Supplemental file of "Differential Evolution with Objective and Dimension Knowledge Utilization"

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TABLE CAPTIONS

TABLE S1 PERFORMANCE COMPARISONS OF ODF WITH SDL AND CDL WITH FIXED F AND CR SETTINGS ON 30-D AND 50-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	30-D								50-D							
	SDL-Fixed			CDL-Fixed			ODFDE-Fixed		SDL-Fixed			CDL-Fixed			ODFDE-Fixed	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	3.60E+03	4.94E+03	=	2.89E+03	4.12E+03	=	2.85E+03	3.01E+03
F3	2.62E+03	6.09E+02	+	1.67E-07	2.61E-07	-	6.49E-07	1.31E-06	1.62E+04	3.28E+03	+	1.00E+02	1.52E+02	=	1.54E+02	2.29E+02
F4	6.05E+01	4.39E+00	-	9.54E+01	1.25E+01	=	9.50E+01	1.16E+01	9.05E+01	4.96E+01	-	1.60E+02	4.38E+01	=	1.50E+02	4.32E+01
F5	1.40E+02	9.32E+00	+	1.34E+01	4.46E+00	+	1.01E+01	2.79E+00	3.04E+02	1.12E+01	+	3.28E+01	8.15E+00	+	2.38E+01	5.70E+00
F6	0.00E+00	0.00E+00	-	1.81E-03	1.29E-02	=	2.25E-08	6.22E-08	1.83E-08	5.64E-08	-	1.22E-03	4.25E-03	+	1.45E-06	3.17E-06
F7	1.75E+02	9.98E+00	+	4.10E+01	3.16E+00	+	3.95E+01	3.26E+00	3.59E+02	1.05E+01	+	7.51E+01	5.62E+00	+	7.19E+01	5.01E+00
F8	1.38E+02	9.07E+00	+	1.28E+01	4.24E+00	+	1.13E+01	4.31E+00	3.02E+02	1.27E+01	+	3.28E+01	8.26E+00	+	2.53E+01	5.21E+00
F9	1.76E-03	1.25E-02	=	3.51E-03	1.76E-02	=	0.00E+00	0.00E+00	3.51E-03	1.76E-02	-	6.42E-01	7.03E-01	+	1.10E-01	1.87E-01
F10	6.31E+03	3.27E+02	+	1.65E+03	1.11E+03	=	1.85E+03	1.44E+03	1.23E+04	2.98E+02	+	3.19E+03	7.36E+02	=	3.26E+03	1.87E+03
F11	6.24E+01	3.22E+01	+	4.66E+01	2.40E+01	+	1.94E+01	1.90E+01	1.20E+02	1.12E+01	+	1.25E+02	2.97E+01	+	7.46E+01	2.02E+01
F12	1.10E+05	6.42E+04	+	1.37E+04	7.53E+03	=	1.26E+04	5.84E+03	3.35E+05	1.92E+05	+	1.91E+05	1.81E+05	+	1.29E+05	9.71E+04
F13	4.30E+03	1.89E+03	+	5.82E+03	4.84E+03	+	4.14E+03	3.91E+03	5.32E+03	4.38E+03	+	5.24E+03	3.30E+03	+	3.39E+03	2.83E+03
F14	8.35E+01	8.39E+00	=	1.04E+02	2.11E+01	+	8.54E+01	1.94E+01	7.75E+03	3.64E+03	+	5.79E+03	4.78E+03	=	4.39E+03	3.84E+03
F15	8.96E+01	2.66E+01	-	2.08E+02	7.61E+01	=	1.81E+02	6.91E+01	1.25E+03	3.18E+02	=	2.86E+03	2.31E+03	=	2.59E+03	2.24E+03
F16	6.79E+02	1.98E+02	+	3.59E+02	2.30E+02	+	2.32E+02	1.78E+02	2.10E+03	2.21E+02	+	6.08E+02	2.00E+02	+	5.37E+02	1.93E+02
F17	1.47E+02	3.28E+01	+	9.22E+01	6.66E+01	+	6.84E+01	4.53E+01	1.14E+03	1.71E+02	+	6.64E+02	2.09E+02	+	5.31E+02	2.24E+02
F18	1.12E+05	4.29E+04	+	2.76E+04	1.57E+04	=	3.41E+04	1.89E+04	7.73E+05	2.75E+05	+	3.76E+04	2.16E+04	=	4.07E+04	1.85E+04
F19	4.08E+01	4.61E+00	-	1.00E+02	3.69E+01	=	9.37E+01	2.93E+01	7.26E+02	6.47E+02	+	2.10E+02	7.88E+01	-	4.96E+02	8.46E+02
F20	1.60E+02	4.52E+01	+	1.36E+02	5.28E+01	+	1.03E+02	6.14E+01	9.73E+02	1.70E+02	+	3.01E+02	1.73E+02	+	2.07E+02	1.38E+02
F21	3.34E+02	1.07E+01	+	2.16E+02	5.56E+00	=	2.14E+02	3.75E+00	5.10E+02	9.73E+00	+	2.34E+02	6.18E+00	+	2.27E+02	5.16E+00
F22	1.00E+02	1.44E-14	+	1.00E+02	2.17E-13	=	1.00E+02	2.27E-13	1.06E+04	4.58E+03	+	2.35E+03	1.58E+03	=	2.60E+03	1.47E+03
F23	4.81E+02	9.45E+00	+	3.71E+02	7.89E+00	+	3.63E+02	6.13E+00	7.19E+02	1.51E+01	+	4.84E+02	1.72E+01	+	4.63E+02	1.15E+01
F24	5.64E+02	8.25E+00	+	4.41E+02	5.54E+00	+	4.34E+02	4.02E+00	8.05E+02	1.45E+01	+	5.58E+02	1.43E+01	+	5.34E+02	7.82E+00
F25	3.87E+02	8.10E-02	-	3.87E+02	6.07E-01	=	3.87E+02	4.28E-01	4.99E+02	3.18E+01	-	5.54E+02	2.35E+01	+	5.43E+02	2.55E+01
F26	2.14E+03	1.24E+02	+	1.16E+03	9.83E+01	+	1.11E+03	7.75E+01	3.85E+03	1.54E+02	+	1.57E+03	1.41E+02	+	1.41E+03	1.09E+02
F27	5.05E+02	5.54E+00	=	5.14E+02	1.02E+01	+	5.08E+02	5.27E+00	5.53E+02	3.46E+01	=	6.18E+02	4.63E+01	+	5.66E+02	3.10E+01
F28	3.35E+02	5.43E+01	-	4.17E+02	2.09E+01	=	4.18E+02	1.52E+01	4.86E+02	2.43E+01	-	5.23E+02	1.71E+01	+	5.11E+02	1.62E+01
F29	6.52E+02	4.13E+01	+	4.73E+02	4.15E+01	+	4.62E+02	4.12E+01	9.36E+02	1.12E+02	+	6.80E+02	1.60E+02	+	5.31E+02	1.04E+02
F30	7.86E+03	4.81E+03	+	3.99E+03	1.37E+03	+	3.15E+03	6.25E+02	7.07E+05	8.47E+04	-	9.06E+05	1.92E+05	=	8.34E+05	1.16E+05
W	**19**			**15**					**20**			**19**				
T	**4**			**13**					**3**			**9**				
L	**6**			**1**					**6**			**1**				

TABLE S2 PARAMETERS, RANGE AND THE TUNED VALUES OF THE CONSIDERED ALGORITHMS FOR THE CEC2017 BENCHMARK SET

	Parameters	Range	Tuned	Recommended in the original paper
ETI-SHADE	*pr*, *LN*, *UN*	*pr* = [0.2, 0.6, 1.0], *LN* = [1, 0.2*NP*, 0.5*NP*, 0.8*NP*], *UN* = [0.1*NP*, 0.4*NP*, 0.7*NP*, *NP*].	*pr* = 0.2, *LN* = 0.5*NP*, *UN* =0.4*NP*	*pr* = 0.2, *LN* = 1, *UN* =*NP*
SaM-SHADE	no specified /parameter-free	N/A	N/A	N/A
SaDE	learning period *LP*	*LP* = [20, 30, 40, 50, 60]	40	20~60
IDE	no specified /parameter-free	N/A	N/A	N/A
ACoS-SHADE	no specified /parameter-free	N/A	N/A	N/A
MLCCDE	CEC2017 was used			
AEPD-SHADE	*T*	[1, 10^{-1}, 10^{-2}, . . ., 10^{-6}]	10^{-1}	10^{-3}
SHADE/eig	eigenvector ratio *P*	0.1~0.9 with a step of 0.2	0.1	0.5
CSM-SHADE	no specified /parameter-free	N/A	N/A	N/A
SCSS-SHADE	CEC2017 was used			

TABLE S3 PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (10-D)

