+01	3.72E+01	0.00E+00	0.00E+00	0.00E+00	1.07E+01
	F6	1.06E-01	1.06E-01	3.39E+00	2.64E-02	1.89E-02	3.09E-02	3.17E-01
	F7	4.33E+00	4.33E+00	5.41E-01	7.66E-03	1.66E-03	8.30E-03	1.44E-01
	F8	9.72E+01	9.72E+01	1.00E+02	1.13E+01	9.72E+01	1.00E+02	1.00E+02
	F9	3.13E+02	3.13E+02	3.28E+02	8.42E+01	1.67E+02	2.94E+02	3.13E+02
	F10	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02
0 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	4.16E-03	4.16E-03	5.05E+01	0.00E+00	0.00E+00	0.00E+00	6.25E-03
	F3	1.09E+01	1.09E+01	1.14E+01	1.09E+01	1.09E+01	1.09E+01	1.09E+01
	F4	1.71E-01	1.71E-01	9.63E-01	2.72E-01	1.91E-01	3.06E-01	2.57E-01
	F5	3.04E+01	3.04E+01	5.45E+01	0.00E+00	0.00E+00	0.00E+00	4.49E-01
	F6	1.48E-01	1.48E-01	2.44E+00	2.65E-02	1.52E-02	3.40E-02	1.20E-01
	F7	4.73E-01	4.73E-01	5.05E+00	1.27E-02	1.32E-03	7.70E-03	9.85E-02
	F8	1.00E+02	1.00E+02	1.00E+02	3.97E+00	9.67E+01	9.67E+01	9.67E+01
	F9	3.12E+02	3.12E+02	3.28E+02	8.40E+01	1.90E+02	2.76E+02	3.25E+02
	F10	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02	4.00E+02
1 1 0	F1	0.00E+00	0.00E+00	0.00E+00	6.77E-08	0.00E+00	0.00E+00	0.00E+00
	F2	4.25E+00	4.25E+00	3.62E+01	1.09E+01	7.36E+00	4.65E+01	1.50E+01
	F3	1.07E+01	1.07E+01	1.13E+01	1.39E+01	1.33E+01	1.35E+01	1.21E+01
	F4	3.48E-01	3.48E-01	5.96E-01	5.04E-02	4.04E-01	5.96E-01	3.65E-01
	F5	5.23E+01	5.23E+01	5.47E+01	8.74E+00	9.22E-01	6.04E-01	3.89E+00
	F6	6.35E-01	6.35E-01	1.25E+01	4.02E-01	3.40E-01	8.10E-01	7.01E-01
	F7	1.12E+00	1.12E+00	1.08E+01	3.49E-01	1.03E-01	2.44E-01	3.59E-01
	F8	1.00E+02	1.00E+02	1.00E+02	2.41E+01	9.81E+01	1.00E+02	1.00E+02
	F9	2.92E+02	2.92E+02	3.28E+02	6.07E+01	1.69E+02	2.57E+02	2.99E+02
	F10	4.19E+02	4.19E+02	4.46E+02	3.78E+02	3.98E+02	4.16E+02	4.12E+02
1 1 1	F1	0.00E+00	0.00E+00	0.00E+00	2.95E-08	0.00E+00	0.00E+00	0.00E+00
	F2	4.87E+00	4.87E+00	2.59E+01	8.87E+00	5.26E+00	4.58E+01	1.20E+01
	F3	1.08E+01	1.08E+01	1.16E+01	1.38E+01	1.36E+01	1.33E+01	1.22E+01

	F4	3.19E-01	3.19E-01	6.04E-01	3.19E-02	4.14E-01	5.50E-01	3.79E-01
	F5	7.46E+01	7.46E+01	2.14E+01	1.31E+01	6.63E-01	6.23E-01	8.77E+00
	F6	6.57E-01	6.57E-01	1.25E+01	4.46E-01	3.55E-01	9.88E-01	4.50E+00
	F7	1.65E+00	1.65E+00	6.29E+00	4.03E-01	1.14E-01	4.10E-01	4.67E-01
	F8	1.00E+02	1.00E+02	1.00E+02	3.22E+01	9.77E+01	9.71E+01	1.00E+02
	F9	2.76E+02	2.76E+02	3.28E+02	8.73E+01	1.54E+02	2.94E+02	3.06E+02
	F10	4.25E+02	4.25E+02	4.47E+02	3.88E+02	3.98E+02	4.10E+02	4.10E+02

Table S3. The results of the first seven test algorithms in 20D CEC 2021

CEC 2021		20D						
	No	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	EDA2	AAVS-EDA
0 0 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.44E+01	5.41E-01	3.33E-01
	F3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.95E+00	2.23E+01	2.02E+01
	F4	1.12E-01	1.52E+00	8.56E-01	0.00E+00	2.28E+00	1.36E+00	1.87E+00
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.06E+00	2.95E-01	5.75E+00
	F6	6.56E-02	2.62E-01	1.24E-01	0.00E+00	4.74E+00	9.92E-01	2.20E+01
	F7	3.73E-02	1.48E-01	7.46E-02	5.21E-06	3.47E-01	8.27E-01	5.53E+00
	F8	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.46E-01	1.79E+00	0.00E+00
	F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F10	4.54E-03	4.88E+01	4.88E+01	3.81E-04	5.15E+01	4.88E+01	4.88E+01
0 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+03	4.39E+00	8.25E+00
	F3	2.02E+01	2.02E+01	2.02E+01	2.02E+01	4.28E+01	2.25E+01	2.02E+01
	F4	7.60E-01	1.34E+00	8.98E-01	5.53E-01	3.74E+00	1.12E+00	2.06E+00
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E+02	9.27E+00	2.10E+00
	F6	8.82E-02	1.92E-01	1.22E-01	8.57E-02	1.05E+02	9.13E+00	2.10E+01
	F7	4.32E-02	8.85E-02	5.73E-02	5.37E-02	7.96E+01	1.08E+01	2.31E+00
	F8	5.63E+01	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02
	F9	9.33E+01	1.10E+02	1.00E+02	1.87E+02	4.12E+02	4.00E+02	3.89E+02
	F10	4.06E+02	4.86E+02	4.09E+02	4.83E+02	4.00E+02	4.86E+02	4.83E+02
0 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.52E+03	1.01E+01	2.02E+01
	F3	2.02E+01	2.02E+01	2.02E+01	2.02E+01	4.55E+01	2.25E+01	2.02E+01
	F4	7.47E-01	1.38E+00	8.94E-01	5.23E-01	3.20E+00	1.27E+00	1.86E+00
	F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.25E+02	5.02E+00	1.83E+00
	F6	9.32E-02	2.02E-01	1.05E-01	9.20E-02	1.00E+02	1.21E+00	2.20E+01
	F7	4.54E-02	8.69E-02	5.92E-02	5.37E-02	7.51E+01	1.08E+01	2.71E+00
	F8	6.45E+01	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02
	F9	1.00E+02	1.07E+02	1.07E+02	1.67E+02	4.16E+02	3.98E+02	3.87E+02
	F10	4.03E+02	4.86E+02	4.20E+02	4.71E+02	4.05E+02	4.86E+02	4.86E+02
1 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.57E+02	0.00E+00	0.00E+00
	F2	6.96E+00	1.05E+02	1.81E+01	6.23E+00	1.58E+03	1.32E+01	1.19E+01
	F3	2.20E+01	2.48E+01	2.30E+01	2.20E+01	3.83E+01	2.40E+01	2.05E+01
	F4	9.44E-01	1.72E+00	1.11E+00	6.97E-01	3.47E+00	1.04E+00	1.93E+00
	F5	1.25E+02	2.72E+02	2.78E+02	3.46E+01	6.69E+04	4.60E+00	4.02E+00
	F6	4.81E-01	1.02E+00	5.71E-01	6.95E-01	1.31E+02	5.22E+00	1.95E+01
	F7	5.64E+00	3.93E+01	1.70E+01	9.14E+00	2.67E+04	7.93E-01	3.00E+00
	F8	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02
	F9	9.00E+01	1.30E+02	1.11E+02	2.46E+02	4.24E+02	3.91E+02	3.62E+02
	F10	4.04E+02	4.14E+02	4.07E+02	4.14E+02	4.53E+02	4.14E+02	4.14E+02
1 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.45E+02	0.00E+00	0.00E+00
	F2	7.70E+00	9.98E+01	1.67E+01	6.63E+00	1.37E+03	1.17E+01	1.53E+01
	F3	2.22E+01	2.46E+01	2.25E+01	2.19E+01	4.04E+01	2.22E+01	2.05E+01

	F4	9.75E-01	1.71E+00	1.10E+00	7.26E-01	3.63E+00	1.46E+00	1.81E+00
	F5	1.25E+02	2.80E+02	3.38E+02	2.87E+01	8.03E+04	1.23E+01	5.51E-01
	F6	4.85E-01	9.76E-01	5.57E-01	7.97E-01	1.25E+02	4.99E+00	2.24E+01
	F7	6.49E+00	3.76E+01	1.83E+01	8.01E+00	2.30E+04	8.06E-01	7.02E+00
	F8	9.82E+01	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02
	F9	8.67E+01	1.54E+02	1.00E+02	2.32E+02	4.24E+02	3.96E+02	3.70E+02
	F10	4.05E+02	4.14E+02	4.07E+02	4.14E+02	4.59E+02	4.14E+02	4.14E+02

Table S4. The results of the laster seven test algorithms in 20D CEC 2021

CEC2021		20D						
	No	EBOwithCMAR	LSHADE-SPACMA	HSES	IMODE	MadDE	CJADE	iLSHADE-RSP
0 0 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	0.00E+00	0.00E+00	3.25E-01	0.00E+00	0.00E+00	0.00E+00	1.67E-02
	F3	1.99E-01	1.99E-01	2.07E+01	0.00E+00	0.00E+00	2.02E+01	1.95E+01
	F4	4.17E-01	4.17E-01	2.11E+00	0.00E+00	0.00E+00	7.43E-01	5.71E-01
	F5	3.02E+00	3.02E+00	1.93E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-01
	F6	3.21E-01	3.21E-01	9.68E-01	8.23E-03	0.00E+00	6.09E-01	2.59E-01
	F7	4.63E-01	4.63E-01	7.04E-01	1.17E-03	0.00E+00	2.26E-01	3.85E-01
	F8	3.71E-01	3.71E-01	1.08E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F10	4.72E+01	4.72E+01	4.91E+01	5.48E-04	0.00E+00	4.88E+01	4.88E+01
0 1 0	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	2.08E-03	2.08E-03	1.69E+02	0.00E+00	0.00E+00	0.00E+00	3.75E-02
	F3	2.02E+01	2.02E+01	2.33E+01	2.02E+01	2.02E+01	2.02E+01	2.02E+01
	F4	4.04E-01	4.04E-01	1.83E+00	6.65E-01	4.54E-01	7.23E-01	5.62E-01
	F5	1.28E+01	1.28E+01	6.47E+01	0.00E+00	0.00E+00	0.00E+00	2.70E-01
	F6	2.36E-01	2.36E-01	1.32E+01	1.81E-01	7.80E-02	9.68E-02	2.46E-01
	F7	1.64E+01	1.64E+01	3.41E+01	1.53E-01	4.06E-02	8.12E-02	1.22E+01
	F8	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02
	F9	3.99E+02	3.99E+02	3.93E+02	1.00E+02	3.30E+02	3.75E+02	3.37E+02
	F10	4.86E+02	4.86E+02	4.20E+02	4.00E+02	4.86E+02	4.86E+02	4.86E+02
0 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	3.12E-03	3.12E-03	2.23E+02	0.00E+00	0.00E+00	0.00E+00	2.81E-02
	F3	2.02E+01	2.02E+01	2.34E+01	2.02E+01	2.02E+01	2.02E+01	2.02E+01
	F4	4.12E-01	4.12E-01	1.97E+00	6.64E-01	4.66E-01	7.47E-01	5.59E-01
	F5	9.05E+00	9.05E+00	8.71E+01	0.00E+00	0.00E+00	0.00E+00	4.21E+00
	F6	2.62E-01	2.62E-01	3.22E+01	1.50E-01	7.47E-02	9.97E-02	2.88E-01
	F7	3.60E+01	3.60E+01	5.02E+01	1.59E-01	4.09E-02	7.55E-02	1.74E+00
	F8	1.00E+02	1.00E+02	1.00E+02	9.08E+01	1.00E+02	1.00E+02	1.00E+02
	F9	3.99E+02	3.99E+02	3.92E+02	1.00E+02	3.25E+02	3.69E+02	3.33E+02
	F10	4.86E+02	4.86E+02	4.32E+02	4.00E+02	4.86E+02	4.86E+02	4.83E+02
1 1 0	F1	0.00E+00	0.00E+00	0.00E+00	1.37E-08	0.00E+00	0.00E+00	0.00E+00
	F2	9.46E-01	9.46E-01	2.78E+02	8.09E+00	2.78E+00	2.74E+01	1.21E+01
	F3	2.05E+01	2.05E+01	2.30E+01	2.23E+01	2.09E+01	2.24E+01	2.26E+01
	F4	5.50E-01	5.50E-01	1.81E+00	9.39E-01	6.48E-01	9.97E-01	7.54E-01
	F5	2.30E+02	2.30E+02	1.83E+02	1.31E+02	1.56E+01	4.79E+01	1.29E+02
	F6	1.18E+00	1.18E+00	4.52E+01	7.20E-01	5.30E-01	6.10E-01	5.40E+00
	F7	4.88E+01	4.88E+01	2.21E+01	6.06E+01	2.14E+00	6.67E+00	3.78E+01
	F8	1.00E+02	1.00E+02	1.00E+02	9.79E+01	1.00E+02	1.00E+02	1.00E+02
	F9	4.02E+02	4.02E+02	3.95E+02	1.00E+02	4.06E+02	4.06E+02	4.04E+02
	F10	4.14E+02	4.14E+02	4.33E+02	4.06E+02	4.14E+02	4.14E+02	4.14E+02
1 1 1	F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	F2	1.20E+00	1.20E+00	2.66E+02	7.40E+00	2.93E+00	2.62E+01	1.72E+01
	F3	2.05E+01	2.05E+01	2.35E+01	2.20E+01	2.11E+01	2.27E+01	2.25E+01

	F4	5.57E-01	5.57E-01	1.93E+00	9.18E-01	6.20E-01	1.01E+00	7.84E-01
	F5	2.21E+02	2.21E+02	2.03E+02	1.65E+02	1.99E+01	3.53E+01	1.25E+02
	F6	1.10E+00	1.10E+00	4.11E+01	7.75E-01	4.84E-01	5.42E-01	1.38E+00
	F7	7.30E+01	7.30E+01	3.28E+01	4.75E+01	1.26E+00	1.96E+00	2.33E+01
	F8	1.00E+02	1.00E+02	1.00E+02	9.85E+01	1.00E+02	1.00E+02	1.00E+02
	F9	4.01E+02	4.01E+02	3.95E+02	9.67E+01	4.06E+02	4.06E+02	4.05E+02
	F10	4.14E+02	4.14E+02	4.26E+02	4.03E+02	4.14E+02	4.14E+02	4.13E+02

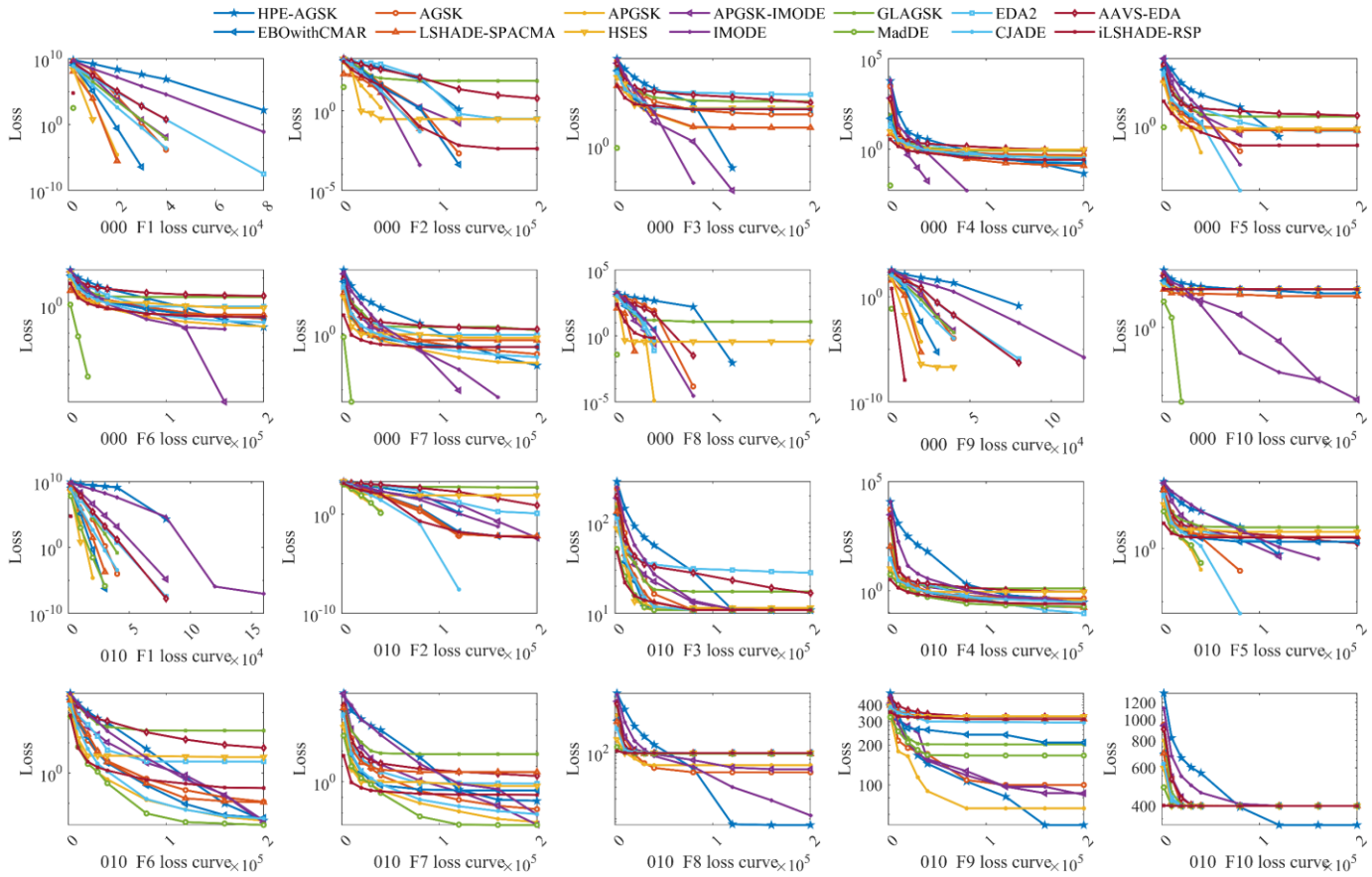

Figure S1. CEC2021 10D 000 010 convergence curve

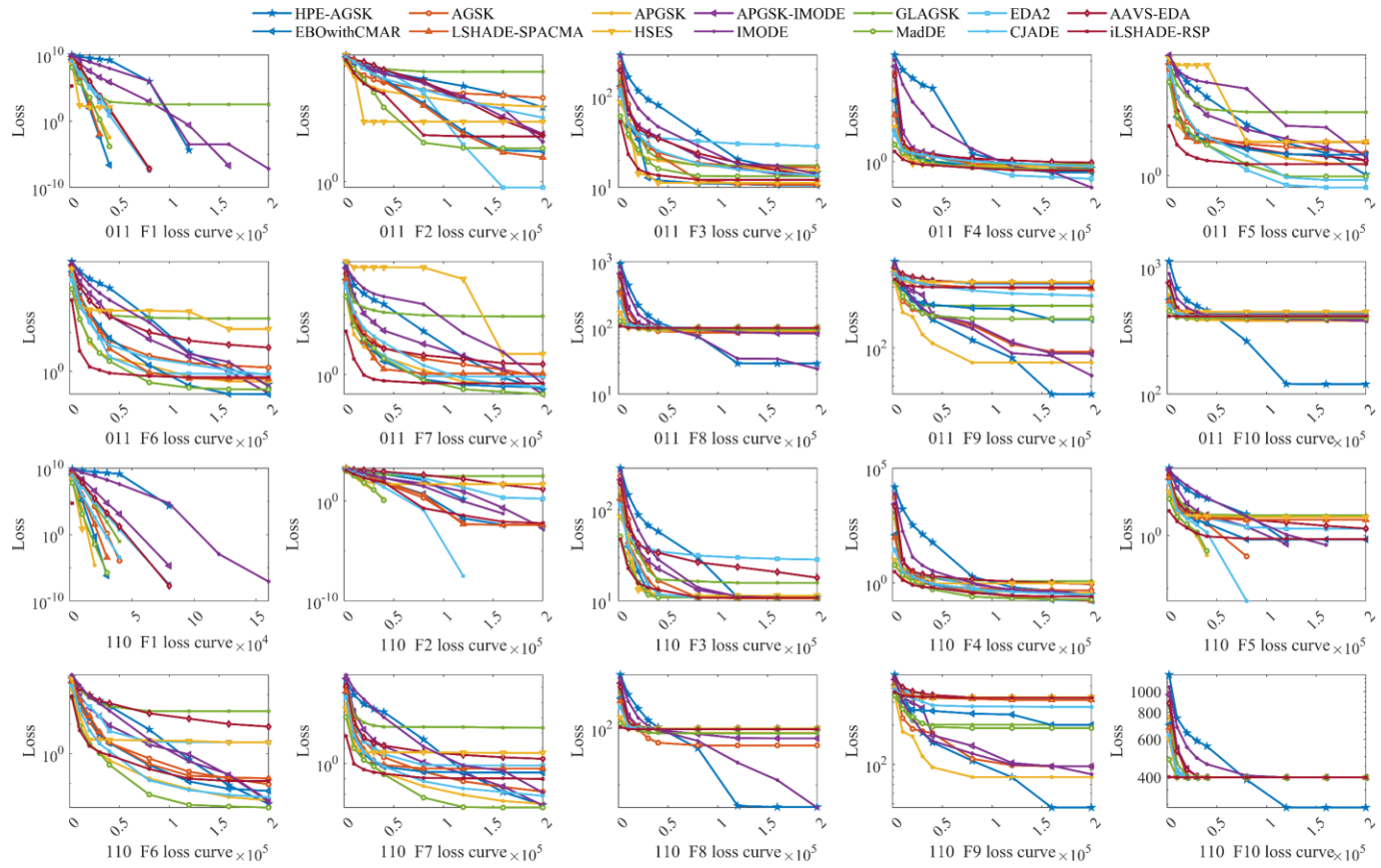

Figure S2. CEC2021 10D 011 110 convergence curve

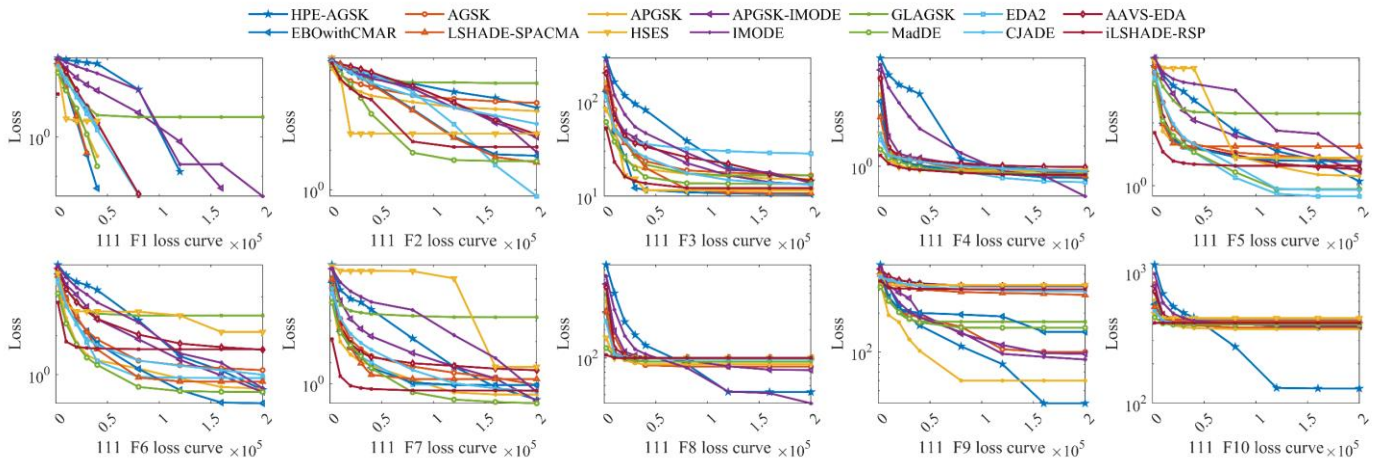

Figure S3. CEC2021 10D 111 convergence curve

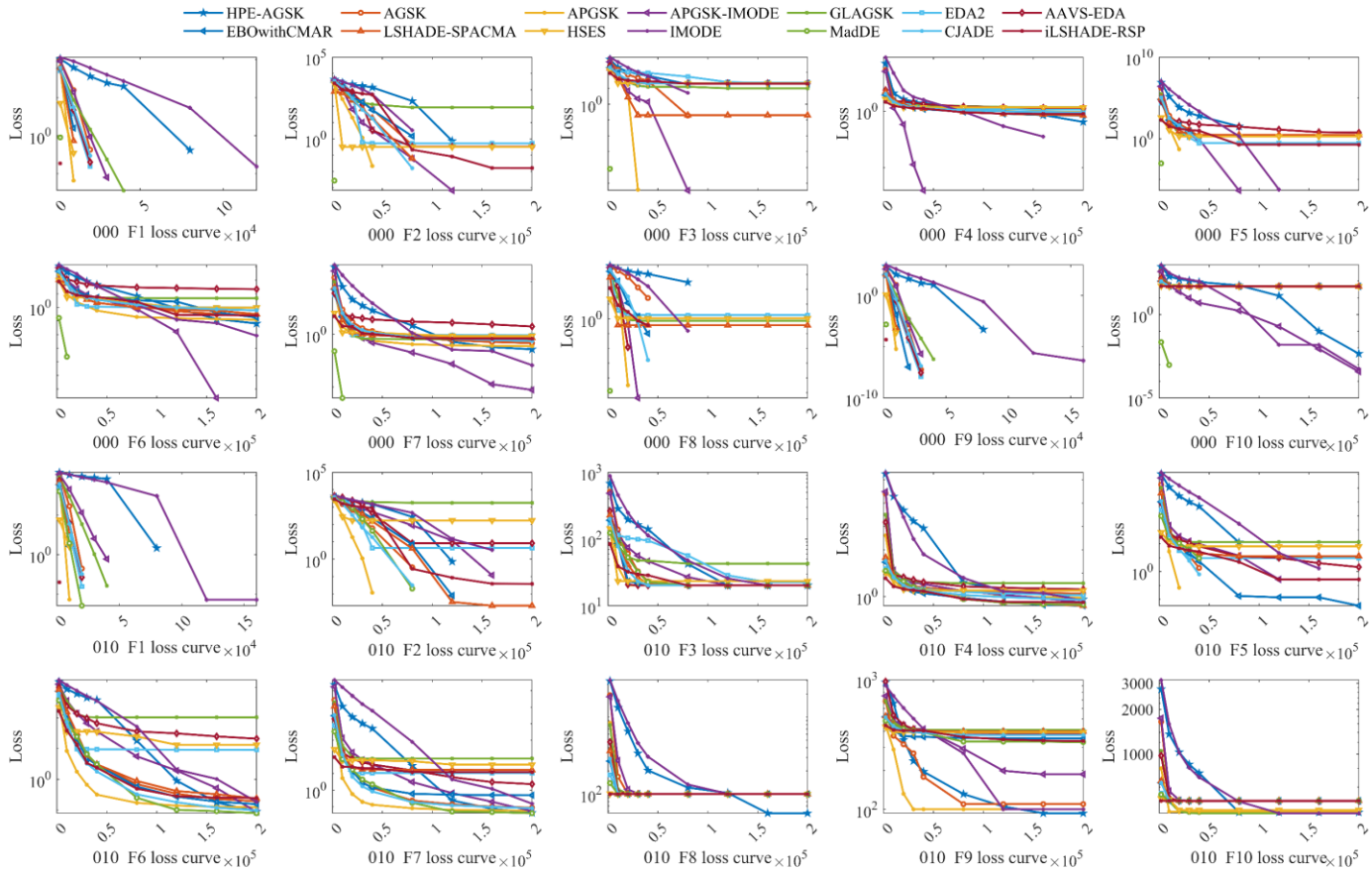

Figure S4. CEC2021 20D 000 010 convergence curve

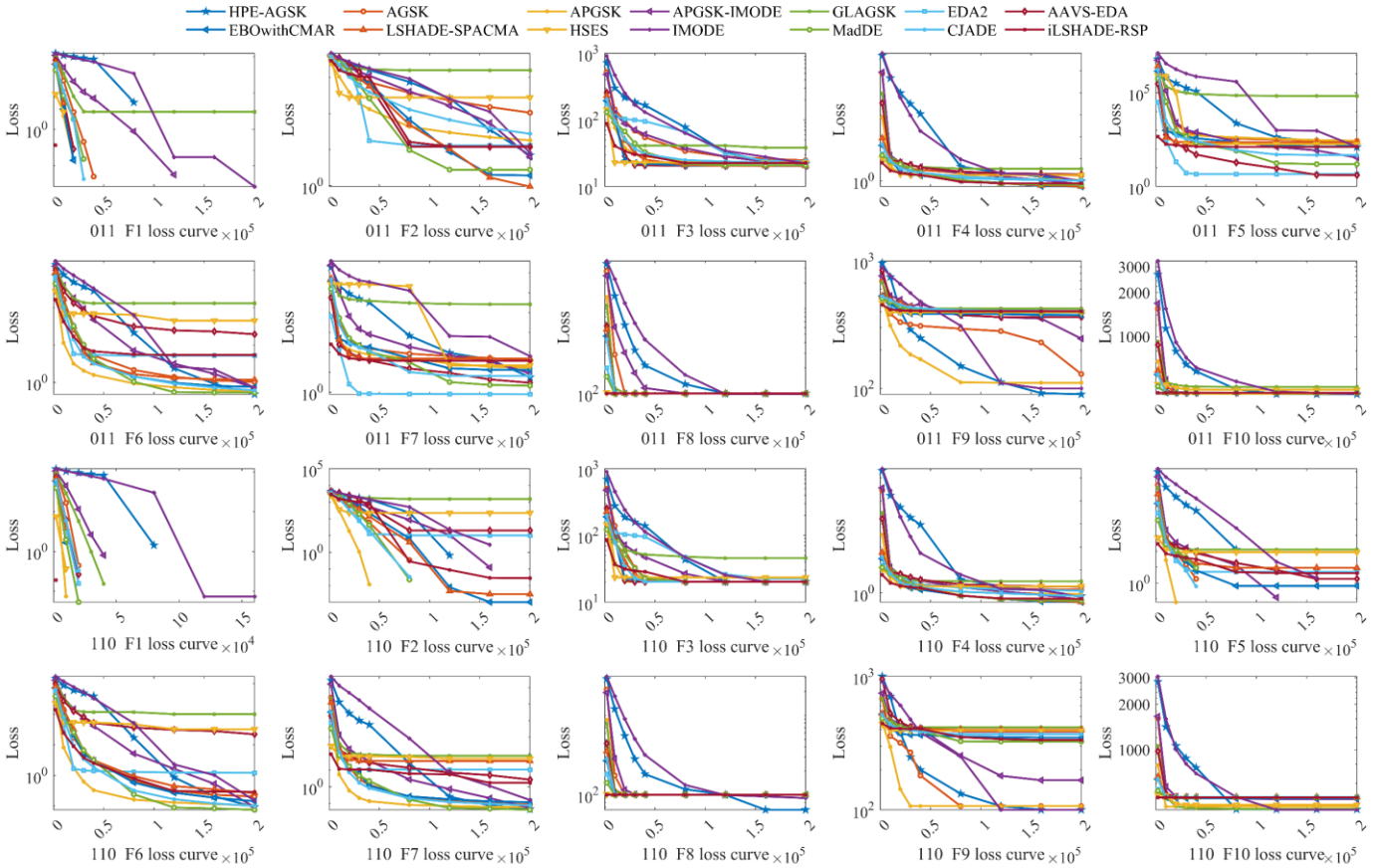

Figure S5. CEC2021 20D 011 110 convergence curve

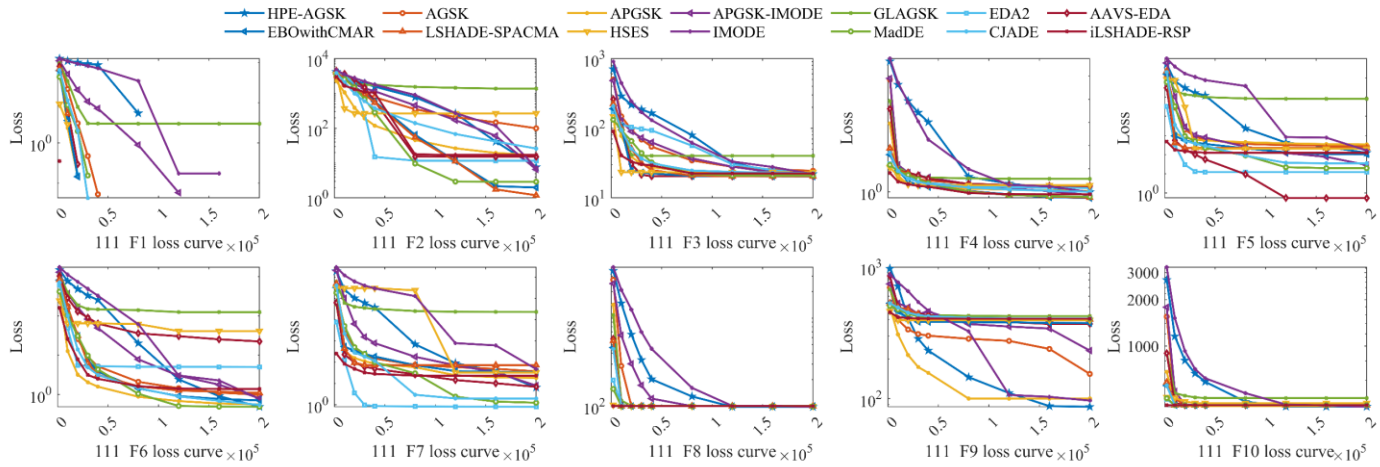

Figure S6. CEC2021 20D 111 convergence curve

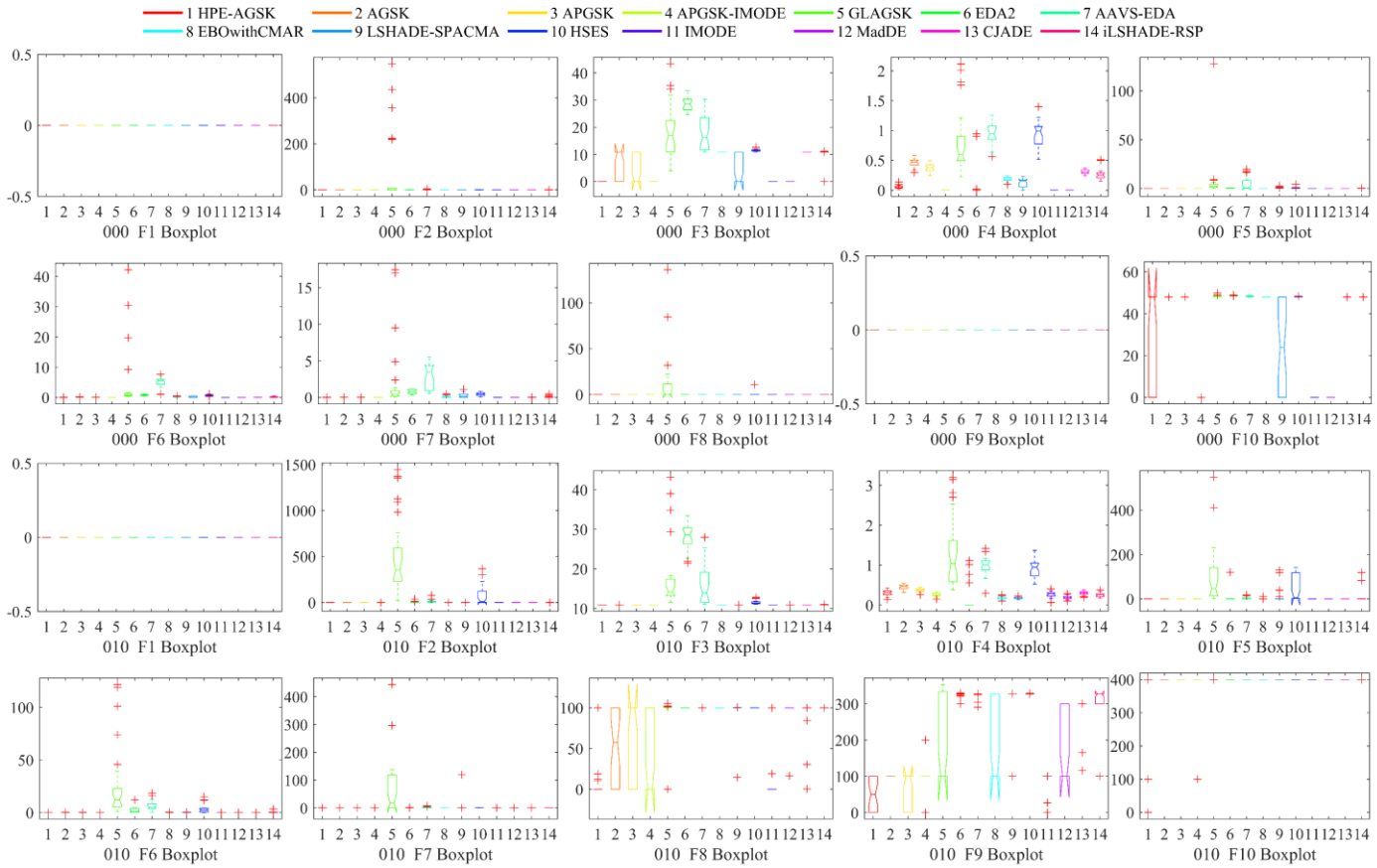

Figure S7. CEC2021 10D 000 010 boxplot

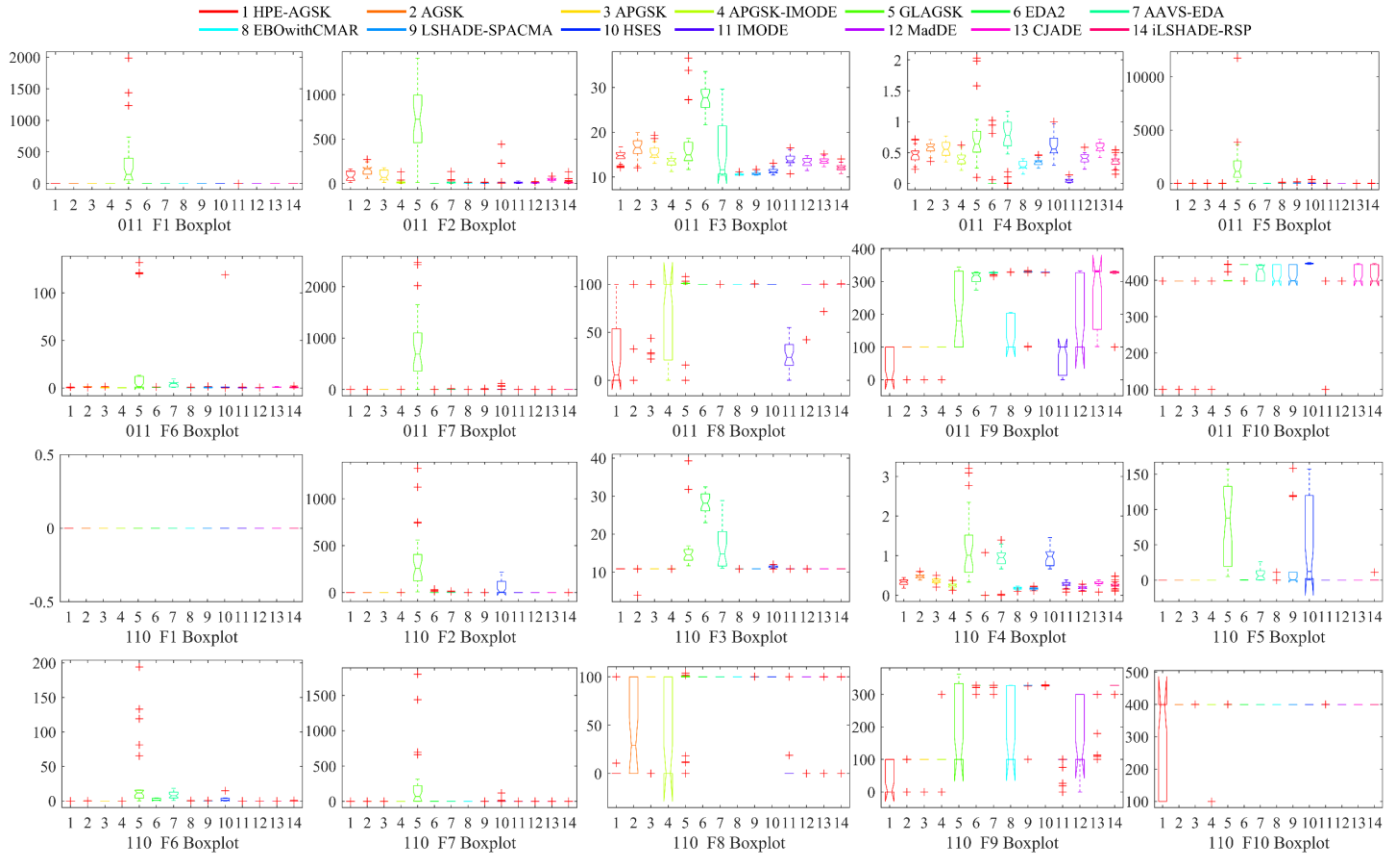

Figure S8. CEC2021 10D 011 110 boxplot

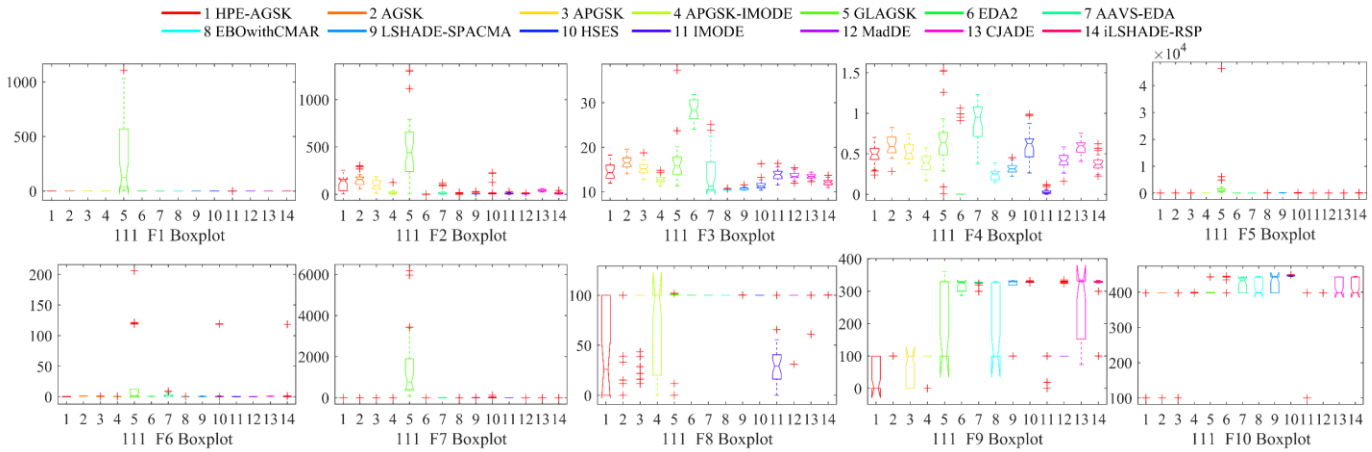

Figure S9. CEC2021 10D 111 boxplot

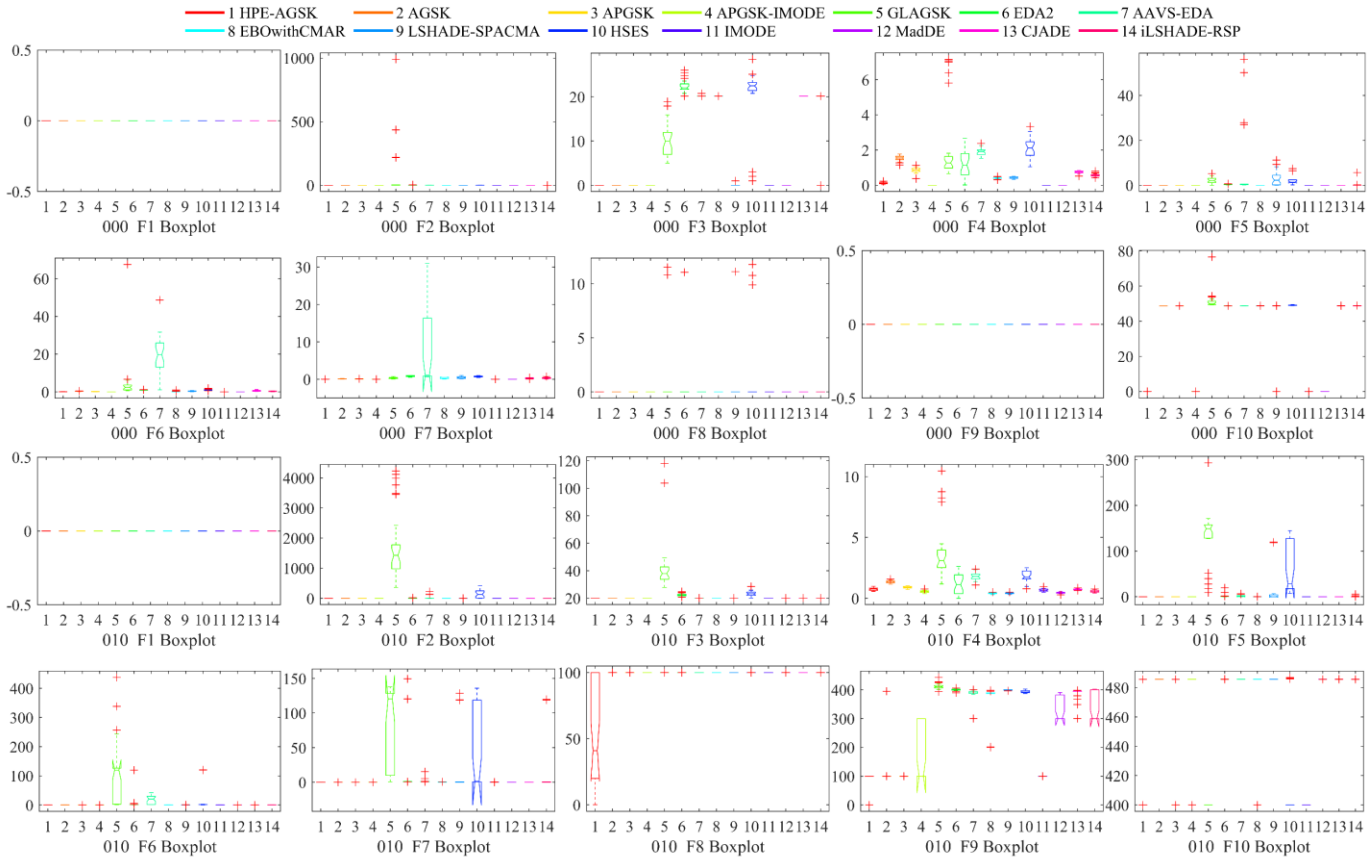

Figure S10. CEC2021 20D 000 010 boxplot

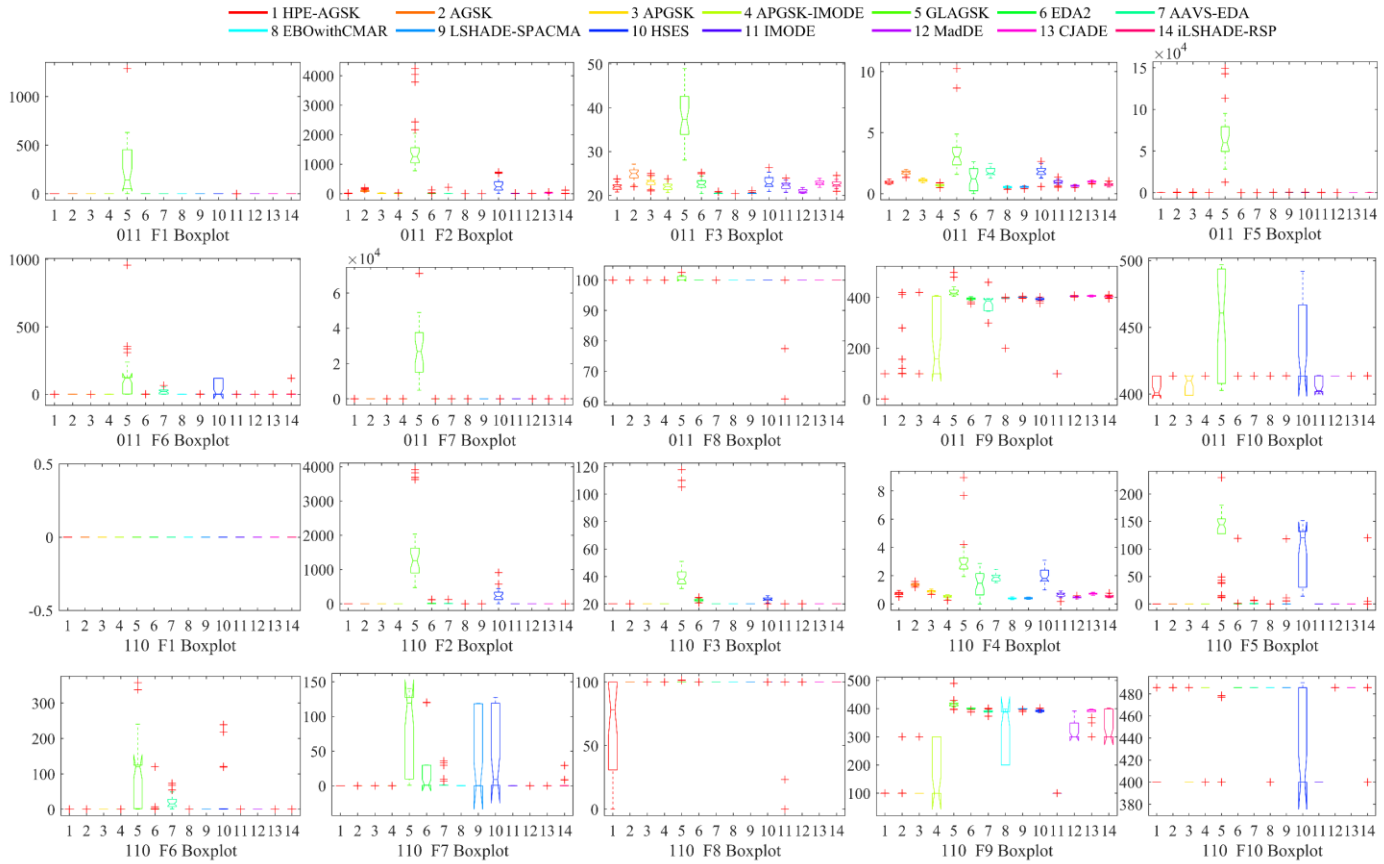

Figure S11. CEC2021 20D 011 110 boxplot

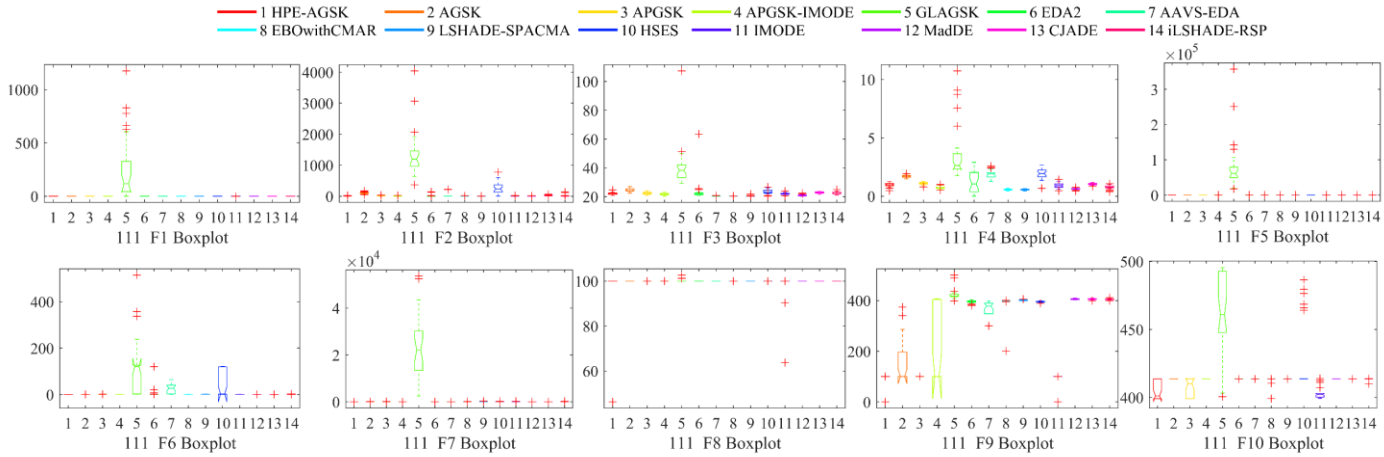

Figure S12. CEC2021 20D 111 boxplot

Table S5 The results of test algorithms in 10 CEC 2018

	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	IMODE	MadDE
F1	3.85E-14	1.04E-13	2.73E-14	1.47E-09	4.17E+02	3.42E-04	2.31E-14
F3	1.89E-14	4.24E-14	6.13E-14	6.80E-14	2.65E-01	3.44E-11	1.11E-15
F4	2.83E-06	3.69E-09	1.01E-13	8.07E-04	4.76E+00	3.00E-11	1.89E-14
F5	6.77E+00	7.21E+00	6.46E+00	3.76E+00	1.09E+01	4.58E+00	3.81E+00
F6	9.16E-05	1.55E-01	1.48E-04	1.47E-13	9.78E-07	8.10E-06	3.74E-13
F7	1.78E+01	1.83E+01	1.60E+01	1.41E+01	1.78E+01	1.57E+01	1.44E+01