	ETI-SHADE			SaM-SHADE			SaDE			IDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	5.90E+02	1.15E+03	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F5	3.15E+00	1.54E+00	+	3.03E+00	8.99E-01	+	5.00E+00	2.31E+00	+	2.95E+00	1.42E+00	+	8.63E-01	1.00E+00
F6	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F7	1.33E+01	1.53E+00	+	1.28E+01	7.76E-01	+	1.84E+01	1.78E+00	+	1.34E+01	9.83E-01	+	1.13E+01	5.15E-01
F8	4.17E+00	1.31E+00	+	2.98E+00	1.06E+00	+	4.86E+00	2.74E+00	+	2.89E+00	1.06E+00	+	6.98E-01	6.98E-01
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	2.83E+01	2.69E+01	+	7.81E+01	5.94E+01	+	4.18E+02	1.19E+02	+	8.06E+01	9.04E+01	=	2.74E+01	4.28E+01
F11	1.95E-02	1.39E-01	=	1.72E+00	8.03E-01	+	1.33E-01	3.44E-01	+	1.09E-09	5.97E-09	=	0.00E+00	0.00E+00
F12	1.03E+02	1.28E+02	=	9.14E+01	8.96E+01	=	1.40E+02	1.02E+02	+	1.04E+01	3.13E+01	-	6.70E+01	7.10E+01
F13	4.62E+00	1.73E+00	=	4.19E+00	2.41E+00	=	2.84E+00	2.63E+00	-	1.35E+00	1.71E+00	-	4.84E+00	1.69E+00
F14	1.01E+00	7.83E-01	+	3.31E-01	3.30E-01	+	6.63E-02	2.52E-01	-	2.66E-07	1.46E-06	-	6.74E-01	3.65E+00
F15	2.02E-01	2.25E-01	=	8.20E-02	1.28E-01	=	1.33E-01	3.05E-01	=	1.44E-02	2.29E-02	=	1.24E-01	1.80E-01
F16	4.16E-01	2.01E-01	-	7.92E-01	1.86E-01	=	4.04E-01	2.22E-01	-	4.95E-01	2.56E-01	-	8.10E-01	3.48E-01
F17	8.83E-01	1.33E+00	-	6.60E-01	3.80E-01	=	3.11E+00	2.32E+00	+	7.88E-01	4.73E-01	=	8.41E-01	3.97E-01
F18	1.03E+00	3.90E+00	-	1.98E-01	2.55E-01	-	2.98E-01	4.07E-01	-	7.43E-02	1.01E-01	-	3.00E+00	6.93E+00
F19	3.52E-02	4.45E-02	=	3.46E-02	4.49E-02	=	2.17E-03	6.53E-03	-	1.02E-02	9.90E-03	=	3.22E-02	4.53E-02
F20	1.22E-02	6.12E-02	-	1.04E-02	5.70E-02	-	1.46E-01	1.58E-01	=	1.82E-02	6.99E-02	-	2.79E-04	8.48E-04
F21	1.68E+02	5.08E+01	+	1.62E+02	4.71E+01	=	1.60E+02	5.33E+01	=	1.77E+02	4.70E+01	+	1.73E+02	4.73E+01
F22	1.00E+02	1.12E-01	-	1.00E+02	1.09E-03	=	9.77E+01	1.28E+01	=	1.00E+02	1.66E-12	-	1.00E+02	1.54E-01
F23	3.05E+02	1.32E+00	+	3.05E+02	1.13E+00	+	3.02E+02	2.19E+00	-	3.03E+02	2.30E+00	=	3.03E+02	1.36E+00
F24	3.23E+02	4.57E+01	+	3.12E+02	6.23E+01	=	3.08E+02	7.07E+01	=	2.93E+02	8.07E+01	-	3.16E+02	5.86E+01
F25	4.15E+02	2.25E+01	=	4.18E+02	2.32E+01	=	4.22E+02	2.33E+01	=	4.07E+02	1.85E+01	-	4.15E+02	2.26E+01
F26	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00
F27	3.89E+02	2.30E-01	-	3.90E+02	9.36E-02	=	3.91E+02	2.36E+00	=	3.92E+02	2.27E+00	+	3.89E+02	1.56E-01
F28	4.28E+02	1.49E+02	=	4.23E+02	1.53E+02	=	3.00E+02	0.00E+00	-	3.09E+02	5.18E+01	-	4.33E+02	1.49E+02
F29	2.32E+02	2.06E+00	-	2.41E+02	4.86E+00	=	2.53E+02	7.98E+00	+	2.36E+02	5.06E+00	-	2.41E+02	5.51E+00
F30	6.45E+04	2.22E+05	-	1.09E+05	2.83E+05	=	2.78E+04	1.49E+05	+	4.19E+02	1.11E+01	-	2.77E+04	1.49E+05
W	**8**			**8**			**9**			**5**				
T	**13**			**19**			**13**			**12**				
L	**8**			**2**			**7**			**12**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (10-D)

	ACoS-SHADE			MLCCDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F5	1.79E+00	5.95E-01	+	2.65E+00	1.29E+00	+	8.63E-01	1.00E+00
F6	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F7	1.25E+01	8.52E-01	+	1.30E+01	1.16E+00	+	1.13E+01	5.15E-01
F8	2.71E+00	7.92E-01	+	2.72E+00	9.75E-01	+	6.98E-01	6.98E-01
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	1.26E+02	5.88E+01	+	8.38E+01	6.64E+01	+	2.74E+01	4.28E+01
F11	5.18E-02	3.70E-01	=	2.50E-05	7.78E-05	+	0.00E+00	0.00E+00
F12	2.03E+01	3.71E+01	-	4.66E+00	2.16E+01	-	6.70E+01	7.10E+01
F13	5.85E+00	5.23E-01	+	1.94E+00	2.20E+00	-	4.84E+00	1.69E+00
F14	8.39E-01	1.34E+00	=	1.84E-04	1.01E-03	-	6.74E-01	3.65E+00
F15	3.70E-02	1.04E-01	-	2.52E-02	2.66E-02	=	1.24E-01	1.80E-01
F16	8.69E-01	2.40E-01	+	2.23E-01	1.57E-01	-	8.10E-01	3.48E-01
F17	6.02E-01	2.11E-01	-	3.08E-01	3.83E-01	-	8.41E-01	3.97E-01
F18	3.46E-02	1.00E-01	-	1.02E-01	1.17E-01	-	3.00E+00	6.93E+00
F19	6.70E-02	2.15E-01	=	1.36E-02	9.48E-03	=	3.22E-02	4.53E-02
F20	9.39E-10	5.45E-09	-	1.04E-02	5.70E-02	-	2.79E-04	8.48E-04
F21	1.00E+02	2.26E-13	-	1.45E+02	5.26E+01	=	1.73E+02	4.73E+01
F22	1.00E+02	1.66E-01	=	1.00E+02	8.48E-04	=	1.00E+02	1.54E-01
F23	3.04E+02	6.77E-01	+	3.02E+02	2.07E+00	=	3.03E+02	1.36E+00
F24	3.17E+02	5.47E+01	=	2.61E+02	1.07E+02	-	3.16E+02	5.86E+01
F25	4.04E+02	1.64E+01	=	4.05E+02	1.73E+01	-	4.15E+02	2.26E+01
F26	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00
F27	3.89E+02	2.55E-01	-	3.90E+02	2.02E+00	=	3.89E+02	1.56E-01
F28	3.00E+02	0.00E+00	-	3.00E+02	0.00E+00	-	4.33E+02	1.49E+02
F29	2.38E+02	7.77E+00	=	2.37E+02	3.03E+00	-	2.41E+02	5.51E+00
F30	4.32E+02	3.47E+01	=	2.76E+04	1.49E+05	-	2.77E+04	1.49E+05
W	**7**			**5**				
T	**14**			**12**				
L	**8**			**12**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (30-D)