F8	7.97E+00	1.02E+01	7.48E+00	3.05E+00	8.96E+00	4.29E+00	4.57E+00
F9	8.91E-03	3.83E-01	1.76E-03	0.00E+00	8.69E-14	6.18E-12	0.00E+00
F1	2.53E+02	3.66E+02	2.59E+02	1.10E+02	8.46E+02	1.21E+02	9.20E+01
F11	6.03E-02	1.26E+00	1.52E-01	3.71E-01	4.56E+00	1.00E+00	1.35E+00
F12	7.47E+01	1.52E+02	8.03E+01	9.88E+01	9.36E+04	2.32E+02	2.01E+01
F13	4.70E+00	6.55E+00	4.18E+00	4.08E+00	4.90E+03	8.74E+00	3.09E+00
F14	1.48E-01	1.94E+00	2.85E-01	2.02E-01	9.92E+01	1.52E+00	6.30E-01
F15	9.01E-02	6.34E-01	9.07E-02	6.10E-02	4.66E+02	4.13E-01	3.02E-01
F16	9.50E-01	2.52E+00	8.47E-01	1.05E+00	2.24E+01	8.09E-01	4.94E-01
F17	9.78E-01	1.17E+01	2.85E+00	7.52E-01	3.87E+01	1.14E+00	2.12E-01
F18	7.27E-01	2.21E+00	3.16E-01	9.49E-01	7.25E+03	3.79E+00	3.09E-01
F19	6.00E-02	7.74E-01	1.76E-01	1.32E-01	6.76E+02	5.40E-01	3.11E-02
F20	3.67E-02	3.27E+00	1.05E-01	8.92E-15	3.29E+01	7.80E-07	1.34E-14
F21	9.80E+01	9.61E+01	9.41E+01	1.00E+02	1.08E+02	9.44E+01	1.00E+02
F22	2.31E+01	9.44E+01	9.70E+01	7.01E+01	9.60E+01	5.50E+01	9.19E+01
F23	2.29E+02	2.84E+02	2.78E+02	2.76E+02	3.09E+02	2.23E+02	2.82E+02
F24	6.08E+01	1.02E+02	7.48E+01	9.28E+01	2.00E+02	8.65E+01	9.51E+01
F25	1.41E+02	4.00E+02	3.98E+02	3.22E+02	4.09E+02	3.80E+02	3.98E+02
F26	9.80E+01	3.00E+02	3.00E+02	1.59E+02	2.94E+02	9.21E-05	1.41E+02
F27	3.74E+02	3.89E+02	3.88E+02	3.89E+02	3.82E+02	3.89E+02	3.88E+02
F28	5.88E+01	2.82E+02	2.24E+02	1.71E+02	3.19E+02	1.35E+02	2.59E+02
F29	2.46E+02	2.52E+02	2.42E+02	2.46E+02	2.71E+02	2.51E+02	2.48E+02
F30	5.12E+02	6.43E+02	4.68E+02	5.10E+02	4.08E+04	7.08E+02	1.13E+03

Table S6 The results of test algorithms in 30 CEC 2018

	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	IMODE	MadDE
F1	4.13E-09	1.03E-05	7.42E-05	4.10E+00	9.95E+03	9.31E-03	1.91E+03
F3	5.49E-02	2.02E+04	6.16E+02	1.00E+04	1.23E+04	1.91E-07	2.68E+04
F4	8.50E+01	5.86E+01	6.84E+01	5.57E+01	8.50E+01	1.59E+01	9.08E+01
F5	3.47E+01	9.19E+01	7.05E+01	4.42E+01	5.48E+01	1.02E+02	7.76E+01
F6	1.43E-03	3.82E+00	1.92E-02	1.13E-04	2.08E-02	9.84E+00	1.14E-01
F7	6.07E+01	1.41E+02	9.80E+01	8.08E+01	8.43E+01	1.38E+02	1.04E+02
F8	4.66E+01	1.04E+02	7.93E+01	4.46E+01	6.02E+01	9.07E+01	7.38E+01
F9	1.07E-02	5.87E+01	6.30E+00	1.58E+01	9.99E-01	1.05E+03	2.00E+01
F1	2.83E+03	4.28E+03	3.00E+03	2.32E+03	3.64E+03	2.75E+03	2.85E+03
F11	2.25E+01	4.40E+01	2.42E+01	2.52E+01	7.75E+01	1.52E+02	7.16E+01
F12	2.78E+03	1.30E+04	8.13E+03	1.92E+04	5.03E+05	1.32E+03	3.48E+05
F13	4.13E+01	8.73E+01	8.41E+01	1.77E+02	9.10E+03	2.15E+02	1.32E+04
F14	2.51E+01	3.52E+01	3.85E+01	4.44E+01	6.22E+03	1.61E+02	8.18E+01
F15	8.90E+00	2.11E+01	1.75E+01	3.64E+01	1.25E+03	1.28E+02	2.72E+02
F16	3.79E+02	5.85E+02	3.43E+02	4.28E+02	7.04E+02	6.81E+02	4.38E+02
F17	7.82E+01	1.66E+02	1.02E+02	8.11E+01	1.71E+02	1.76E+02	7.04E+01
F18	2.69E+01	5.54E+01	1.62E+02	1.31E+03	2.01E+05	8.95E+01	5.99E+04
F19	8.47E+00	1.87E+01	1.59E+01	2.18E+01	4.49E+03	6.32E+01	1.38E+02
F20	7.65E+01	2.70E+02	1.88E+02	1.00E+02	2.73E+02	2.28E+02	8.80E+01
F21	1.83E+02	2.85E+02	2.38E+02	2.08E+02	2.52E+02	1.32E+02	1.94E+02
F22	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.01E+02	1.00E+02
F23	3.74E+02	4.14E+02	3.98E+02	3.99E+02	3.95E+02	4.51E+02	4.14E+02
F24	4.39E+02	4.73E+02	4.59E+02	4.74E+02	4.50E+02	5.55E+02	4.89E+02
F25	3.87E+02	3.87E+02	3.87E+02	3.87E+02	3.86E+02	3.92E+02	3.87E+02
F26	3.00E+02	1.74E+03	1.43E+03	3.45E+02	1.41E+03	2.84E+02	2.76E+02
F27	4.99E+02	5.02E+02	5.06E+02	5.13E+02	5.00E+02	5.48E+02	5.13E+02
F28	3.88E+02	3.16E+02	3.13E+02	3.74E+02	4.50E+02	3.23E+02	3.98E+02
F29	4.89E+02	6.58E+02	5.78E+02	5.03E+02	5.32E+02	6.72E+02	5.37E+02
F30	2.09E+03	2.09E+03	2.38E+03	2.86E+03	5.74E+02	3.34E+03	1.30E+04

Table S7 The results of test algorithms in 50 CEC 2018

	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	IMODE	MadDE
F1	1.29E+02	2.93E+01	4.52E+01	5.36E+02	1.38E+07	1.57E-02	1.04E+04
F3	1.24E+04	1.24E+05	3.27E+04	8.86E+04	4.91E+04	9.58E-07	1.24E+05
F4	1.11E+02	9.20E+01	7.07E+01	6.97E+01	2.03E+02	3.84E+01	1.13E+02
F5	7.20E+01	2.47E+02	1.94E+02	1.32E+02	1.51E+02	3.11E+02	3.07E+02
F6	1.72E-02	9.59E+00	1.68E-01	1.47E-02	5.20E-01	3.32E+01	2.05E+00
F7	1.43E+02	3.40E+02	2.38E+02	2.07E+02	1.87E+02	5.33E+02	3.56E+02
F8	8.32E+01	2.46E+02	1.96E+02	1.34E+02	1.33E+02	3.15E+02	3.10E+02
F9	2.47E-02	9.10E+01	9.35E+00	6.90E+01	1.98E+02	1.04E+04	2.81E+03
F1	7.67E+03	9.44E+03	7.04E+03	5.22E+03	7.06E+03	5.64E+03	8.25E+03
F11	3.34E+01	6.77E+01	7.47E+01	1.02E+02	2.30E+02	2.54E+02	3.45E+02
F12	5.26E+04	1.39E+05	6.25E+04	2.29E+05	2.16E+06	2.20E+03	3.30E+06
F13	1.85E+02	4.20E+02	1.12E+03	9.71E+02	1.06E+03	4.93E+02	2.40E+04
F14	4.19E+01	9.54E+01	8.70E+01	1.30E+02	4.87E+04	2.88E+02	1.00E+05
F15	3.78E+01	1.03E+02	1.09E+02	1.91E+02	4.96E+03	3.03E+02	1.52E+04
F16	8.38E+02	1.45E+03	8.59E+02	9.68E+02	8.38E+02	1.79E+03	1.12E+03
F17	5.02E+02	9.60E+02	6.77E+02	7.15E+02	9.55E+02	1.54E+03	8.07E+02
F18	8.06E+01	2.02E+03	6.63E+03	1.81E+04	1.25E+06	1.92E+02	7.55E+05
F19	2.53E+01	4.97E+01	4.48E+01	8.11E+01	1.40E+04	1.36E+02	1.70E+04
F20	3.22E+02	8.79E+02	5.46E+02	5.61E+02	7.55E+02	9.56E+02	5.96E+02
F21	2.87E+02	4.36E+02	3.75E+02	3.44E+02	2.98E+02	5.20E+02	4.68E+02
F22	5.74E+03	5.94E+03	4.57E+03	3.42E+02	5.24E+03	3.98E+03	1.41E+02
F23	4.89E+02	6.18E+02	5.60E+02	5.87E+02	5.35E+02	8.83E+02	7.11E+02
F24	5.45E+02	6.45E+02	6.01E+02	6.43E+02	5.89E+02	1.04E+03	7.67E+02
F25	4.83E+02	4.82E+02	5.25E+02	5.39E+02	6.43E+02	5.37E+02	6.08E+02
F26	1.67E+03	3.04E+03	2.54E+03	2.59E+03	2.85E+03	4.69E+03	3.07E+02
F27	5.53E+02	6.01E+02	5.85E+02	6.12E+02	5.00E+02	1.07E+03	7.21E+02
F28	4.59E+02	4.59E+02	4.68E+02	4.92E+02	5.00E+02	4.88E+02	5.56E+02
F29	4.99E+02	1.05E+03	8.40E+02	6.16E+02	6.95E+02	1.91E+03	1.12E+03
F30	6.24E+05	6.26E+05	6.07E+05	6.74E+05	1.38E+03	6.05E+05	4.17E+06

Table S8 The results of test algorithms in 100 CEC 2018

	HPE-AGSK	AGSK	APGSK	APSGSK-IMODE	GLAGSK	IMODE	MadDE
F1	6.26E+03	2.18E+03	1.19E+03	3.24E+03	1.10E+09	1.38E-01	2.06E+09
F3	2.02E+05	4.14E+05	1.83E+05	3.51E+05	1.90E+05	7.01E-05	3.58E+05
F4	2.23E+02	2.27E+02	2.34E+02	2.80E+02	6.80E+02	9.17E+01	8.30E+02
F5	3.04E+02	6.60E+02	6.05E+02	5.47E+02	4.03E+02	1.11E+03	1.06E+03
F6	7.76E-02	4.47E+00	2.19E+00	8.21E-01	7.07E+00	6.13E+01	2.53E+01
F7	4.73E+02	8.84E+02	6.37E+02	6.19E+02	7.00E+02	2.14E+03	1.17E+03
F8	3.03E+02	6.53E+02	5.89E+02	5.15E+02	4.45E+02	1.17E+03	1.04E+03
F9	8.78E-03	1.08E+02	8.02E+00	2.04E+01	1.43E+04	3.31E+04	4.48E+04
F1	2.39E+04	2.58E+04	2.10E+04	1.64E+04	1.70E+04	1.21E+04	2.48E+04
F11	3.18E+02	6.53E+02	8.95E+02	1.08E+03	1.11E+04	1.36E+03	5.99E+04
F12	1.49E+05	8.35E+05	2.34E+05	9.51E+05	8.95E+07	9.72E+04	2.20E+08
F13	1.43E+03	2.33E+03	2.27E+03	2.85E+03	8.16E+03	6.64E+02	4.70E+04
F14	2.75E+02	9.29E+02	3.50E+03	9.92E+03	1.34E+06	4.82E+02	2.73E+06
F15	3.26E+02	7.58E+02	4.79E+02	5.03E+02	8.07E+02	2.67E+02	2.38E+04
F16	2.46E+03	5.31E+03	3.32E+03	3.50E+03	3.82E+03	4.65E+03	6.26E+03
F17	1.62E+03	3.15E+03	2.08E+03	2.61E+03	2.75E+03	4.19E+03	3.59E+03
F18	3.52E+04	9.43E+05	1.00E+05	1.89E+05	1.55E+06	6.88E+04	2.72E+06
F19	1.60E+02	3.07E+02	7.87E+02	7.79E+02	9.86E+02	4.68E+02	3.07E+04
F20	1.76E+03	3.53E+03	2.21E+03	2.67E+03	2.82E+03	3.04E+03	3.45E+03
F21	5.23E+02	8.72E+02	7.44E+02	7.78E+02	5.41E+02	1.51E+03	1.12E+03
F22	2.53E+04	2.67E+04	2.26E+04	1.72E+04	2.02E+04	1.42E+04	2.52E+04
F23	6.78E+02	1.05E+03	1.00E+03	8.92E+02	8.45E+02	2.10E+03	1.41E+03
F24	1.04E+03	1.37E+03	1.19E+03	1.31E+03	1.22E+03	2.54E+03	1.78E+03
F25	7.46E+02	7.17E+02	8.11E+02	8.52E+02	1.36E+03	7.10E+02	1.59E+03
F26	4.70E+03	8.69E+03	6.62E+03	7.29E+03	9.74E+03	1.30E+04	1.81E+04
F27	5.90E+02	6.71E+02	8.86E+02	7.57E+02	5.00E+02	1.63E+03	1.26E+03
F28	5.46E+02	5.43E+02	5.93E+02	6.44E+02	1.59E+03	4.80E+02	2.07E+03
F29	2.16E+03	3.77E+03	3.25E+03	3.15E+03	2.54E+03	4.72E+03	6.07E+03
F30	2.54E+03	2.87E+03	4.10E+03	6.63E+03	4.47E+04	7.75E+03	3.44E+06