	ETI-SHADE			SaM-SHADE			SaDE			IDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	2.29E+03	1.18E+04	-	0.00E+00	0.00E+00	-	6.77E+00	1.11E+01	+	6.15E+03	1.37E+04
F4	5.82E+01	8.53E+00	+	5.22E+01	1.93E+01	+	1.31E+01	2.46E+01	-	6.77E+00	1.62E+01	-	5.90E+01	1.51E+00
F5	1.95E+01	7.72E+00	+	1.48E+01	2.37E+00	+	2.78E+01	7.91E+00	+	2.66E+01	5.41E+00	+	1.10E+01	4.85E+00
F6	2.43E-05	3.01E-05	+	2.23E-05	2.72E-05	+	3.50E-06	9.52E-06	=	0.00E+00	0.00E+00	-	1.75E-07	3.78E-07
F7	4.91E+01	6.13E+00	+	4.54E+01	3.33E+00	+	5.87E+01	6.89E+00	+	5.32E+01	5.44E+00	+	4.12E+01	4.94E+00
F8	1.94E+01	6.57E+00	+	1.59E+01	3.12E+00	+	2.82E+01	6.76E+00	+	2.62E+01	6.16E+00	+	1.24E+01	4.84E+00
F9	3.54E-02	9.26E-02	+	4.08E-02	1.18E-01	+	4.89E-01	6.39E-01	+	1.76E-03	1.25E-02	=	0.00E+00	0.00E+00
F10	1.32E+03	3.93E+02	-	1.76E+03	2.16E+02	+	5.42E+03	4.85E+02	+	2.14E+03	4.14E+02	+	1.49E+03	4.19E+02
F11	2.65E+01	2.54E+01	+	3.35E+01	2.46E+01	+	5.60E+01	3.00E+01	+	1.34E+01	1.59E+01	=	2.36E+01	2.78E+01
F12	1.19E+03	3.66E+02	+	6.78E+03	4.22E+03	+	8.91E+03	6.07E+03	+	4.70E+03	2.90E+03	+	5.00E+02	2.70E+02
F13	2.66E+01	9.52E+00	+	3.59E+01	2.28E+01	+	4.96E+03	7.08E+03	+	4.08E+01	1.18E+01	+	2.22E+01	1.56E+01
F14	2.90E+01	7.29E+00	+	2.97E+01	6.11E+00	+	1.04E+02	3.25E+01	+	2.67E+01	9.64E+00	+	2.37E+01	3.60E+00
F15	1.91E+01	1.51E+01	+	4.68E+01	8.02E+01	+	1.04E+02	5.65E+01	+	1.02E+01	3.25E+00	+	3.57E+00	1.95E+00
F16	2.03E+02	1.62E+02	=	2.77E+02	1.39E+02	+	2.76E+02	1.73E+02	+	3.01E+02	1.20E+02	+	1.82E+02	1.61E+02
F17	3.38E+01	2.65E+01	=	5.21E+01	2.44E+01	+	5.35E+01	1.58E+01	+	3.80E+01	1.18E+01	+	3.45E+01	2.81E+01
F18	3.19E+01	1.23E+01	+	6.08E+01	4.34E+01	+	7.52E+02	1.01E+03	+	3.09E+01	5.51E+00	+	2.44E+01	1.15E+01
F19	8.16E+00	3.57E+00	+	1.31E+01	8.70E+00	+	7.33E+01	3.46E+01	+	8.80E+00	1.96E+00	+	5.98E+00	2.79E+00
F20	3.55E+01	4.44E+01	-	6.66E+01	4.48E+01	=	3.19E+01	3.62E+01	-	4.41E+01	4.09E+01	=	7.76E+01	6.15E+01
F21	2.21E+02	7.63E+00	+	2.18E+02	3.43E+00	+	2.31E+02	1.05E+01	+	2.27E+02	5.78E+00	+	2.13E+02	4.56E+00
F22	1.00E+02	1.44E-14	=	1.00E+02	3.44E-01	+	1.00E+02	6.22E-01	+	1.00E+02	1.11E-13	=	1.00E+02	1.21E-13
F23	3.71E+02	7.46E+00	+	3.64E+02	5.23E+00	+	3.80E+02	6.88E+00	+	3.69E+02	7.83E+00	+	3.61E+02	7.07E+00
F24	4.42E+02	7.22E+00	+	4.37E+02	3.37E+00	+	4.49E+02	1.03E+01	+	4.39E+02	6.28E+00	+	4.36E+02	5.78E+00
F25	3.87E+02	1.58E-01	+	3.87E+02	1.01E-01	+	3.88E+02	6.34E-01	+	3.87E+02	1.25E-01	+	3.87E+02	1.92E-02
F26	1.15E+03	1.03E+02	+	1.07E+03	1.25E+02	=	1.24E+03	8.68E+01	+	1.16E+03	1.67E+02	+	1.07E+03	6.58E+01
F27	5.04E+02	5.81E+00	=	5.04E+02	6.59E+00	=	5.08E+02	8.55E+00	+	5.02E+02	7.15E+00	=	5.03E+02	5.63E+00
F28	3.37E+02	5.39E+01	+	3.54E+02	6.39E+01	+	3.18E+02	4.08E+01	+	3.23E+02	4.38E+01	=	3.24E+02	4.68E+01
F29	4.27E+02	2.10E+01	=	4.62E+02	1.79E+01	+	4.75E+02	4.30E+01	+	4.54E+02	2.37E+01	+	4.35E+02	1.55E+01
F30	2.08E+03	1.18E+02	+	2.16E+03	1.67E+02	+	3.30E+03	1.38E+03	+	2.53E+03	2.62E+02	+	2.02E+03	9.06E+01
W	**20**			**24**			**24**			**20**				
T	**6**			**4**			**2**			**7**				
L	**3**			**1**			**3**			**2**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (30-D)

	ACoS-SHADE			MLCCDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	6.15E+03	1.37E+04
F4	3.91E+01	2.78E+01	+	3.21E+01	3.08E+01	=	5.90E+01	1.51E+00
F5	1.66E+01	1.64E+00	+	2.16E+01	3.33E+00	+	1.10E+01	4.85E+00
F6	1.76E-04	2.31E-04	+	2.68E-09	1.92E-08	-	1.75E-07	3.78E-07
F7	4.71E+01	2.10E+00	+	5.27E+01	4.46E+00	+	4.12E+01	4.94E+00
F8	1.96E+01	1.87E+00	+	2.31E+01	4.78E+00	+	1.24E+01	4.84E+00
F9	1.78E-02	8.91E-02	=	1.76E-03	1.25E-02	=	0.00E+00	0.00E+00
F10	1.95E+03	9.19E+01	+	1.95E+03	3.56E+02	+	1.49E+03	4.19E+02
F11	3.11E+01	8.33E+00	+	8.27E+00	1.17E+01	=	2.36E+01	2.78E+01
F12	1.19E+03	2.86E+02	+	2.86E+03	2.32E+03	+	5.00E+02	2.70E+02
F13	3.31E+01	5.00E+00	+	2.67E+01	1.05E+01	+	2.22E+01	1.56E+01
F14	2.65E+01	4.60E+00	=	2.34E+01	9.78E+00	+	2.37E+01	3.60E+00
F15	4.01E+01	9.48E+00	+	9.12E+00	3.82E+00	+	3.57E+00	1.95E+00
F16	8.65E+01	1.16E+02	=	2.43E+02	1.37E+02	+	1.82E+02	1.61E+02
F17	5.12E+01	8.87E+00	+	2.73E+01	1.17E+01	=	3.45E+01	2.81E+01
F18	8.04E+01	4.35E+01	+	2.78E+01	6.98E+00	+	2.44E+01	1.15E+01
F19	1.70E+01	1.11E+01	+	7.09E+00	2.44E+00	+	5.98E+00	2.79E+00
F20	1.03E+02	6.46E+01	+	2.79E+01	3.24E+01	-	7.76E+01	6.15E+01
F21	2.28E+02	7.79E+00	+	2.22E+02	4.05E+00	+	2.13E+02	4.56E+00
F22	1.00E+02	2.30E-13	+	1.00E+02	1.00E-13	=	1.00E+02	1.21E-13
F23	3.68E+02	2.34E+00	+	3.67E+02	5.85E+00	+	3.61E+02	7.07E+00
F24	4.35E+02	1.51E+00	=	4.38E+02	4.66E+00	+	4.36E+02	5.78E+00
F25	3.87E+02	2.95E-02	+	3.87E+02	1.53E-01	+	3.87E+02	1.92E-02
F26	1.01E+03	7.15E+01	-	1.14E+03	7.61E+01	+	1.07E+03	6.58E+01
F27	4.96E+02	3.56E+00	-	4.99E+02	6.54E+00	-	5.03E+02	5.63E+00
F28	3.65E+02	5.70E+01	+	3.21E+02	4.54E+01	+	3.24E+02	4.68E+01
F29	4.79E+02	2.73E+01	+	4.42E+02	1.91E+01	+	4.35E+02	1.55E+01
F30	2.23E+03	1.21E+02	+	2.08E+03	1.15E+02	+	2.02E+03	9.06E+01
W	**21**			**19**				
T	**5**			**6**				
L	**3**			**4**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (50-D)