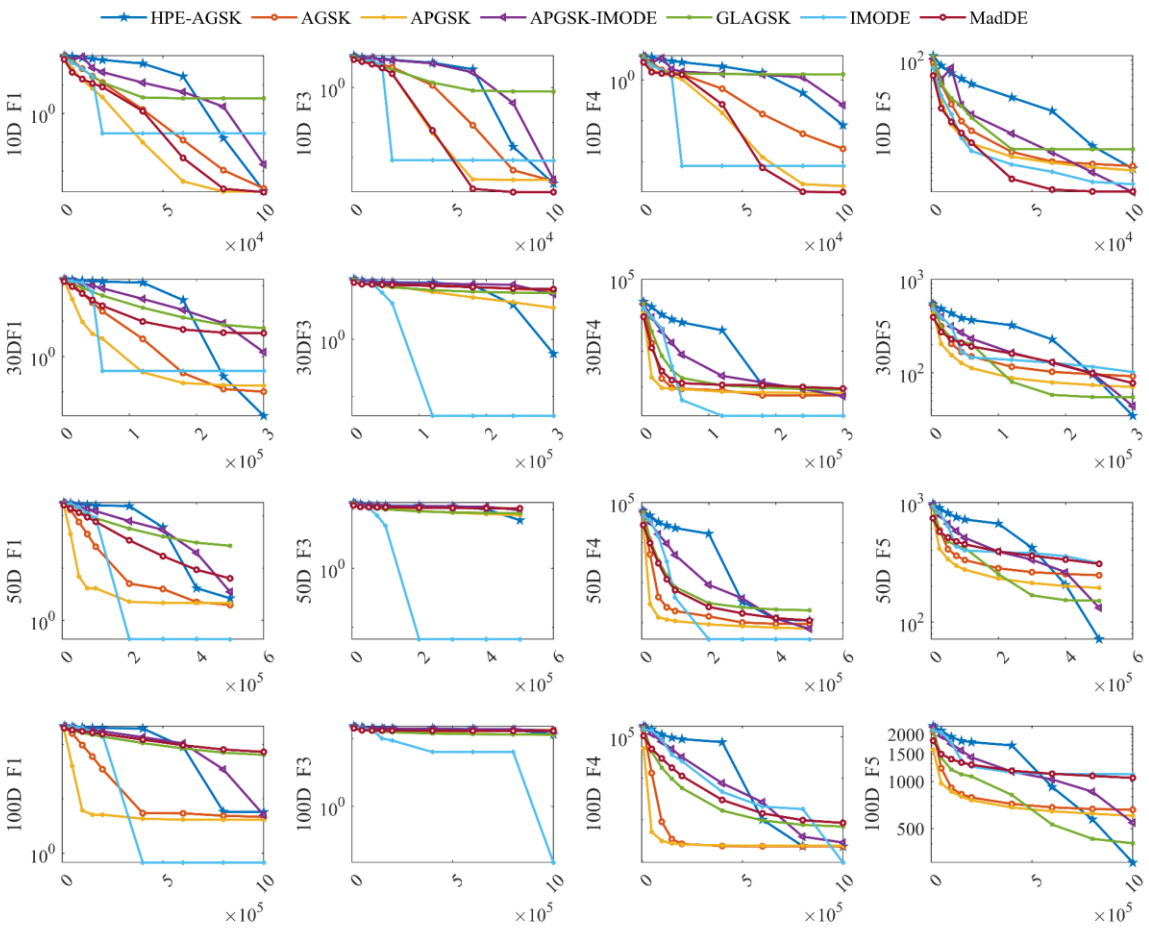

Figure S13. CEC2018 F1-F5 convergence curve

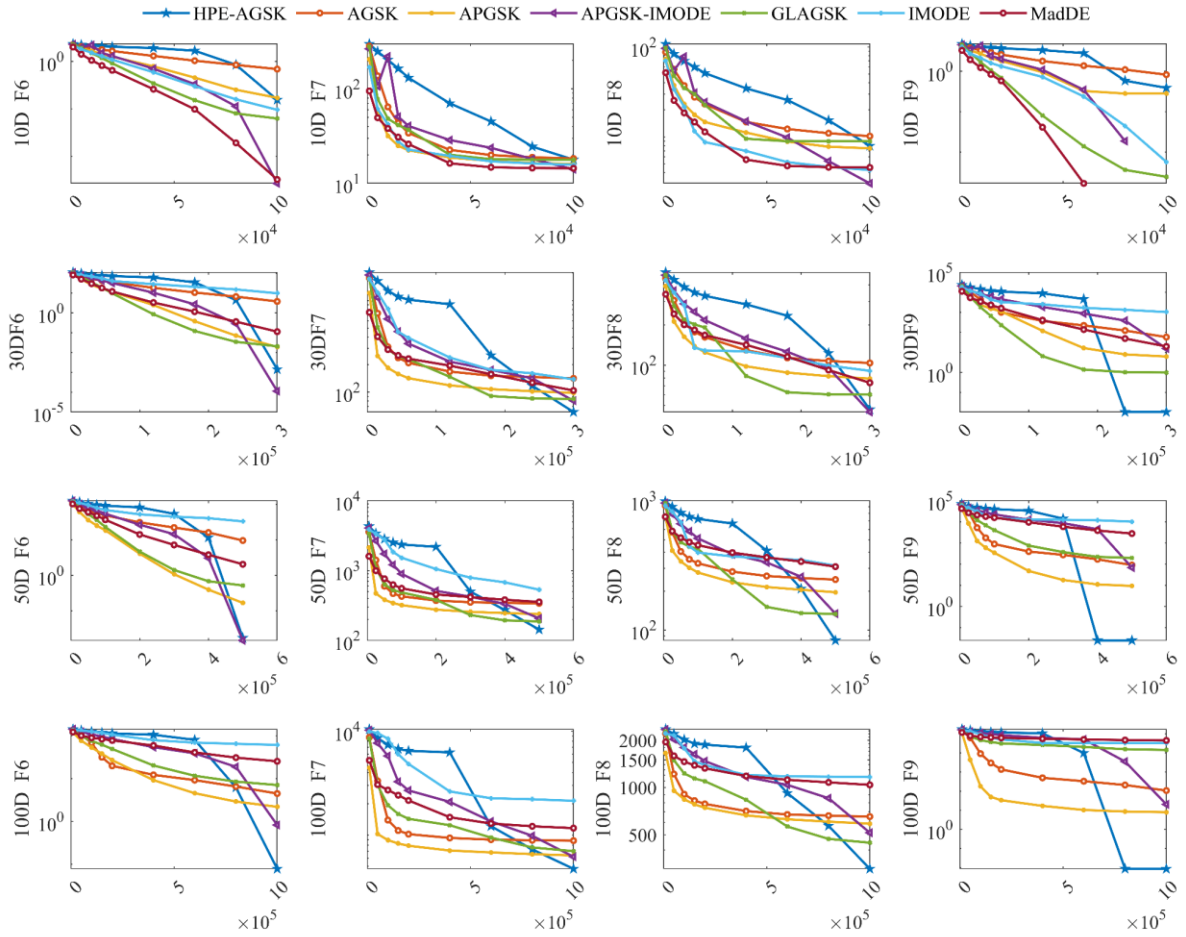

Figure S14. CEC2018 F6-F9 convergence curve

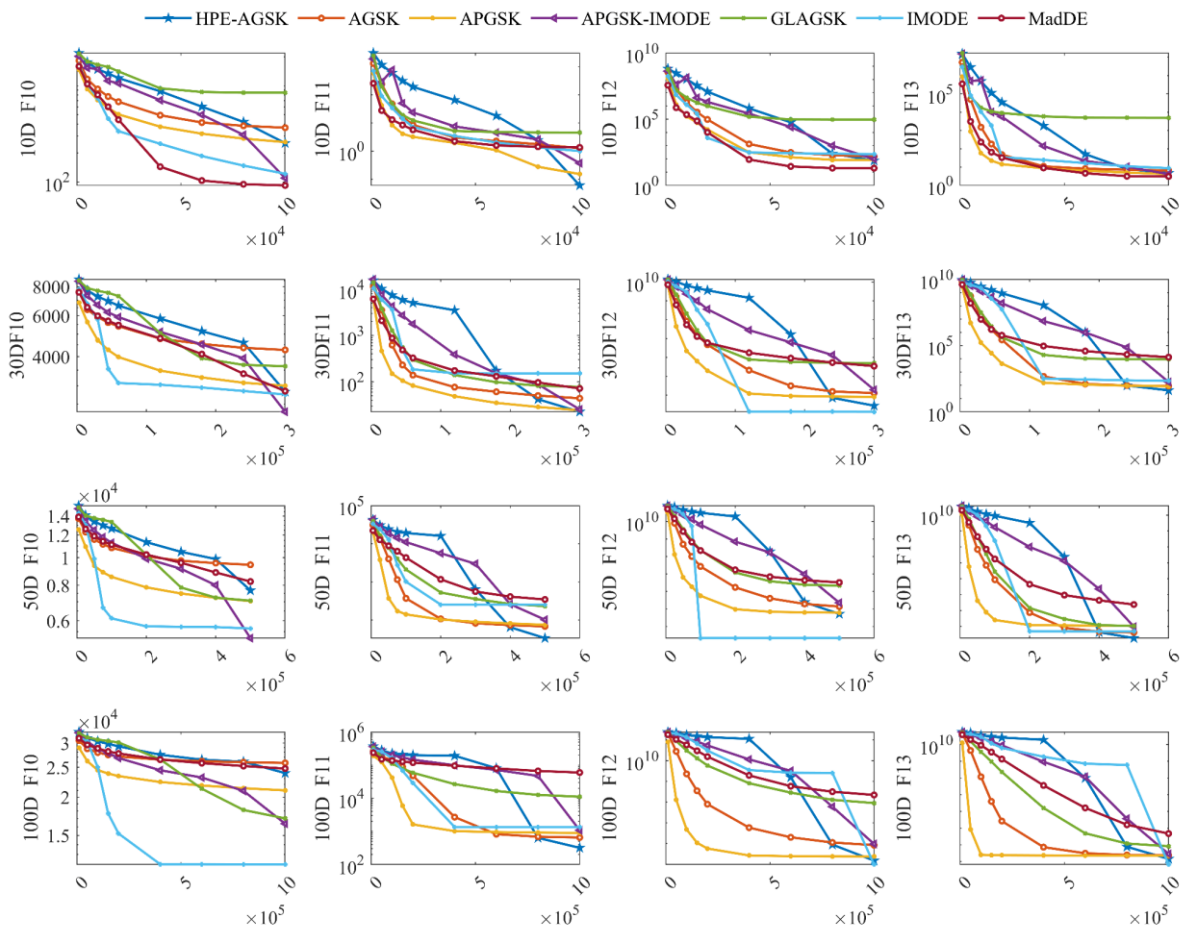

Figure S15. CEC2018 F10-F13 convergence curve

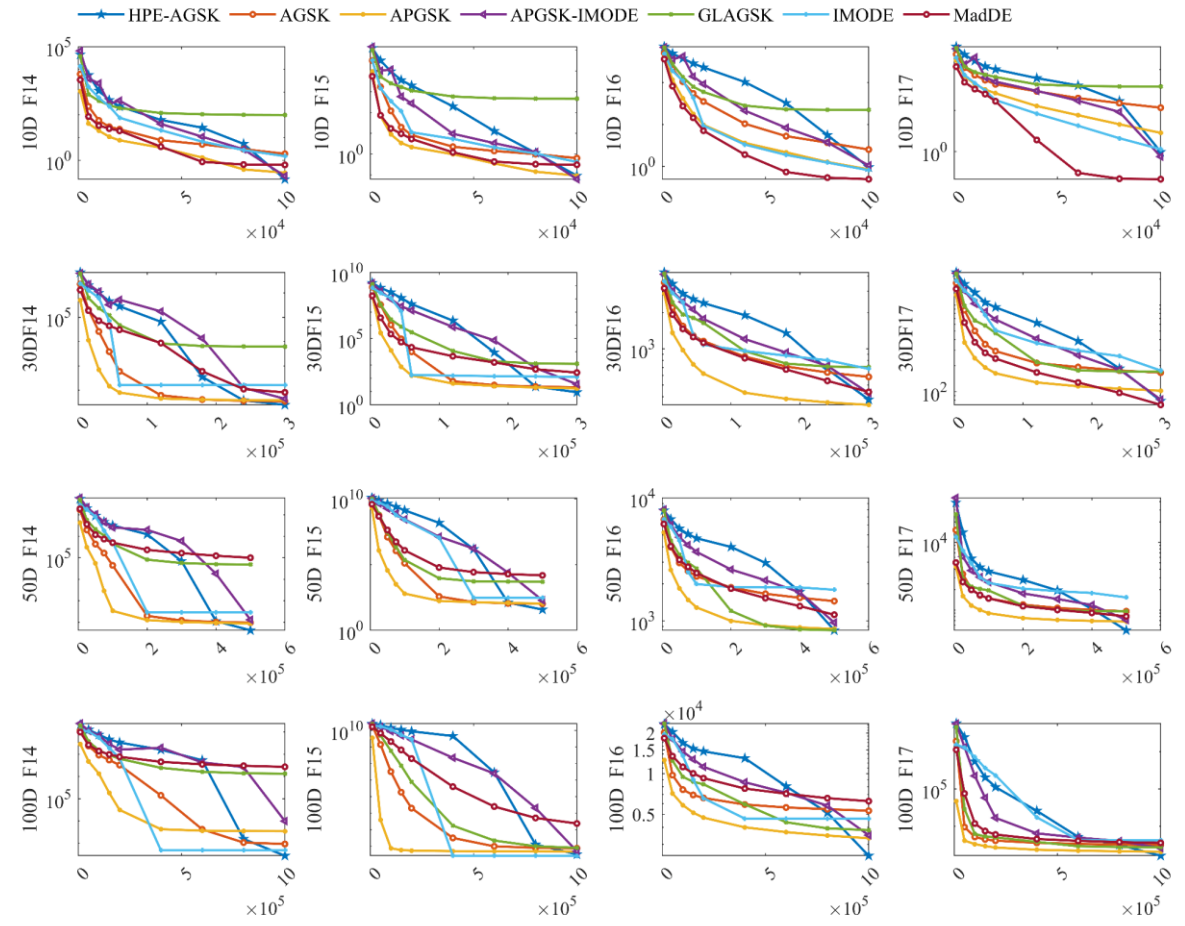

Figure S16. CEC2018 F14-F17 convergence curve

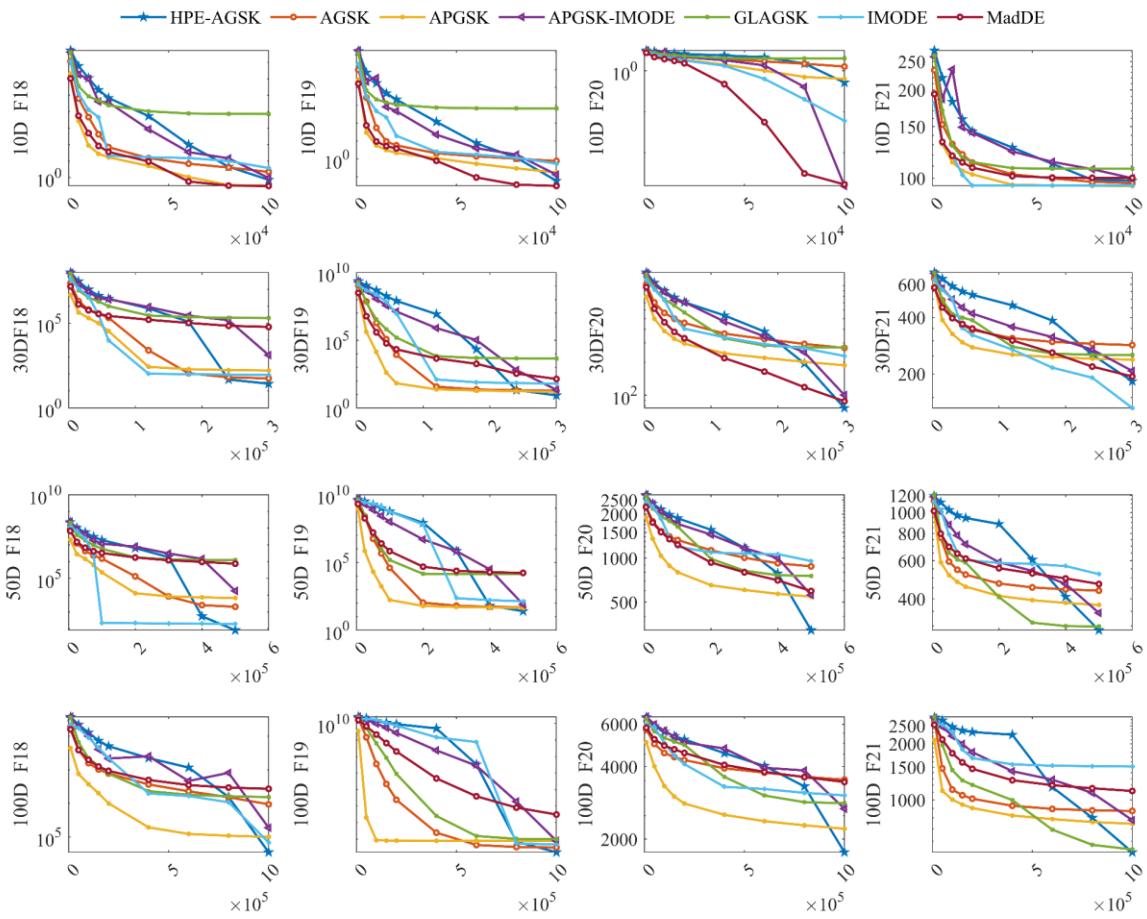

Figure S17. CEC2018 F18-F21 convergence curve

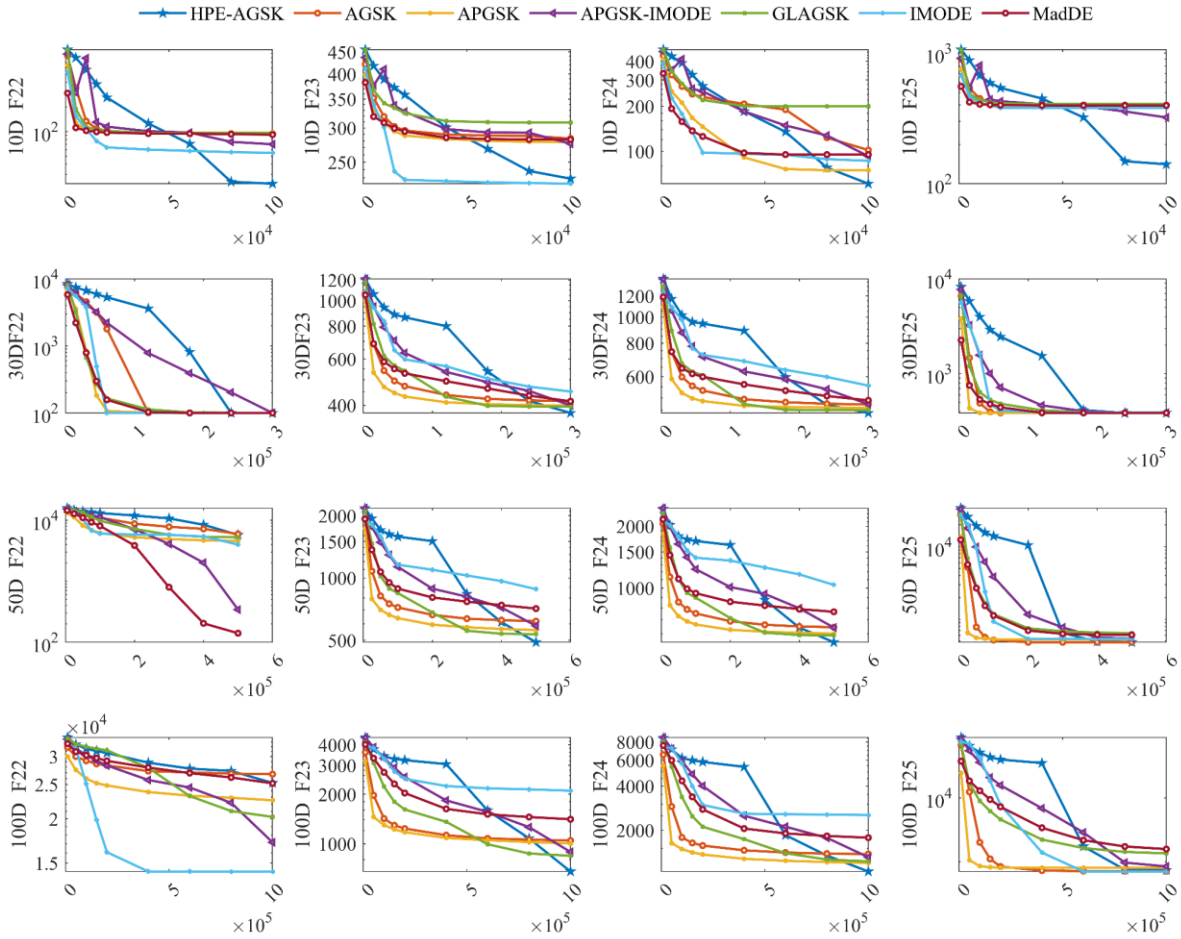

Figure S18. CEC2018 F22-F25 convergence curve

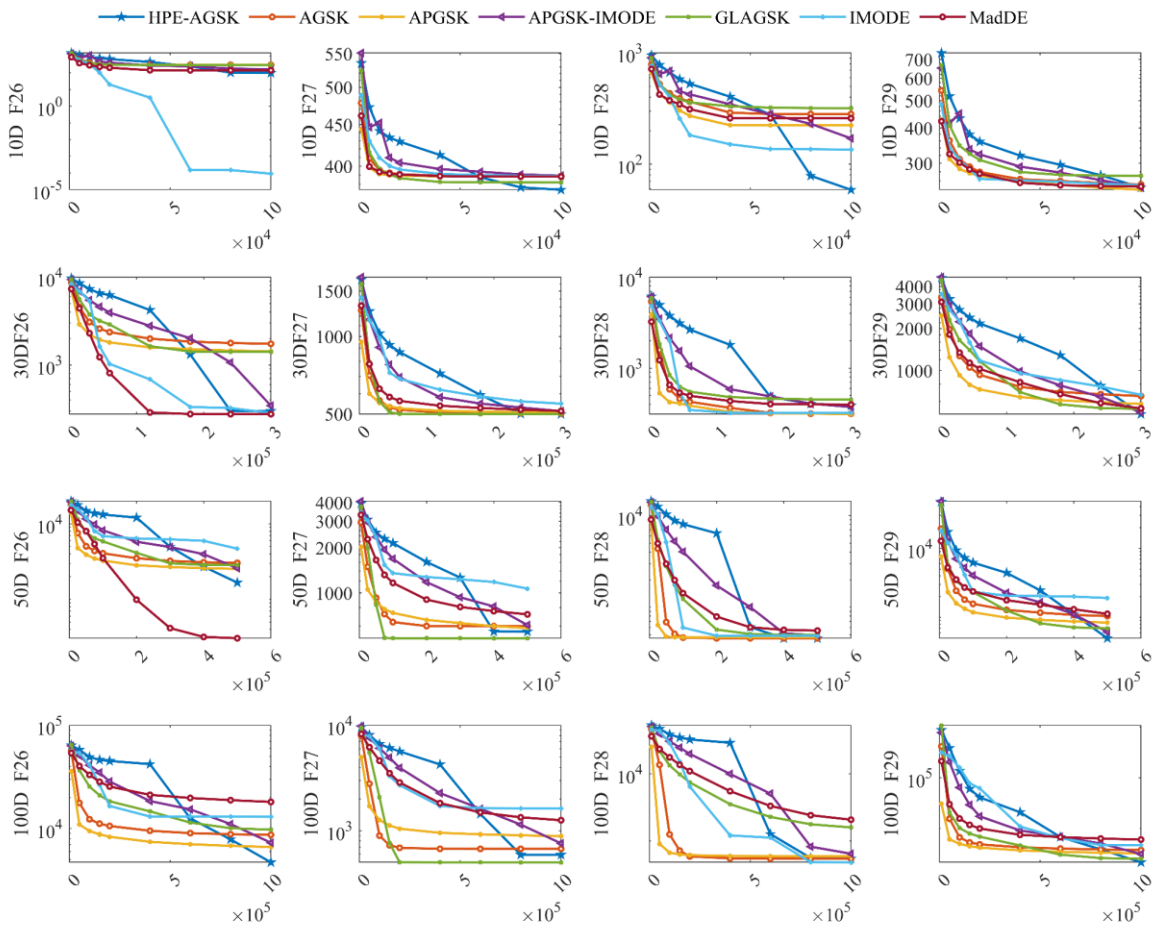

Figure S19. CEC2018 F26-F29 convergence curve

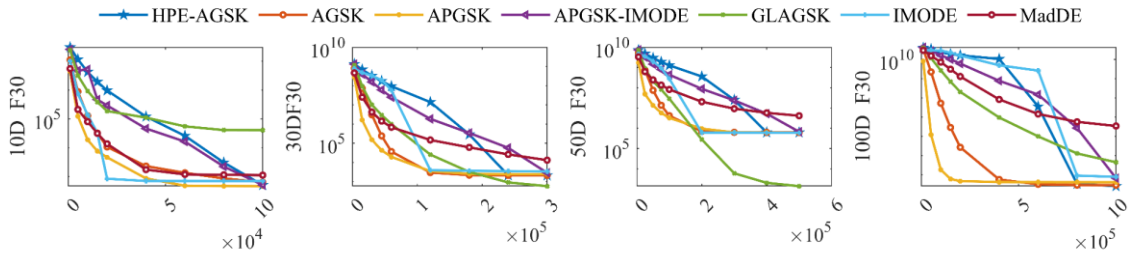

Figure S20. CEC2018 F30 convergence curve

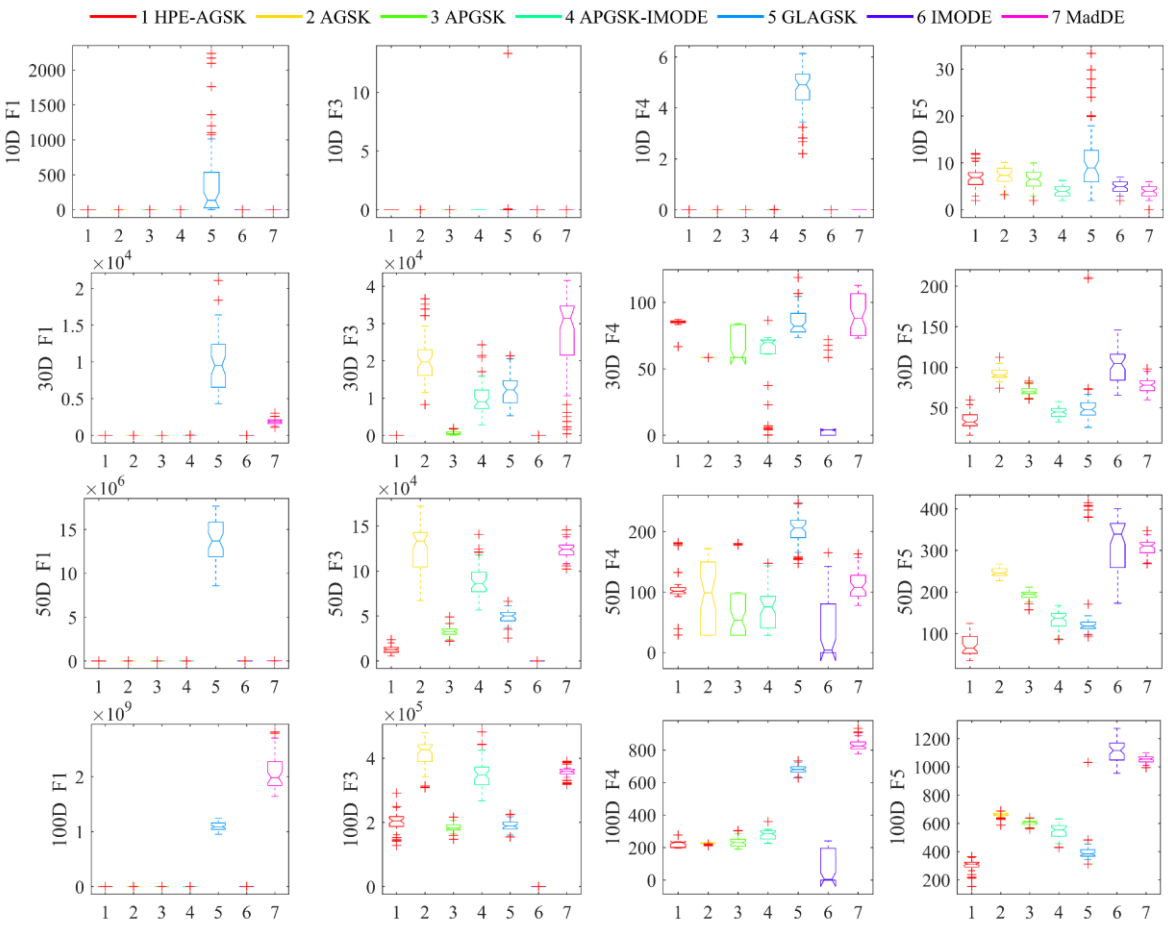

Figure S21 CEC2018 F1-F5 boxplot

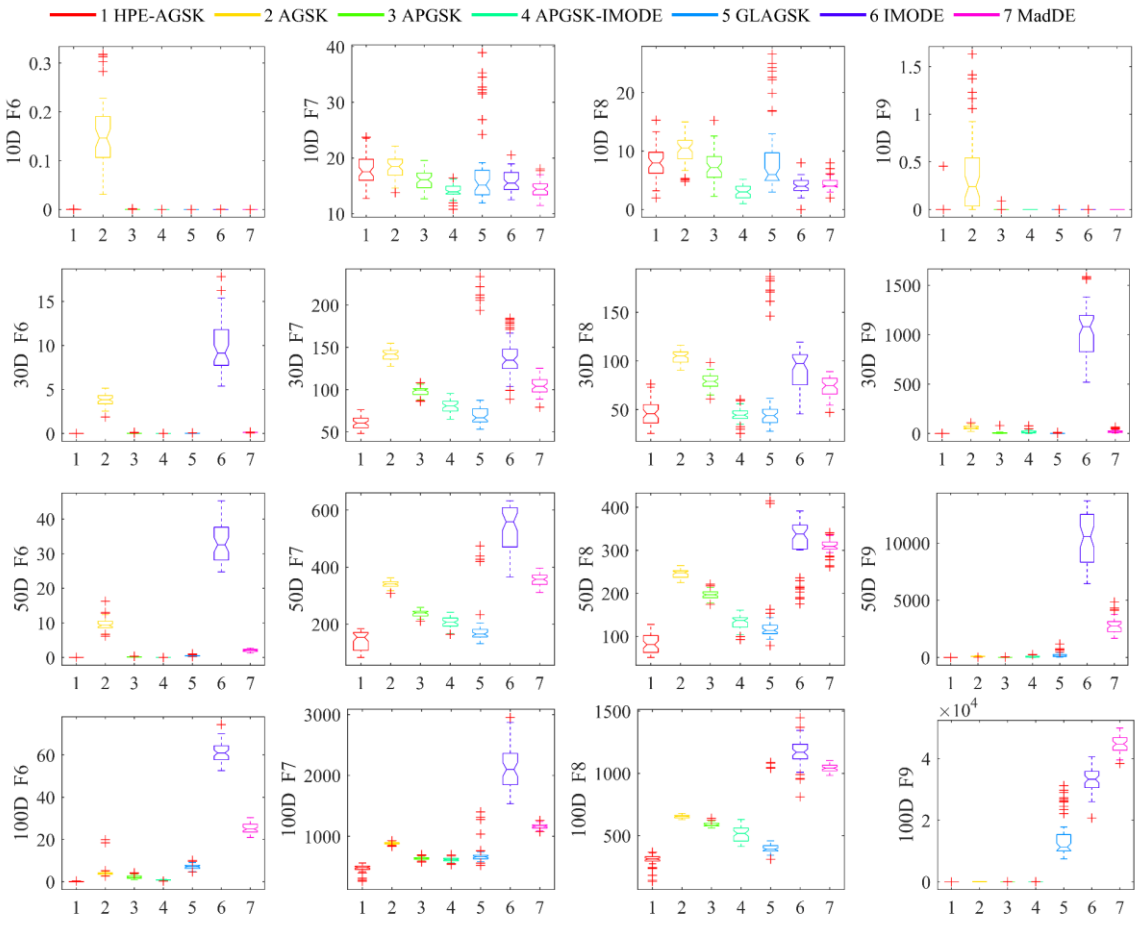

Figure S22 CEC2018 F6-F9 boxplot

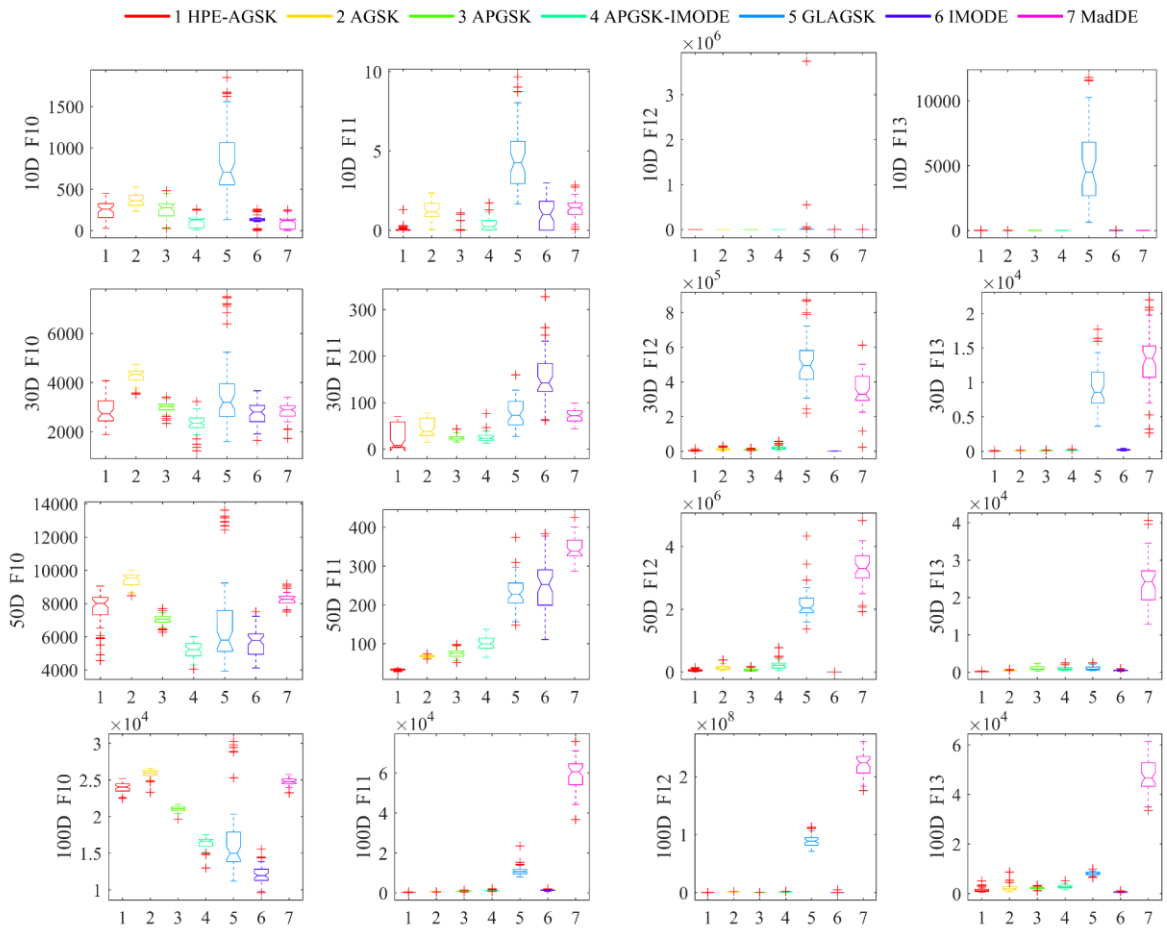

Figure S23 CEC2018 F10-F13 boxplot

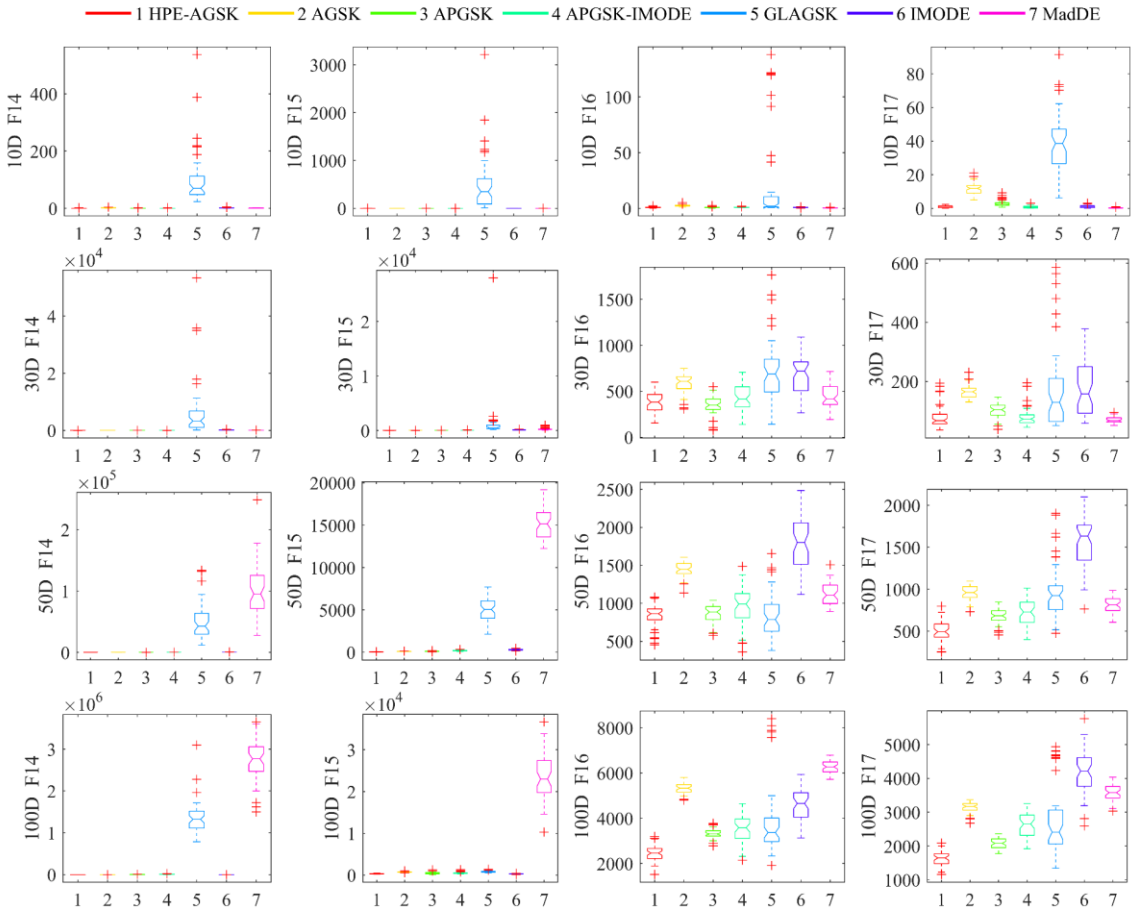

Figure S24 CEC2018 F14-F17 boxplot

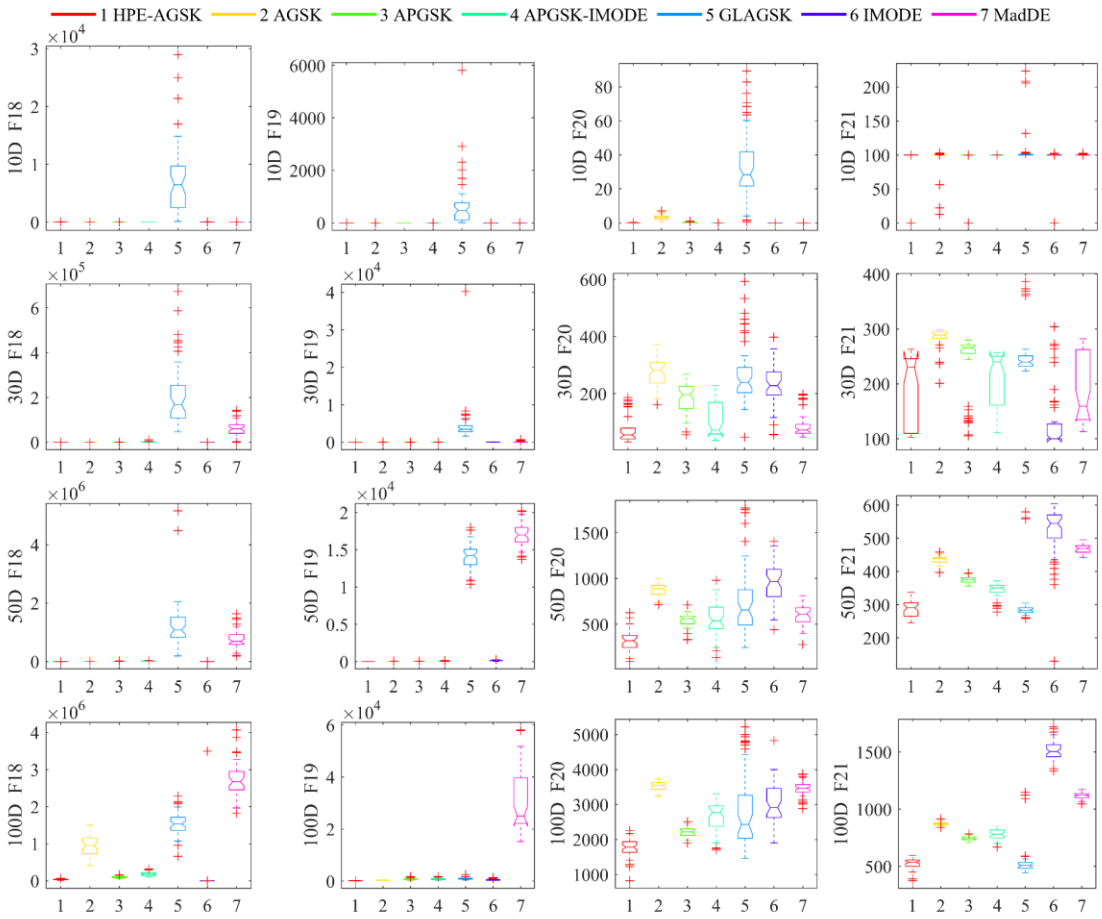