	ETI-SHADE			SaM-SHADE			SaDE			IDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	6.79E-02	1.28E-01	+	2.03E+03	2.01E+03	+	3.00E-02	4.38E-02	+	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	3.19E-04	9.02E-04	+	2.75E+03	8.78E+02	+	2.34E+04	4.54E+04
F4	5.10E+01	4.31E+01	=	6.02E+01	5.17E+01	=	7.87E+01	4.23E+01	+	7.18E+01	4.74E+01	=	5.79E+01	5.06E+01
F5	4.15E+01	1.05E+01	+	3.55E+01	5.87E+00	+	7.13E+01	1.41E+01	+	6.51E+01	9.60E+00	+	2.67E+01	5.95E+00
F6	1.05E-03	1.40E-03	+	5.39E-04	5.41E-04	+	5.41E-03	9.16E-03	+	5.10E-07	1.33E-06	-	1.37E-05	1.76E-05
F7	8.62E+01	1.07E+01	+	8.21E+01	5.20E+00	+	1.25E+02	1.32E+01	+	1.05E+02	9.75E+00	+	7.51E+01	7.98E+00
F8	4.28E+01	1.41E+01	+	3.42E+01	5.91E+00	+	7.41E+01	1.48E+01	+	6.51E+01	1.28E+01	+	2.70E+01	7.50E+00
F9	9.20E-01	6.14E-01	+	8.42E-01	7.59E-01	+	2.48E+01	1.88E+01	+	3.10E-01	4.04E-01	+	2.13E-02	9.01E-02
F10	2.81E+03	6.19E+02	-	3.30E+03	2.85E+02	=	9.48E+03	1.76E+03	+	4.26E+03	5.44E+02	+	3.38E+03	4.80E+02
F11	1.23E+02	3.19E+01	+	1.32E+02	3.85E+01	+	1.11E+02	3.20E+01	+	4.21E+01	7.60E+00	+	3.73E+01	8.59E+00
F12	5.33E+03	3.38E+03	=	7.84E+03	4.46E+03	+	3.58E+04	2.16E+04	+	2.35E+04	1.73E+04	+	6.83E+03	7.60E+03
F13	1.17E+02	4.45E+01	+	1.14E+03	2.08E+03	+	3.16E+03	4.05E+03	+	2.78E+02	3.84E+02	+	6.40E+01	5.19E+01
F14	1.26E+02	6.74E+01	+	2.00E+02	6.18E+01	+	5.44E+02	2.66E+02	+	6.04E+01	9.43E+00	+	3.89E+01	1.45E+01
F15	1.28E+02	7.08E+01	+	2.89E+02	1.19E+02	+	2.18E+03	2.35E+03	+	4.97E+01	1.22E+01	=	5.87E+01	4.01E+01
F16	7.40E+02	2.40E+02	+	7.36E+02	1.52E+02	+	7.14E+02	2.40E+02	=	6.51E+02	1.62E+02	=	6.07E+02	2.10E+02
F17	5.23E+02	1.90E+02	=	5.10E+02	1.21E+02	=	4.23E+02	1.73E+02	-	4.23E+02	1.27E+02	-	5.83E+02	2.29E+02
F18	1.47E+02	1.24E+02	+	2.26E+02	1.08E+02	+	2.09E+04	2.37E+04	+	7.62E+02	5.93E+02	+	7.42E+01	3.96E+01
F19	1.04E+02	4.27E+01	+	1.48E+02	5.40E+01	+	9.27E+03	4.19E+03	+	2.25E+01	4.51E+00	=	2.73E+01	1.22E+01
F20	2.90E+02	1.62E+02	-	3.50E+02	1.02E+02	=	2.44E+02	2.00E+02	-	2.38E+02	1.46E+02	-	3.73E+02	1.88E+02
F21	2.39E+02	8.83E+00	+	2.35E+02	5.29E+00	+	2.67E+02	1.23E+01	+	2.61E+02	9.89E+00	+	2.30E+02	7.59E+00
F22	2.53E+03	1.86E+03	-	3.35E+03	1.54E+03	=	4.42E+03	3.85E+03	=	2.42E+03	2.41E+03	=	3.35E+03	1.26E+03
F23	4.70E+02	1.56E+01	+	4.55E+02	7.10E+00	=	4.91E+02	1.74E+01	+	4.86E+02	1.49E+01	+	4.59E+02	1.57E+01
F24	5.40E+02	1.14E+01	+	5.30E+02	6.68E+00	=	5.60E+02	1.82E+01	+	5.52E+02	1.43E+01	+	5.30E+02	8.13E+00
F25	5.18E+02	3.91E+01	=	5.19E+02	3.58E+01	+	5.57E+02	3.75E+01	+	5.43E+02	3.49E+01	+	5.10E+02	3.58E+01
F26	1.49E+03	1.27E+02	+	1.41E+03	8.63E+01	=	1.96E+03	2.02E+02	+	1.80E+03	1.73E+02	+	1.40E+03	1.08E+02
F27	5.54E+02	2.88E+01	+	5.45E+02	2.23E+01	+	6.10E+02	4.49E+01	+	5.33E+02	1.21E+01	+	5.21E+02	9.76E+00
F28	4.88E+02	2.45E+01	+	4.86E+02	2.41E+01	+	4.98E+02	1.36E+01	+	4.91E+02	2.19E+01	+	4.67E+02	1.84E+01
F29	4.24E+02	6.10E+01	+	4.44E+02	9.08E+01	+	6.23E+02	1.32E+02	+	3.80E+02	5.89E+01	=	3.86E+02	6.73E+01
F30	6.77E+05	8.28E+04	+	6.74E+05	8.98E+04	+	6.25E+05	4.95E+04	=	6.33E+05	2.81E+04	+	6.11E+05	3.57E+04
W	**20**			**20**			**24**			**20**				
T	**5**			**8**			**3**			**6**				
L	**4**			**1**			**2**			**3**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (50-D)

	ACoS-SHADE			MLCCDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	1.43E-08	8.78E-08	=	2.34E+04	4.54E+04
F4	5.72E+01	4.06E+01	+	4.29E+01	4.28E+01	=	5.79E+01	5.06E+01
F5	4.87E+01	3.94E+00	+	5.18E+01	9.99E+00	+	2.67E+01	5.95E+00
F6	1.48E-02	9.41E-03	+	5.83E-07	1.34E-06	-	1.37E-05	1.76E-05
F7	9.05E+01	4.83E+00	+	9.59E+01	7.46E+00	+	7.51E+01	7.98E+00
F8	4.40E+01	6.11E+00	+	5.22E+01	7.56E+00	+	2.70E+01	7.50E+00
F9	1.86E+00	1.22E+00	+	4.22E-01	4.32E-01	+	2.13E-02	9.01E-02
F10	3.55E+03	1.27E+02	+	3.82E+03	4.88E+02	+	3.38E+03	4.80E+02
F11	1.48E+02	2.32E+01	+	5.00E+01	1.32E+01	+	3.73E+01	8.59E+00
F12	2.55E+03	2.37E+02	-	1.48E+04	1.18E+04	+	6.83E+03	7.60E+03
F13	5.56E+02	1.29E+02	+	2.17E+02	2.74E+02	+	6.40E+01	5.19E+01
F14	2.76E+02	3.98E+01	+	7.61E+01	2.05E+01	+	3.89E+01	1.45E+01
F15	2.49E+02	1.21E+02	+	6.32E+01	1.71E+01	+	5.87E+01	4.01E+01
F16	7.38E+02	1.98E+02	+	6.53E+02	1.81E+02	=	6.07E+02	2.10E+02
F17	5.52E+02	9.97E+01	=	3.59E+02	1.20E+02	-	5.83E+02	2.29E+02
F18	4.86E+02	1.86E+02	+	3.37E+02	3.03E+02	+	7.42E+01	3.96E+01
F19	1.53E+02	3.75E+01	+	3.47E+01	1.24E+01	+	2.73E+01	1.22E+01
F20	3.46E+02	7.10E+01	=	2.16E+02	1.21E+02	-	3.73E+02	1.88E+02
F21	2.33E+02	3.07E+00	+	2.50E+02	9.25E+00	+	2.30E+02	7.59E+00
F22	1.79E+03	2.12E+03	=	3.30E+03	2.03E+03	+	3.35E+03	1.26E+03
F23	4.64E+02	8.41E+00	+	4.74E+02	1.30E+01	+	4.59E+02	1.57E+01
F24	5.28E+02	7.19E+00	-	5.42E+02	9.46E+00	+	5.30E+02	8.13E+00
F25	5.52E+02	2.01E+01	+	5.36E+02	2.84E+01	+	5.10E+02	3.58E+01
F26	1.60E+03	6.45E+01	+	1.58E+03	1.48E+02	+	1.40E+03	1.08E+02
F27	6.14E+02	4.59E+01	+	5.38E+02	2.32E+01	+	5.21E+02	9.76E+00
F28	4.88E+02	1.90E+01	+	4.88E+02	2.18E+01	+	4.67E+02	1.84E+01
F29	6.15E+02	6.76E+01	+	3.71E+02	5.02E+01	=	3.86E+02	6.73E+01
F30	6.11E+05	7.93E+04	=	5.90E+05	2.41E+04	-	6.11E+05	3.57E+04
W	**21**			**20**				
T	**5**			**5**				
L	**3**			**4**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (100-D)