Figure S25 CEC2018 F18-F21 boxplot

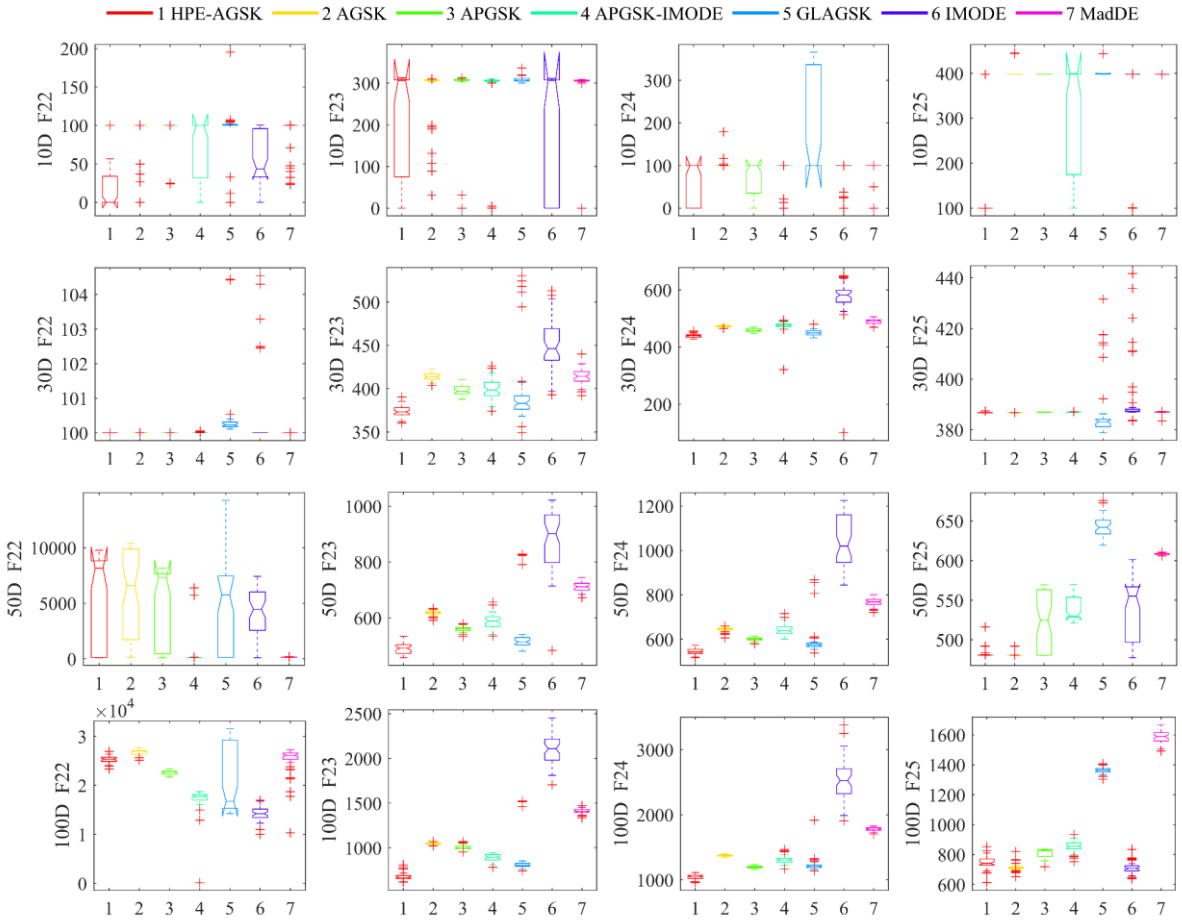

Figure S26 CEC2018 F22-F25 boxplot

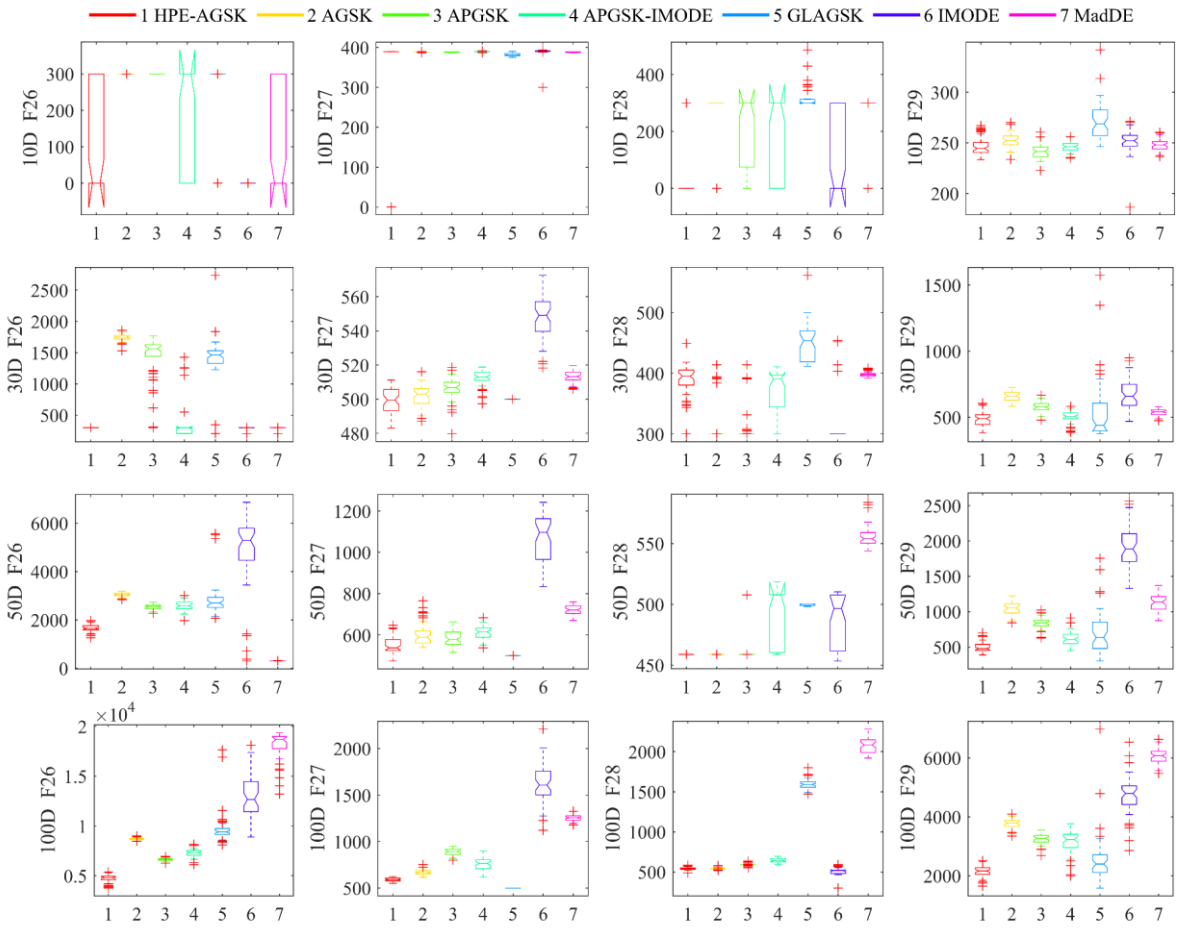

Figure S27 CEC2018 F26-F29 boxplot

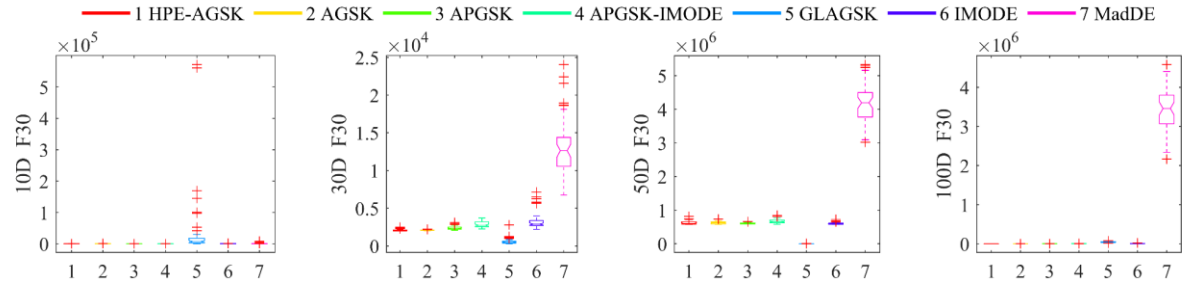

Figure S28 CEC2018 F30 boxplot

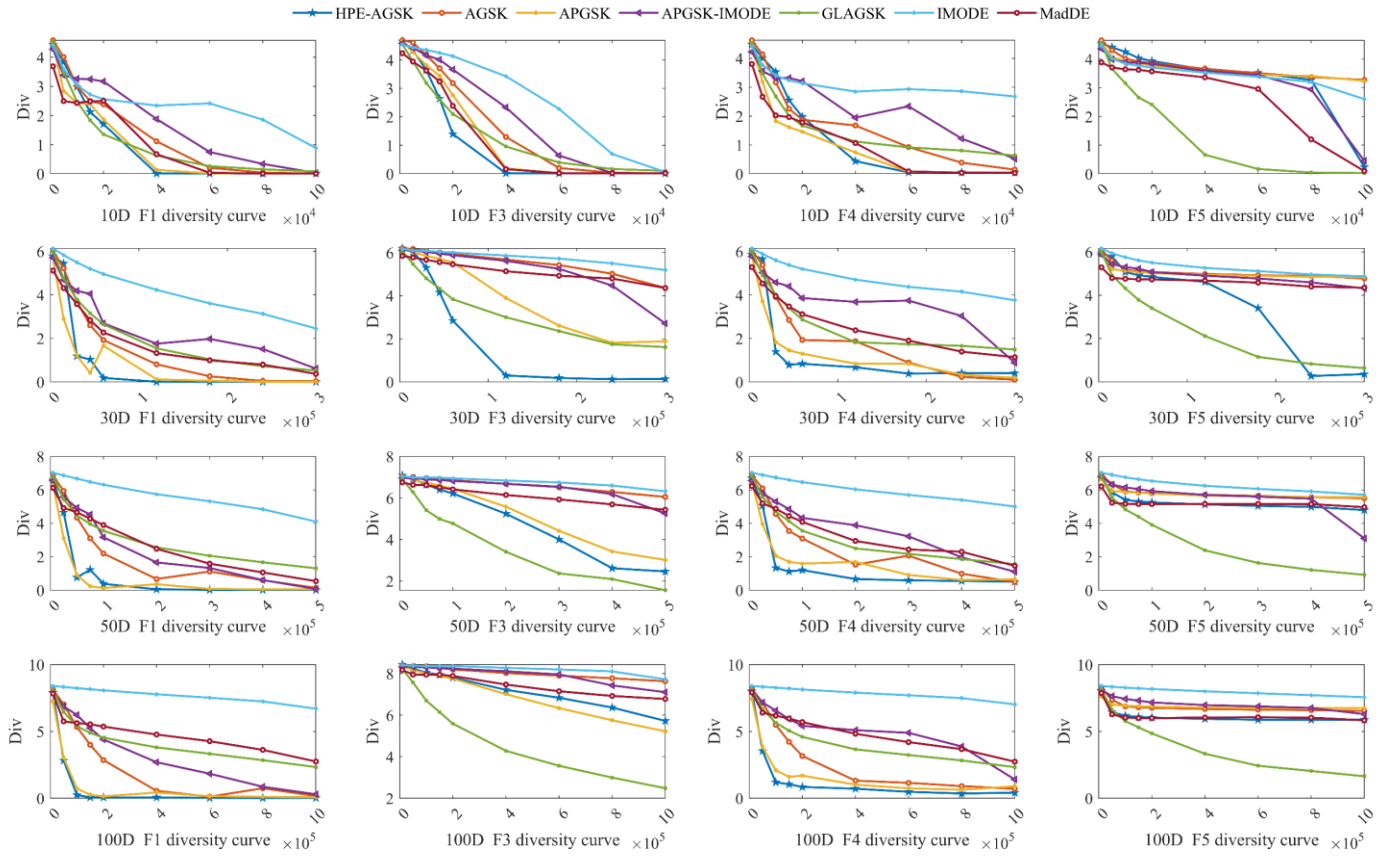

Figure S29 CEC2018 F1-F5 population diversity curves

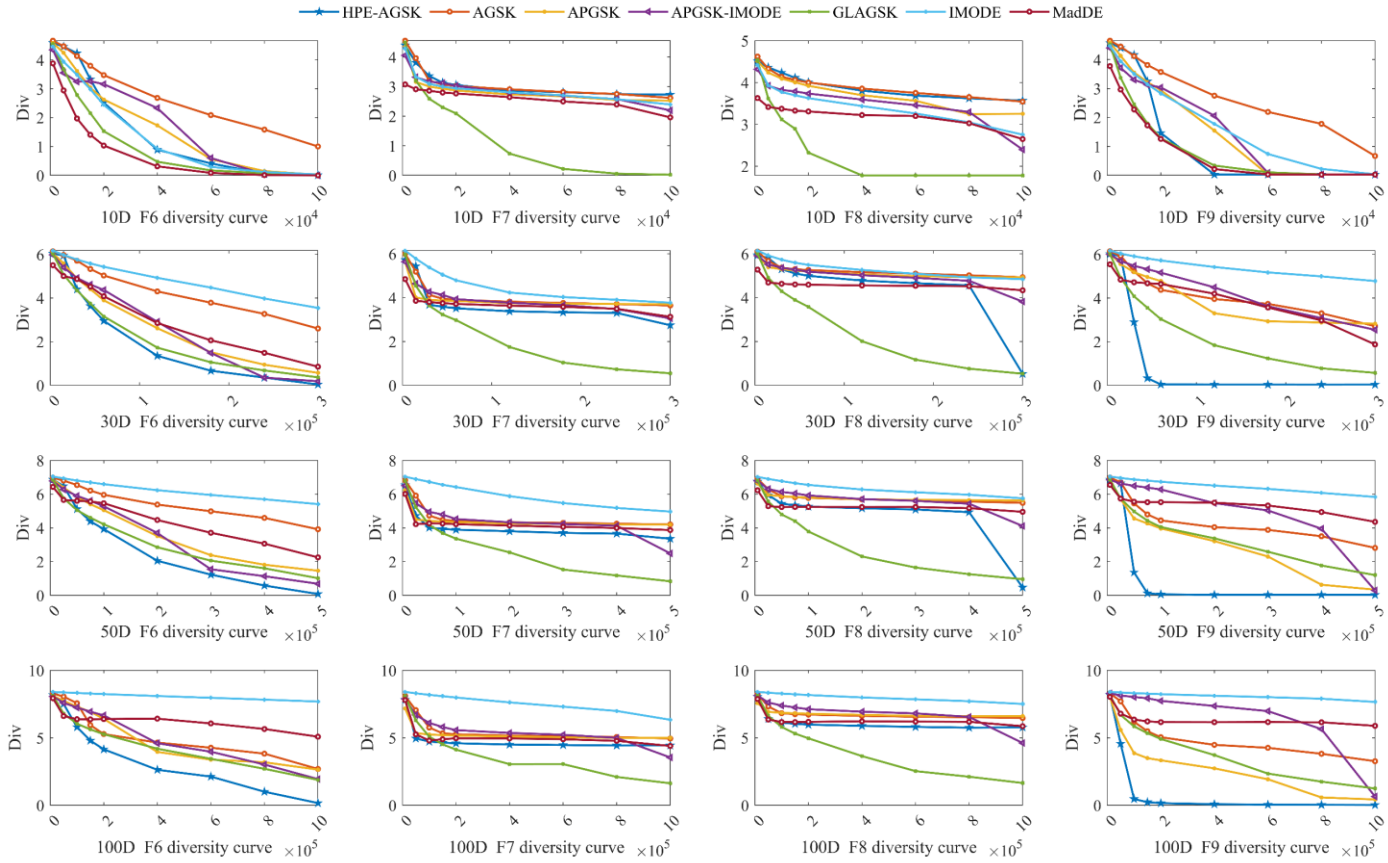

Figure S30 CEC2018 F6-F9 population diversity curves

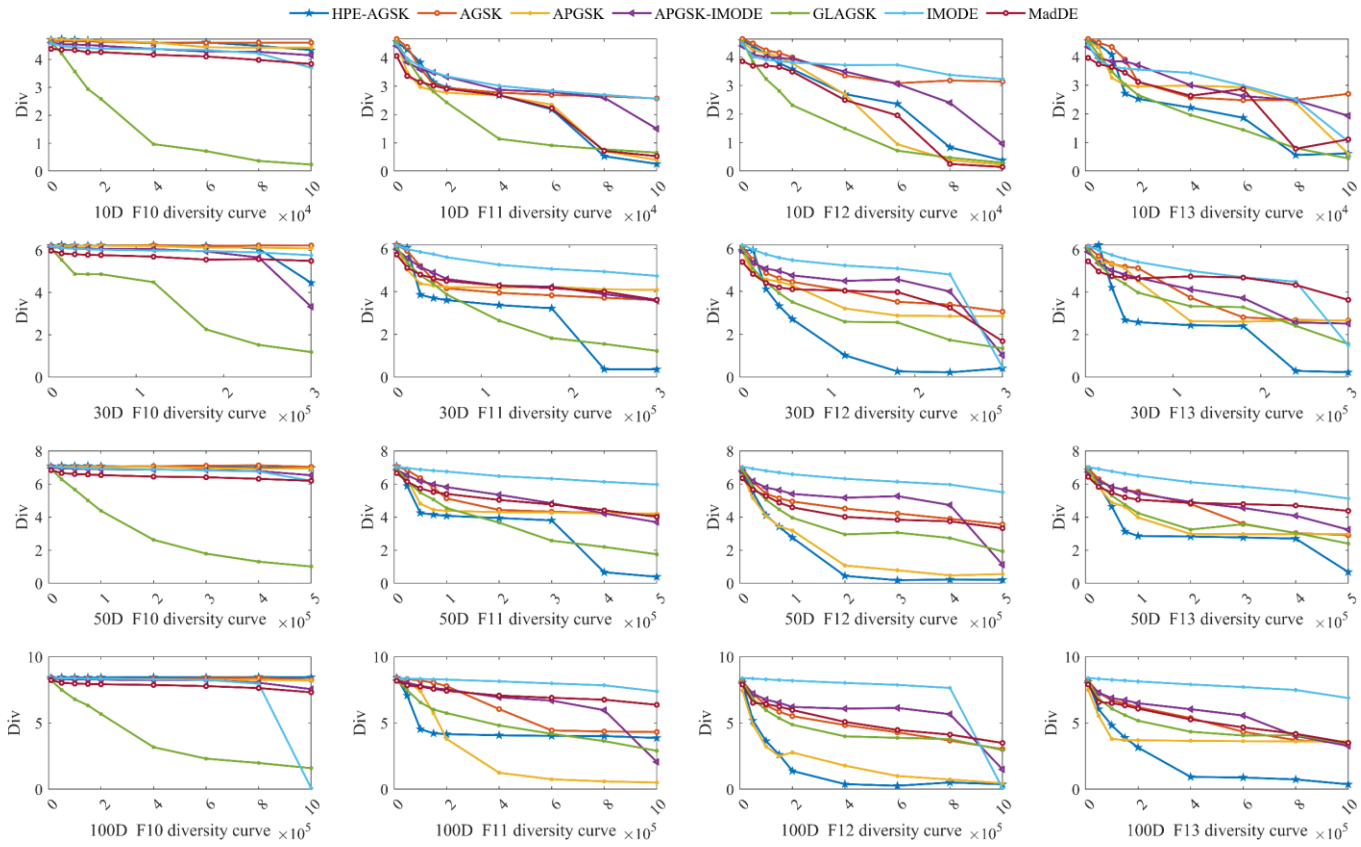