	ETI-SHADE			SaM-SHADE			SaDE			IDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	5.79E+02	1.30E+03	+	3.39E+03	3.01E+03	+	3.47E+00	5.95E+00	+	0.00E+00	0.00E+00
F3	7.02E-07	1.19E-06	-	5.46E+04	1.51E+05	-	1.71E+03	1.40E+03	+	1.03E+05	1.11E+04	+	3.64E+04	8.74E+04
F4	1.03E+02	7.48E+01	=	1.15E+02	7.19E+01	=	1.57E+02	5.31E+01	=	1.73E+02	4.19E+01	+	1.12E+02	8.56E+01
F5	1.08E+02	1.98E+01	+	1.03E+02	1.40E+01	+	2.44E+02	4.06E+01	+	1.73E+02	2.10E+01	+	8.73E+01	1.51E+01
F6	8.31E-02	4.83E-02	+	7.81E-02	4.30E-02	+	5.10E-01	3.10E-01	+	1.99E-05	2.15E-05	-	1.39E-04	1.25E-04
F7	2.16E+02	2.14E+01	+	2.08E+02	1.25E+01	+	4.03E+02	5.37E+01	+	2.54E+02	2.51E+01	+	1.86E+02	1.48E+01
F8	1.14E+02	1.93E+01	+	1.02E+02	1.35E+01	+	2.42E+02	4.09E+01	+	1.70E+02	1.98E+01	+	9.06E+01	1.57E+01
F9	2.33E+01	1.05E+01	+	2.62E+01	1.71E+01	+	1.06E+03	6.04E+02	+	1.92E+00	1.39E+00	+	1.32E+00	1.13E+00
F10	8.49E+03	1.07E+03	-	9.41E+03	5.54E+02	=	1.27E+04	1.10E+03	+	1.11E+04	8.13E+02	+	9.37E+03	9.58E+02
F11	9.11E+02	1.99E+02	+	3.41E+03	7.98E+03	+	8.36E+02	1.75E+02	+	2.41E+02	4.59E+01	-	3.60E+02	1.10E+02
F12	1.61E+04	9.44E+03	-	1.61E+04	7.76E+03	-	3.08E+05	1.26E+05	+	3.41E+05	1.75E+05	+	3.16E+04	1.91E+04
F13	2.58E+02	1.73E+02	+	3.48E+03	3.66E+03	+	3.06E+03	2.65E+03	+	2.12E+03	1.27E+03	+	9.75E+01	5.43E+01
F14	5.25E+02	1.76E+02	+	6.39E+02	2.08E+02	+	3.03E+04	1.82E+04	+	2.56E+02	6.11E+01	+	2.13E+02	1.09E+02
F15	3.88E+02	1.49E+02	+	3.93E+02	1.21E+02	+	1.31E+03	1.65E+03	+	6.81E+02	9.00E+02	+	1.95E+02	2.11E+02
F16	2.21E+03	5.52E+02	=	2.40E+03	3.10E+02	+	2.52E+03	5.38E+02	+	2.16E+03	3.34E+02	=	2.21E+03	4.98E+02
F17	1.72E+03	3.81E+02	=	1.82E+03	2.65E+02	=	2.02E+03	4.18E+02	=	1.52E+03	3.17E+02	-	1.75E+03	3.60E+02
F18	3.65E+03	4.07E+03	=	1.78E+03	1.71E+03	-	1.97E+05	1.16E+05	+	6.31E+04	2.61E+04	+	4.26E+03	4.64E+03
F19	2.81E+02	5.91E+01	+	5.28E+02	9.20E+02	+	1.31E+03	1.37E+03	+	4.29E+02	6.05E+02	+	6.79E+02	1.76E+03
F20	1.85E+03	4.83E+02	=	1.67E+03	2.29E+02	-	1.96E+03	3.19E+02	=	1.51E+03	2.58E+02	-	1.81E+03	3.36E+02
F21	3.43E+02	2.17E+01	+	3.35E+02	1.65E+01	+	4.34E+02	3.36E+01	+	3.90E+02	2.10E+01	+	3.22E+02	1.76E+01
F22	9.65E+03	1.92E+03	-	1.05E+04	6.42E+02	+	1.40E+04	1.23E+03	+	1.29E+04	9.69E+02	+	1.02E+04	9.96E+02
F23	6.64E+02	2.30E+01	+	6.14E+02	1.28E+01	-	7.20E+02	2.94E+01	+	6.76E+02	2.04E+01	+	6.37E+02	2.98E+01
F24	9.99E+02	2.72E+01	=	9.97E+02	2.20E+01	=	1.11E+03	3.30E+01	+	1.00E+03	2.57E+01	+	9.90E+02	1.92E+01
F25	7.45E+02	5.23E+01	=	7.40E+02	5.96E+01	=	8.02E+02	5.18E+01	+	8.00E+02	5.19E+01	+	7.42E+02	4.14E+01
F26	4.34E+03	2.87E+02	+	4.30E+03	2.43E+02	+	6.34E+03	6.87E+02	+	4.58E+03	2.86E+02	+	4.18E+03	2.35E+02
F27	6.72E+02	3.14E+01	+	6.67E+02	2.57E+01	+	8.53E+02	6.94E+01	+	6.61E+02	2.13E+01	+	6.32E+02	2.49E+01
F28	5.21E+02	3.18E+01	=	5.29E+02	4.21E+01	=	5.51E+02	2.24E+01	+	5.77E+02	2.59E+01	+	5.13E+02	5.54E+01
F29	2.10E+03	3.94E+02	+	2.18E+03	3.12E+02	+	2.64E+03	4.04E+02	+	1.73E+03	3.21E+02	=	1.75E+03	3.84E+02
F30	2.58E+03	2.12E+02	=	2.74E+03	6.10E+02	+	3.03E+03	1.69E+02	+	5.27E+03	1.53E+03	+	2.62E+03	9.90E+02
W	**15**			**18**			**26**			**23**				
T	**10**			**6**			**3**			**2**				
L	**4**			**5**			**0**			**4**				

TABLE S3 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK-BASED DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (100-D)

	ACoS-SHADE			MLCCDE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	3.24E-06	1.82E-05	+	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	2.59E+03	1.19E+04	+	3.64E+04	8.74E+04
F4	1.28E+02	1.04E+02	+	1.09E+02	4.76E+01	=	1.12E+02	8.56E+01
F5	1.96E+02	1.98E+01	+	1.53E+02	2.32E+01	+	8.73E+01	1.51E+01
F6	5.82E-01	2.07E-01	+	2.68E-04	2.06E-04	+	1.39E-04	1.25E-04
F7	2.79E+02	1.63E+01	+	2.41E+02	2.19E+01	+	1.86E+02	1.48E+01
F8	1.67E+02	1.21E+01	+	1.51E+02	1.97E+01	+	9.06E+01	1.57E+01
F9	1.11E+02	4.13E+01	+	2.84E+01	1.46E+01	+	1.32E+00	1.13E+00
F10	1.06E+04	2.45E+02	+	1.05E+04	9.20E+02	+	9.37E+03	9.58E+02
F11	9.97E+02	7.04E+01	+	2.03E+02	7.08E+01	-	3.60E+02	1.10E+02
F12	1.25E+04	3.91E+03	-	1.29E+05	5.97E+04	+	3.16E+04	1.91E+04
F13	5.13E+02	1.91E+02	+	2.34E+03	1.91E+03	+	9.75E+01	5.43E+01
F14	4.89E+02	7.11E+01	+	9.57E+02	1.75E+03	+	2.13E+02	1.09E+02
F15	3.61E+02	1.84E+01	+	1.01E+03	9.94E+02	+	1.95E+02	2.11E+02
F16	2.59E+03	1.51E+02	+	2.22E+03	3.04E+02	=	2.21E+03	4.98E+02
F17	2.19E+03	1.23E+02	+	1.38E+03	3.20E+02	-	1.75E+03	3.60E+02
F18	2.78E+02	1.75E+01	-	1.68E+04	1.10E+04	+	4.26E+03	4.64E+03
F19	2.65E+02	5.82E+01	+	6.10E+02	7.93E+02	+	6.79E+02	1.76E+03
F20	1.70E+03	1.89E+02	-	1.45E+03	2.41E+02	-	1.81E+03	3.36E+02
F21	4.13E+02	1.76E+01	+	3.68E+02	2.33E+01	+	3.22E+02	1.76E+01
F22	1.22E+04	4.69E+02	+	1.20E+04	8.51E+02	+	1.02E+04	9.96E+02
F23	6.34E+02	1.88E+01	=	6.44E+02	2.25E+01	+	6.37E+02	2.98E+01
F24	1.01E+03	3.89E+01	=	1.02E+03	2.71E+01	+	9.90E+02	1.92E+01
F25	7.25E+02	3.17E+01	-	7.83E+02	4.99E+01	+	7.42E+02	4.14E+01
F26	5.17E+03	4.18E+02	+	4.51E+03	2.74E+02	+	4.18E+03	2.35E+02
F27	7.62E+02	1.01E+01	+	7.02E+02	2.39E+01	+	6.32E+02	2.49E+01
F28	3.64E+02	1.18E+02	-	5.50E+02	3.19E+01	+	5.13E+02	5.54E+01
F29	2.09E+03	2.96E+02	+	1.72E+03	3.34E+02	=	1.75E+03	3.84E+02
F30	2.49E+03	1.16E+02	=	2.84E+03	1.11E+03	=	2.62E+03	9.90E+02
W	**19**			**22**				
T	**4**			**4**				
L	**6**			**3**				

TABLE S4 PERFORMANCE COMPARISONS OF ODFDE WITH DSK-BASED DES ON 10-D, 30-D, 50-D, AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	10-D								30-D							
	AEPD-SHADE			SHADE/eig			ODFDE		AEPD-SHADE			SHADE/eig			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	8.70E+03	1.61E+04	=	0.00E+00	0.00E+00	-	6.15E+03	1.37E+04
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	9.34E+00	2.03E+01	-	3.21E+01	2.99E+01	=	5.90E+01	1.51E+00
F5	2.02E+00	1.40E+00	+	2.37E+00	8.53E-01	+	8.63E-01	1.00E+00	1.38E+01	3.89E+00	+	2.02E+01	3.84E+00	+	1.10E+01	4.85E+00
F6	1.07E-07	3.63E-07	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	4.90E-02	1.72E-01	+	8.05E-09	3.25E-08	-	1.75E-07	3.78E-07
F7	1.17E+01	2.18E+00	+	1.28E+01	7.39E-01	+	1.13E+01	5.15E-01	4.20E+01	2.47E+00	=	4.83E+01	2.89E+00	+	4.12E+01	4.94E+00
F8	2.01E+00	1.40E+00	+	2.63E+00	8.70E-01	+	6.98E-01	6.98E-01	1.46E+01	8.92E+00	=	2.01E+01	3.17E+00	+	1.24E+01	4.84E+00
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	1.89E+00	5.52E+00	+	3.51E-03	1.76E-02	=	0.00E+00	0.00E+00
F10	1.11E+02	6.71E+01	+	7.93E+01	6.93E+01	+	2.74E+01	4.28E+01	1.61E+03	3.46E+02	=	1.89E+03	2.28E+02	+	1.49E+03	4.19E+02
F11	1.77E+00	1.69E+00	+	7.90E-01	1.03E+00	+	0.00E+00	0.00E+00	8.19E+01	3.48E+01	+	2.54E+01	2.29E+01	+	2.36E+01	2.78E+01
F12	1.33E+02	9.65E+01	+	4.39E+01	6.44E+01	-	6.70E+01	7.10E+01	1.69E+04	2.27E+04	+	1.57E+03	1.85E+03	+	5.00E+02	2.70E+02
F13	5.37E+00	2.82E+00	=	3.35E+00	2.38E+00	-	4.84E+00	1.69E+00	6.26E+02	1.42E+03	+	3.14E+01	1.90E+01	+	2.22E+01	1.56E+01
F14	2.43E+00	1.04E+00	+	1.96E-01	1.81E-01	+	6.74E-01	3.65E+00	7.79E+01	2.52E+01	+	2.66E+01	4.68E+00	+	2.37E+01	3.60E+00
F15	6.02E-01	6.26E-01	+	1.92E-01	1.38E-01	+	1.24E-01	1.80E-01	7.40E+01	4.75E+01	+	9.84E+00	6.12E+00	+	3.57E+00	1.95E+00
F16	9.91E+00	3.07E+01	=	6.02E-01	1.62E-01	-	8.10E-01	3.48E-01	4.34E+02	1.68E+02	+	3.40E+02	1.38E+02	+	1.82E+02	1.61E+02
F17	4.84E-01	5.50E-01	-	5.15E-01	2.40E-01	-	8.41E-01	3.97E-01	6.73E+01	5.87E+01	+	5.58E+01	2.47E+01	+	3.45E+01	2.81E+01
F18	9.70E-01	1.84E+00	=	1.71E-01	1.71E-01	-	3.00E+00	6.93E+00	7.62E+02	2.43E+03	+	4.46E+01	3.25E+01	+	2.44E+01	1.15E+01
F19	1.05E-01	1.93E-01	+	2.81E-02	1.60E-02	+	3.22E-02	4.53E-02	3.55E+01	3.78E+01	+	8.67E+00	2.41E+00	+	5.98E+00	2.79E+00
F20	4.36E-02	1.89E-01	-	1.22E-02	6.12E-02	-	2.79E-04	8.48E-04	1.41E+02	5.14E+01	+	5.84E+01	4.00E+01	=	7.76E+01	6.15E+01
F21	1.61E+02	5.03E+01	=	1.39E+02	4.83E+01	=	1.73E+02	4.73E+01	2.16E+02	8.15E+00	=	2.20E+02	3.35E+00	+	2.13E+02	4.56E+00
F22	9.71E+01	1.83E+01	+	1.00E+02	1.37E-03	=	1.00E+02	1.54E-01	1.01E+02	1.95E+00	+	1.00E+02	1.44E-14	=	1.00E+02	1.21E-13
F23	3.05E+02	3.43E+00	+	3.03E+02	1.30E+00	=	3.03E+02	1.36E+00	3.61E+02	1.63E+01	=	3.63E+02	5.71E+00	=	3.61E+02	7.07E+00
F24	3.07E+02	7.02E+01	-	3.02E+02	7.12E+01	-	3.16E+02	5.86E+01	4.48E+02	1.76E+01	+	4.35E+02	3.17E+00	=	4.36E+02	5.78E+00
F25	4.30E+02	2.14E+01	+	4.21E+02	2.30E+01	=	4.15E+02	2.26E+01	3.90E+02	9.59E+00	+	3.87E+02	5.48E-01	+	3.87E+02	1.92E-02
F26	2.80E+02	6.10E+01	-	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	1.04E+03	4.27E+02	=	1.12E+03	6.84E+01	+	1.07E+03	6.58E+01
F27	3.94E+02	2.77E+00	+	3.90E+02	1.61E+00	=	3.89E+02	1.56E-01	5.40E+02	1.81E+01	+	5.02E+02	7.46E+00	=	5.03E+02	5.63E+00
F28	4.30E+02	1.56E+02	=	4.62E+02	1.51E+02	=	4.33E+02	1.49E+02	3.14E+02	3.57E+01	+	3.19E+02	4.42E+01	+	3.24E+02	4.68E+01
F29	2.51E+02	1.06E+01	+	2.46E+02	4.82E+00	+	2.41E+02	5.51E+00	4.57E+02	4.16E+01	+	4.65E+02	1.27E+01	+	4.35E+02	1.55E+01
F30	5.50E+04	2.07E+05	+	4.05E+02	1.98E+01	-	2.77E+04	1.49E+05	2.95E+03	8.31E+02	+	2.11E+03	9.84E+01	+	2.02E+03	9.06E+01
W	**15**			**9**					**20**			**19**				
T	**10**			**12**					**8**			**8**				
L	**4**			**8**					**1**			**2**				