Figure S31 CEC2018 F10-F13 population diversity curves

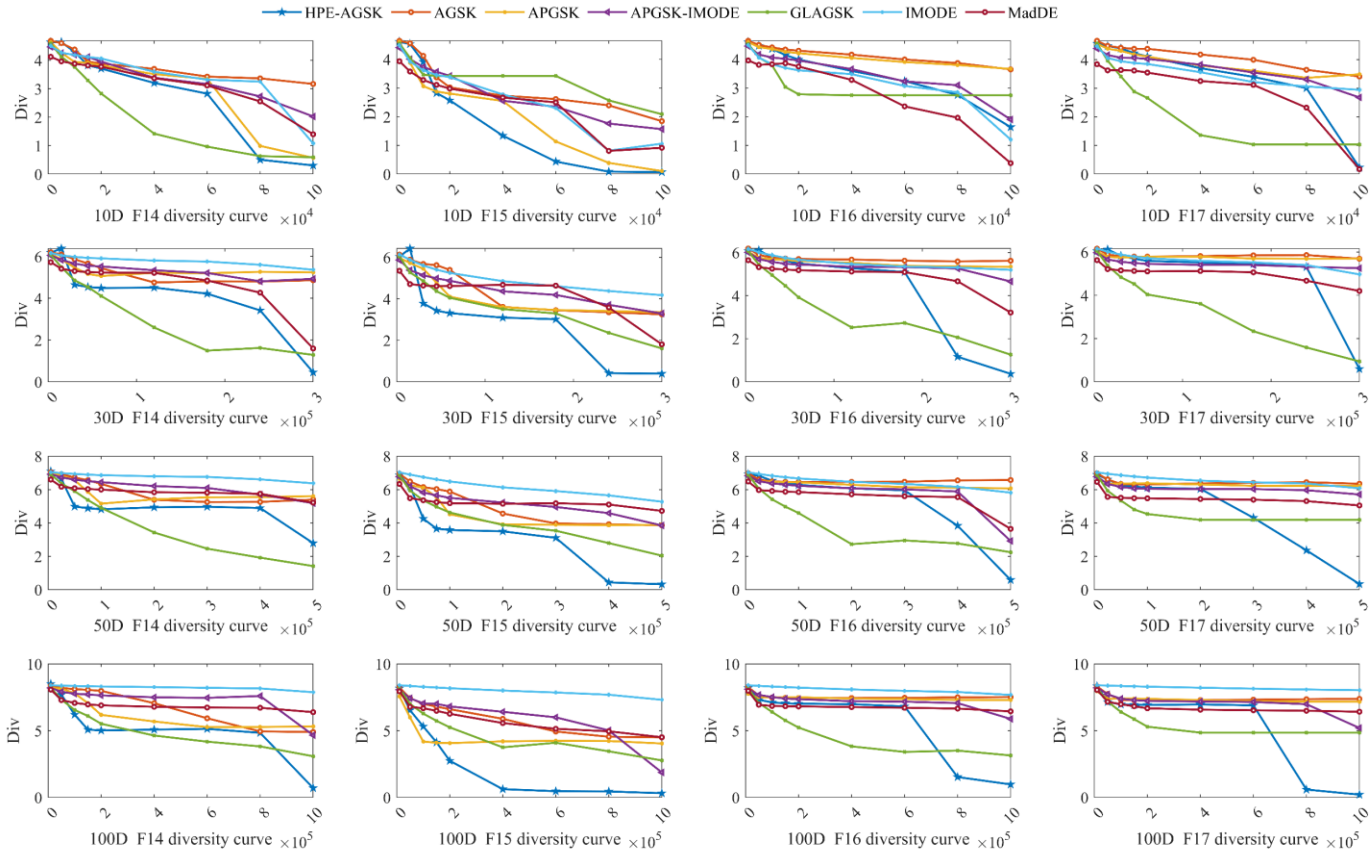

Figure S32 CEC2018 F14-F17 population diversity curves

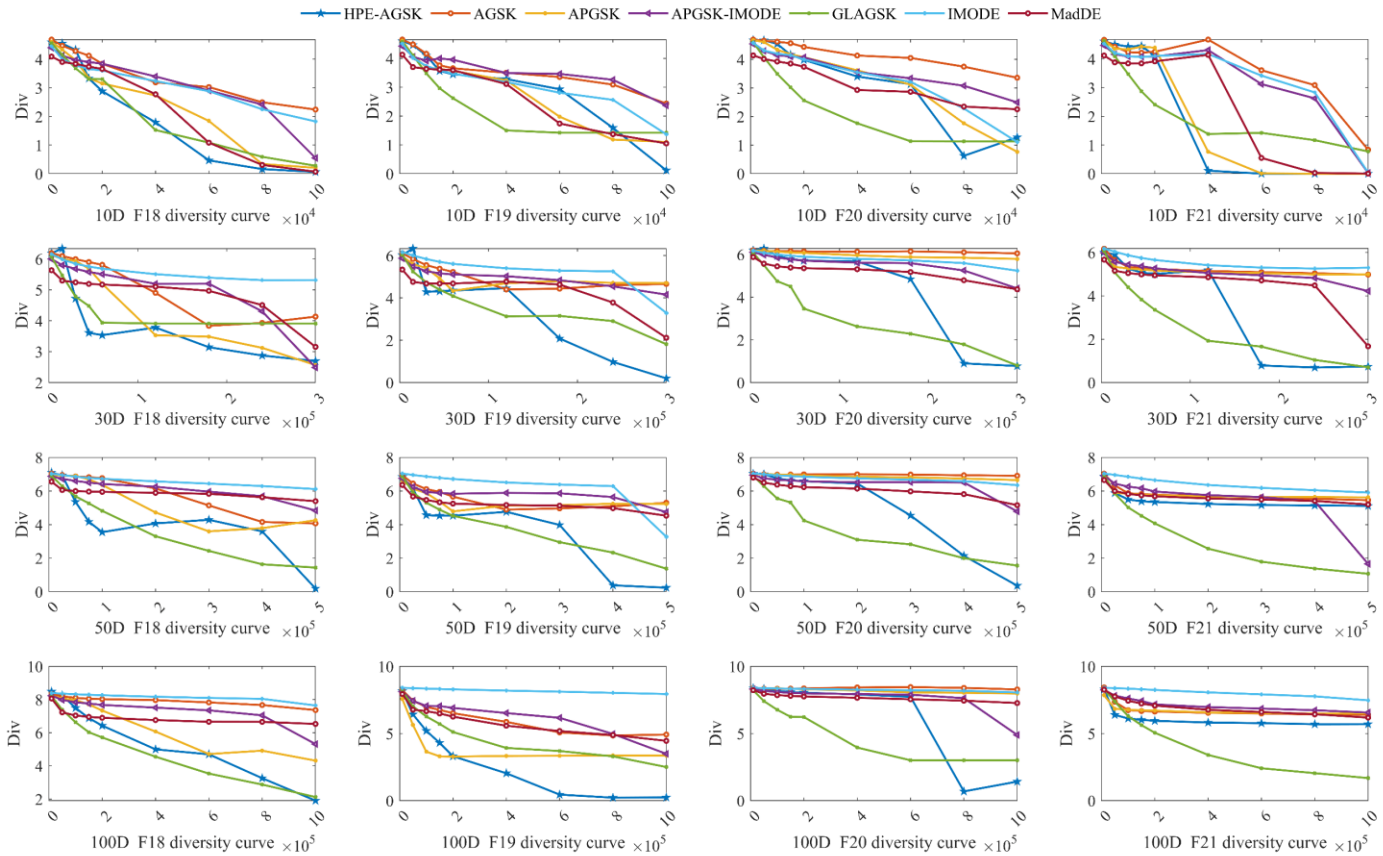

Figure S33 CEC2018 F18-F21 population diversity curves

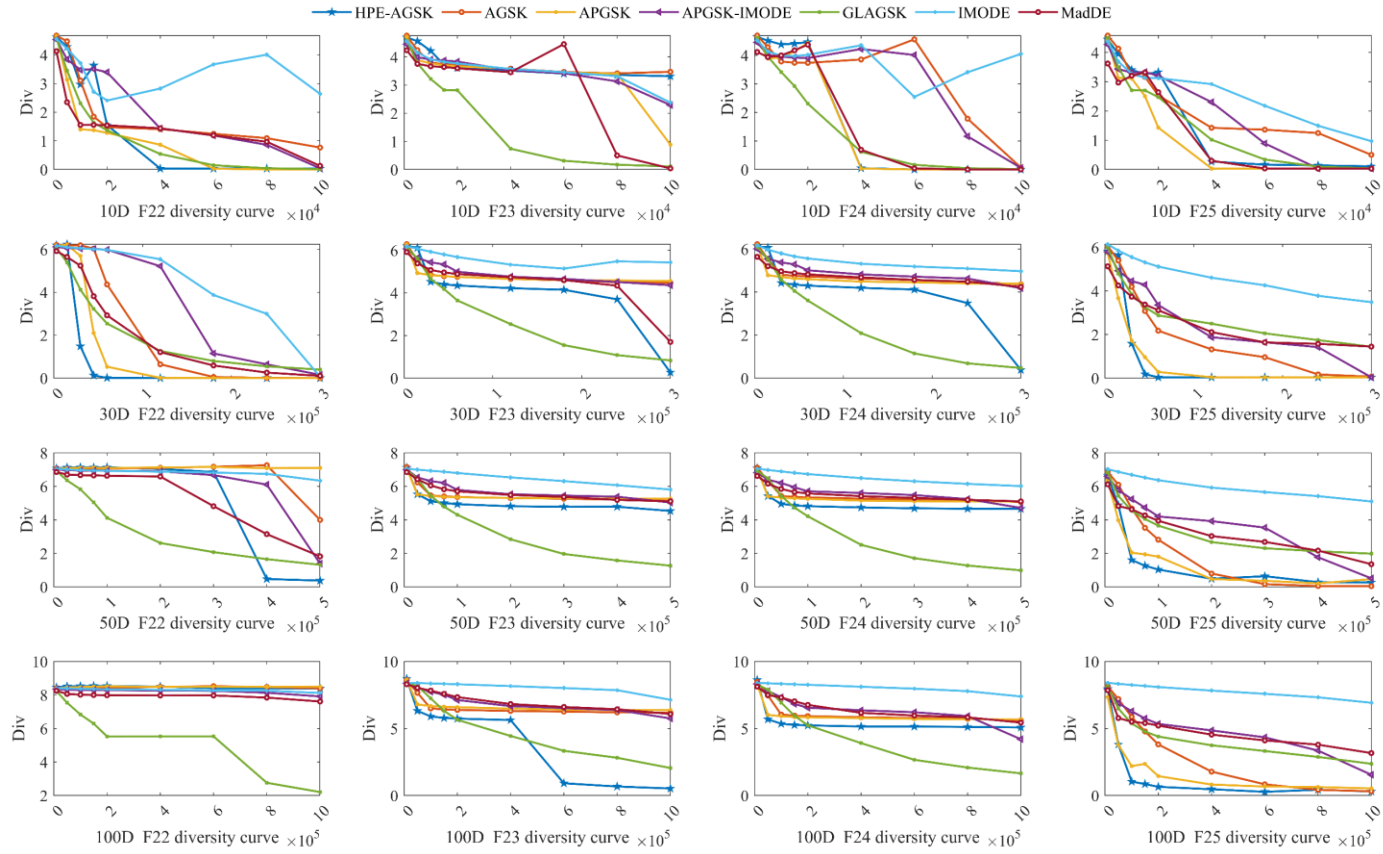

Figure S34 CEC2018 F22-F25 population diversity curves

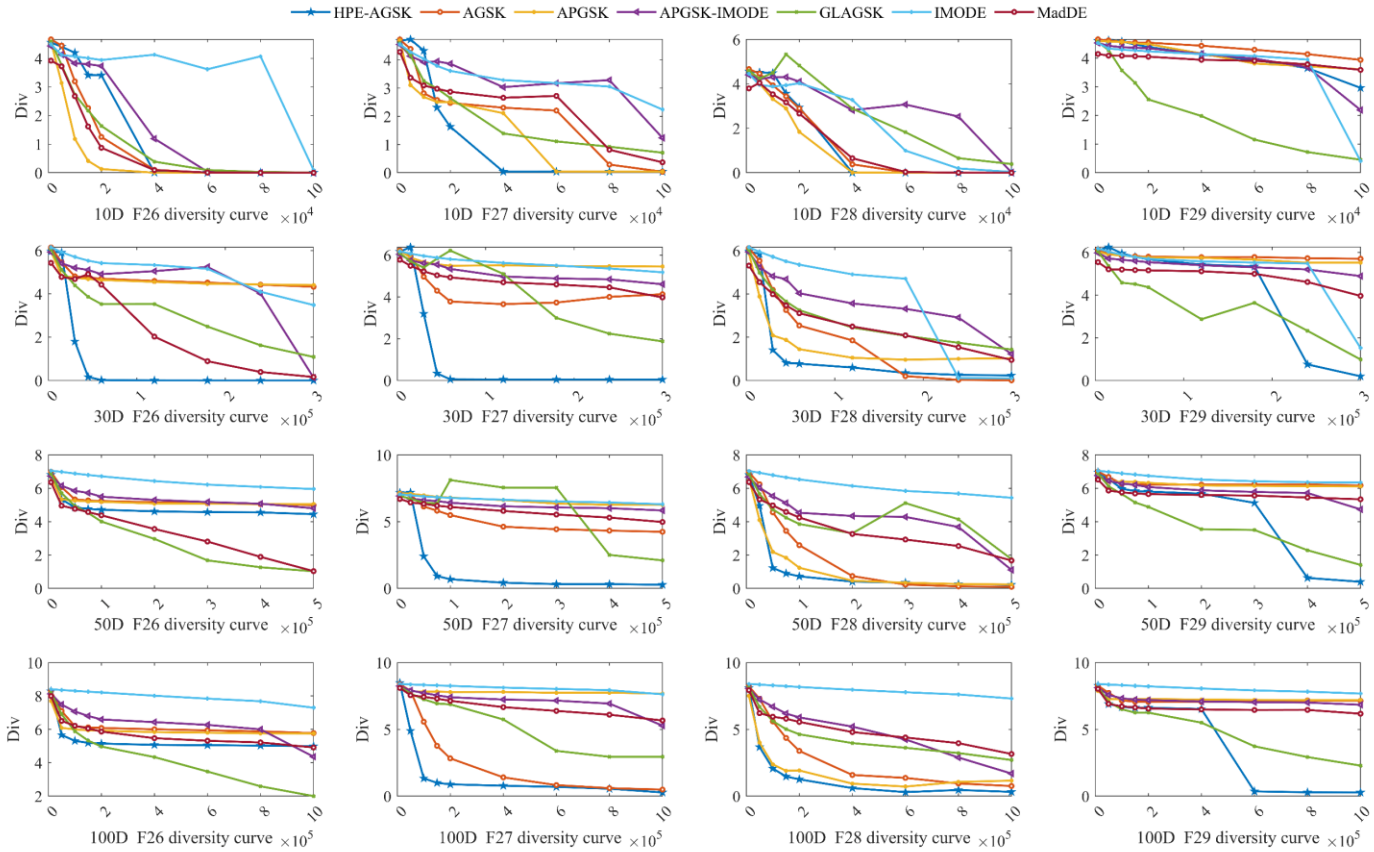

Figure S35 CEC2018 F26-F29 population diversity curves

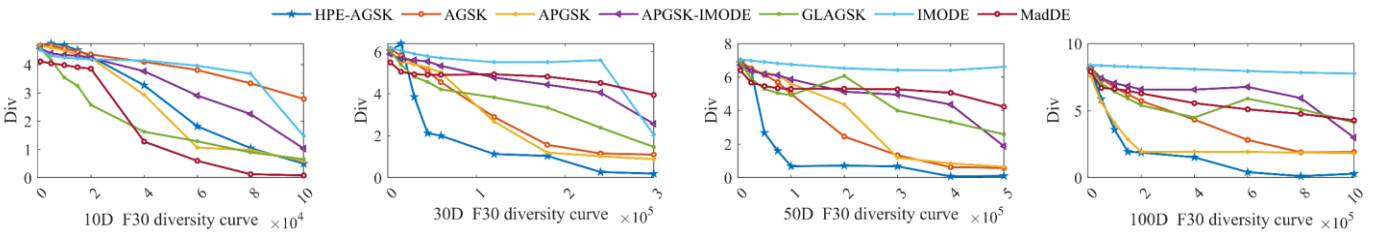

Figure S36 CEC2018 F30 population diversity curves