TABLE S4 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH DSK-BASED DES ON 10-D, 30-D, 50-D, AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	50-D								100-D							
	AEPD-SHADE			SHADE/eig			ODFDE		AEPD-SHADE			SHADE/eig			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	3.79E+02	1.58E+03	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	4.94E+03	8.02E+03	+	2.22E-07	4.38E-07	+	0.00E+00	0.00E+00
F3	1.66E+04	3.78E+04	=	0.00E+00	0.00E+00	-	2.34E+04	4.54E+04	1.07E+05	1.15E+05	=	4.77E-06	1.80E-05	-	3.64E+04	8.74E+04
F4	4.27E+01	4.70E+01	=	3.71E+01	4.73E+01	=	5.79E+01	5.06E+01	1.62E+02	4.64E+01	=	6.97E+01	5.68E+01	-	1.12E+02	8.56E+01
F5	3.69E+01	3.85E+01	=	4.72E+01	6.78E+00	+	2.67E+01	5.95E+00	1.18E+02	2.77E+01	+	1.53E+02	1.58E+01	+	8.73E+01	1.51E+01
F6	3.96E-03	2.17E-02	-	4.28E-06	7.22E-06	-	1.37E-05	1.76E-05	3.16E-05	3.38E-05	-	3.11E-02	2.74E-02	+	1.39E-04	1.25E-04
F7	7.59E+01	5.69E+00	=	9.11E+01	6.56E+00	+	7.51E+01	7.98E+00	2.05E+02	2.22E+01	+	2.73E+02	2.19E+01	+	1.86E+02	1.48E+01
F8	2.84E+01	1.93E+01	=	5.02E+01	6.92E+00	+	2.70E+01	7.50E+00	1.16E+02	3.37E+01	+	1.49E+02	1.49E+01	+	9.06E+01	1.57E+01
F9	1.23E+00	1.98E+00	+	8.03E-01	8.39E-01	+	2.13E-02	9.01E-02	2.15E+02	2.29E+02	+	6.78E+01	5.91E+01	+	1.32E+00	1.13E+00
F10	2.50E+03	5.70E+02	-	3.66E+03	3.11E+02	+	3.38E+03	4.80E+02	7.19E+03	1.04E+03	-	9.83E+03	4.68E+02	+	9.37E+03	9.58E+02
F11	1.27E+02	4.22E+01	+	7.77E+01	2.00E+01	+	3.73E+01	8.59E+00	3.01E+03	4.58E+03	+	9.04E+02	1.89E+02	+	3.60E+02	1.10E+02
F12	1.59E+05	1.91E+05	+	5.70E+03	3.68E+03	=	6.83E+03	7.60E+03	1.14E+06	1.07E+06	+	2.82E+04	1.10E+04	=	3.16E+04	1.91E+04
F13	3.29E+03	4.07E+03	+	2.19E+02	1.16E+02	+	6.40E+01	5.19E+01	4.96E+03	2.94E+03	+	3.00E+03	2.41E+03	+	9.75E+01	5.43E+01
F14	1.03E+03	2.25E+03	+	1.14E+02	3.19E+01	+	3.89E+01	1.45E+01	2.25E+04	3.91E+04	+	5.97E+02	2.26E+02	+	2.13E+02	1.09E+02
F15	3.08E+02	2.59E+02	+	1.92E+02	8.28E+01	+	5.87E+01	4.01E+01	1.59E+03	1.41E+03	+	4.72E+02	3.72E+02	+	1.95E+02	2.11E+02
F16	6.45E+02	2.21E+02	=	7.73E+02	1.22E+02	+	6.07E+02	2.10E+02	1.98E+03	4.86E+02	-	2.39E+03	3.78E+02	+	2.21E+03	4.98E+02
F17	4.91E+02	1.58E+02	=	5.60E+02	1.31E+02	=	5.83E+02	2.29E+02	1.42E+03	3.16E+02	-	1.78E+03	2.54E+02	=	1.75E+03	3.60E+02
F18	1.58E+03	1.45E+03	+	1.74E+02	8.46E+01	+	7.42E+01	3.96E+01	8.85E+03	9.22E+03	+	2.39E+03	1.43E+03	=	4.26E+03	4.64E+03
F19	1.85E+03	2.70E+03	+	1.06E+02	3.65E+01	+	2.73E+01	1.22E+01	3.29E+03	4.76E+03	+	7.94E+02	1.37E+03	+	6.79E+02	1.76E+03
F20	3.14E+02	1.56E+02	=	3.15E+02	9.43E+01	=	3.73E+02	1.88E+02	1.31E+03	3.94E+02	-	1.66E+03	2.34E+02	-	1.81E+03	3.36E+02
F21	2.33E+02	1.93E+01	=	2.46E+02	6.54E+00	+	2.30E+02	7.59E+00	3.35E+02	2.40E+01	+	3.69E+02	1.50E+01	+	3.22E+02	1.76E+01
F22	3.36E+03	1.24E+03	=	2.95E+03	2.03E+03	=	3.35E+03	1.26E+03	8.25E+03	1.94E+03	-	1.09E+04	1.63E+03	+	1.02E+04	9.96E+02
F23	4.72E+02	6.12E+01	=	4.64E+02	1.15E+01	+	4.59E+02	1.57E+01	8.02E+02	2.63E+02	=	6.34E+02	1.29E+01	=	6.37E+02	2.98E+01
F24	6.17E+02	7.80E+01	+	5.37E+02	8.88E+00	+	5.30E+02	8.13E+00	9.66E+02	3.29E+01	-	1.01E+03	2.56E+01	+	9.90E+02	1.92E+01
F25	5.53E+02	4.52E+01	+	5.29E+02	3.89E+01	+	5.10E+02	3.58E+01	7.72E+02	7.29E+01	=	7.78E+02	5.85E+01	+	7.42E+02	4.14E+01
F26	1.45E+03	8.05E+02	-	1.56E+03	1.14E+02	+	1.40E+03	1.08E+02	6.40E+03	5.35E+03	=	4.72E+03	2.84E+02	+	4.18E+03	2.35E+02
F27	8.61E+02	9.34E+01	+	5.43E+02	2.43E+01	+	5.21E+02	9.76E+00	1.30E+03	2.59E+02	+	7.16E+02	3.35E+01	+	6.32E+02	2.49E+01
F28	4.92E+02	3.34E+01	+	4.98E+02	1.50E+01	+	4.67E+02	1.84E+01	5.32E+02	2.98E+01	+	5.33E+02	3.92E+01	+	5.13E+02	5.54E+01
F29	5.53E+02	1.66E+02	+	4.71E+02	7.84E+01	+	3.86E+02	6.73E+01	1.94E+03	5.62E+02	=	2.21E+03	2.83E+02	+	1.75E+03	3.84E+02
F30	7.71E+05	1.30E+05	+	6.67E+05	8.60E+04	+	6.11E+05	3.57E+04	7.22E+03	3.46E+03	+	2.87E+03	7.68E+02	+	2.62E+03	9.90E+02
W	**15**			**21**					**16**			**22**				
T	**11**			**6**					**6**			**4**				
L	**3**			**2**					**7**			**3**				

TABLE S5 PERFORMANCE COMPARISONS OF ODFDE WITH OSK AND SSK-BASED DES ON 10-D, 30-D, 50-D, AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	10-D								30-D							
	CSM-SHADE			SCSS-SHADE			ODFDE		CSM-SHADE			SCSS-SHADE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	2.87E+02	4.65E+02	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	1.94E+03	1.62E+03	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	6.15E+03	1.37E+04
F4	1.04E+00	1.86E-01	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	5.14E+00	1.34E+01	-	5.32E+01	1.75E+01	+	5.90E+01	1.51E+00
F5	2.95E+00	2.42E+00	+	2.75E+00	9.59E-01	+	8.63E-01	1.00E+00	1.91E+01	5.43E+00	+	1.36E+01	3.43E+00	+	1.10E+01	4.85E+00
F6	1.03E-02	3.52E-02	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	5.55E-02	7.18E-02	+	2.58E-05	4.27E-05	+	1.75E-07	3.78E-07
F7	1.30E+01	1.58E+00	+	1.30E+01	1.20E+00	+	1.13E+01	5.15E-01	4.41E+01	4.53E+00	+	4.35E+01	2.39E+00	+	4.12E+01	4.94E+00
F8	2.34E+00	1.46E+00	+	3.08E+00	1.21E+00	+	6.98E-01	6.98E-01	1.81E+01	4.61E+00	+	1.45E+01	3.16E+00	+	1.24E+01	4.84E+00
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	4.67E-01	8.80E-01	+	8.36E-02	1.96E-01	+	0.00E+00	0.00E+00
F10	4.90E+01	6.47E+01	=	6.77E+01	6.39E+01	+	2.74E+01	4.28E+01	1.82E+03	4.08E+02	+	1.65E+03	2.13E+02	+	1.49E+03	4.19E+02
F11	4.95E+00	2.17E+00	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	7.33E+01	2.47E+01	+	3.29E+01	2.61E+01	+	2.36E+01	2.78E+01
F12	1.13E+03	1.19E+03	+	3.43E+01	6.47E+01	-	6.70E+01	7.10E+01	2.84E+04	1.34E+04	+	1.10E+03	4.54E+02	+	5.00E+02	2.70E+02
F13	5.34E+00	2.61E+00	=	4.09E+00	2.21E+00	-	4.84E+00	1.69E+00	1.40E+02	5.54E+01	+	2.96E+01	1.25E+01	+	2.22E+01	1.56E+01
F14	4.81E+00	7.97E+00	+	1.39E-01	2.89E-01	=	6.74E-01	3.65E+00	8.53E+01	2.35E+01	+	2.64E+01	2.13E+00	+	2.37E+01	3.60E+00
F15	1.68E+00	1.40E+00	+	8.64E-02	1.73E-01	-	1.24E-01	1.80E-01	1.51E+02	6.11E+01	+	1.19E+01	8.61E+00	+	3.57E+00	1.95E+00
F16	5.48E+00	2.19E+01	+	5.20E-01	3.12E-01	-	8.10E-01	3.48E-01	3.77E+02	1.64E+02	+	2.06E+02	1.34E+02	=	1.82E+02	1.61E+02
F17	4.25E+00	7.68E+00	=	3.05E-01	1.70E-01	-	8.41E-01	3.97E-01	6.11E+01	4.29E+01	+	4.82E+01	1.57E+01	+	3.45E+01	2.81E+01
F18	1.23E+01	9.56E+00	+	8.26E-01	3.64E+00	-	3.00E+00	6.93E+00	1.56E+02	6.41E+01	+	2.91E+01	1.19E+01	+	2.44E+01	1.15E+01
F19	1.14E+00	6.88E-01	+	4.33E-02	3.97E-02	+	3.22E-02	4.53E-02	7.76E+01	2.34E+01	+	7.53E+00	1.88E+00	+	5.98E+00	2.79E+00
F20	7.28E-02	1.77E-01	-	3.12E-02	9.53E-02	-	2.79E-04	8.48E-04	8.26E+01	5.28E+01	+	6.51E+01	4.43E+01	=	7.76E+01	6.15E+01
F21	1.96E+02	2.69E+01	+	1.70E+02	4.94E+01	=	1.73E+02	4.73E+01	2.19E+02	6.24E+00	+	2.15E+02	2.80E+00	+	2.13E+02	4.56E+00
F22	1.00E+02	1.70E-01	=	1.00E+02	1.72E-01	=	1.00E+02	1.54E-01	1.00E+02	1.95E-13	+	1.00E+02	1.17E-13	+	1.00E+02	1.21E-13
F23	3.04E+02	2.16E+00	=	3.04E+02	1.48E+00	+	3.03E+02	1.36E+00	3.69E+02	9.16E+00	+	3.63E+02	5.36E+00	=	3.61E+02	7.07E+00
F24	3.16E+02	5.88E+01	=	3.09E+02	7.07E+01	=	3.16E+02	5.86E+01	4.37E+02	5.61E+00	=	4.34E+02	3.29E+00	=	4.36E+02	5.78E+00
F25	4.36E+02	1.72E+01	+	4.18E+02	2.34E+01	=	4.15E+02	2.26E+01	3.96E+02	1.86E+01	+	3.87E+02	5.04E-02	+	3.87E+02	1.92E-02
F26	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	1.21E+03	1.13E+02	+	1.06E+03	6.60E+01	=	1.07E+03	6.58E+01
F27	3.96E+02	1.47E+00	+	3.89E+02	1.80E-01	=	3.89E+02	1.56E-01	5.13E+02	7.95E+00	+	5.04E+02	6.74E+00	=	5.03E+02	5.63E+00
F28	5.84E+02	8.23E+01	+	4.00E+02	1.44E+02	=	4.33E+02	1.49E+02	3.14E+02	3.95E+01	+	3.43E+02	5.83E+01	+	3.24E+02	4.68E+01
F29	2.41E+02	6.17E+00	=	2.33E+02	3.80E+00	-	2.41E+02	5.51E+00	5.18E+02	4.87E+01	+	4.58E+02	2.00E+01	+	4.35E+02	1.55E+01
F30	4.94E+02	5.35E+01	+	1.51E+05	3.50E+05	-	2.77E+04	1.49E+05	2.48E+03	1.34E+02	+	2.10E+03	1.85E+02	+	2.02E+03	9.06E+01
W	**18**			**6**					**26**			**21**				
T	**10**			**14**					**1**			**7**				
L	**1**			**9**					**2**			**1**				

TABLE S5 (CONTINUED) PERFORMANCE COMPARISONS OF ODFDE WITH OSK AND SSK-BASED DES ON 10-D, 30-D, 50-D, AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	50-D								100-D							
	CSM-SHADE			SCSS-SHADE			ODFDE		CSM-SHADE			SCSS-SHADE			ODFDE	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	1.36E+03	2.13E+03	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	4.63E+03	3.56E+03	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	2.34E+04	4.54E+04	1.40E-06	1.00E-05	-	5.86E+01	4.18E+02	-	3.64E+04	8.74E+04
F4	7.20E+01	4.52E+01	=	5.48E+01	4.98E+01	=	5.79E+01	5.06E+01	7.33E+01	5.13E+01	=	1.14E+02	7.03E+01	=	1.12E+02	8.56E+01
F5	4.71E+01	8.67E+00	+	3.06E+01	5.02E+00	+	2.67E+01	5.95E+00	1.54E+02	1.99E+01	+	9.36E+01	1.58E+01	=	8.73E+01	1.51E+01
F6	1.11E-01	1.18E-01	+	1.29E-03	4.87E-03	+	1.37E-05	1.76E-05	1.88E+00	5.55E-01	+	4.86E-02	3.02E-02	+	1.39E-04	1.25E-04
F7	8.32E+01	7.40E+00	+	7.80E+01	4.89E+00	+	7.51E+01	7.98E+00	2.57E+02	2.47E+01	+	1.99E+02	1.29E+01	+	1.86E+02	1.48E+01
F8	4.31E+01	7.73E+00	+	3.03E+01	4.65E+00	+	2.70E+01	7.50E+00	1.52E+02	1.49E+01	+	9.66E+01	1.19E+01	+	9.06E+01	1.57E+01
F9	1.27E+01	1.48E+01	+	7.03E-01	6.71E-01	+	2.13E-02	9.01E-02	4.23E+02	2.69E+02	+	2.23E+01	1.05E+01	+	1.32E+00	1.13E+00
F10	3.35E+03	3.76E+02	=	3.34E+03	2.86E+02	=	3.38E+03	4.80E+02	9.11E+03	5.38E+02	=	9.25E+03	4.98E+02	=	9.37E+03	9.58E+02
F11	1.32E+02	2.60E+01	+	1.00E+02	3.21E+01	+	3.73E+01	8.59E+00	1.08E+03	1.82E+02	+	1.06E+03	2.16E+02	+	3.60E+02	1.10E+02
F12	4.04E+05	1.22E+05	+	6.17E+03	4.32E+03	=	6.83E+03	7.60E+03	4.89E+05	1.39E+05	+	1.76E+04	8.47E+03	-	3.16E+04	1.91E+04
F13	4.03E+02	1.67E+02	+	1.56E+02	9.24E+01	+	6.40E+01	5.19E+01	3.18E+03	2.06E+03	+	4.90E+02	1.36E+03	+	9.75E+01	5.43E+01
F14	2.44E+02	5.80E+01	+	8.03E+01	2.74E+01	+	3.89E+01	1.45E+01	3.55E+02	8.03E+01	+	6.53E+02	1.56E+02	+	2.13E+02	1.09E+02
F15	3.31E+02	9.01E+01	+	1.54E+02	8.36E+01	+	5.87E+01	4.01E+01	2.48E+02	3.39E+01	+	3.73E+02	1.29E+02	+	1.95E+02	2.11E+02
F16	8.17E+02	3.05E+02	+	6.89E+02	1.82E+02	+	6.07E+02	2.10E+02	2.59E+03	5.32E+02	+	2.31E+03	2.90E+02	=	2.21E+03	4.98E+02
F17	5.54E+02	1.87E+02	=	5.37E+02	1.45E+02	=	5.83E+02	2.29E+02	1.91E+03	3.80E+02	=	1.84E+03	2.13E+02	=	1.75E+03	3.60E+02
F18	1.36E+02	9.89E+01	+	1.89E+02	1.29E+02	+	7.42E+01	3.96E+01	8.43E+02	6.23E+02	-	1.69E+03	1.22E+03	-	4.26E+03	4.64E+03
F19	1.20E+02	3.87E+01	+	1.06E+02	4.91E+01	+	2.73E+01	1.22E+01	2.28E+02	5.48E+01	+	2.49E+02	5.31E+01	+	6.79E+02	1.76E+03
F20	2.96E+02	1.20E+02	-	2.80E+02	1.21E+02	-	3.73E+02	1.88E+02	1.66E+03	3.56E+02	-	1.75E+03	2.23E+02	=	1.81E+03	3.36E+02
F21	2.40E+02	7.08E+00	+	2.32E+02	5.87E+00	=	2.30E+02	7.59E+00	3.63E+02	1.88E+01	+	3.21E+02	1.33E+01	=	3.22E+02	1.76E+01
F22	2.76E+03	2.00E+03	=	3.60E+03	1.30E+03	=	3.35E+03	1.26E+03	1.07E+04	6.26E+02	+	1.06E+04	5.19E+02	+	1.02E+04	9.96E+02
F23	4.78E+02	1.31E+01	+	4.54E+02	6.67E+00	=	4.59E+02	1.57E+01	6.78E+02	4.31E+01	+	6.17E+02	1.37E+01	-	6.37E+02	2.98E+01
F24	5.39E+02	1.07E+01	+	5.28E+02	5.81E+00	=	5.30E+02	8.13E+00	1.03E+03	2.66E+01	+	9.84E+02	2.16E+01	=	9.90E+02	1.92E+01
F25	5.64E+02	3.59E+01	+	5.08E+02	3.31E+01	=	5.10E+02	3.58E+01	7.92E+02	6.98E+01	+	7.35E+02	5.01E+01	=	7.42E+02	4.14E+01
F26	1.74E+03	1.44E+02	+	1.38E+03	8.23E+01	=	1.40E+03	1.08E+02	5.56E+03	4.39E+02	+	4.20E+03	2.41E+02	=	4.18E+03	2.35E+02
F27	6.08E+02	2.99E+01	+	5.48E+02	2.55E+01	+	5.21E+02	9.76E+00	8.31E+02	3.61E+01	+	6.60E+02	2.88E+01	+	6.32E+02	2.49E+01
F28	5.02E+02	1.01E+01	+	4.80E+02	2.38E+01	+	4.67E+02	1.84E+01	5.49E+02	3.47E+01	+	5.16E+02	5.11E+01	=	5.13E+02	5.54E+01
F29	8.90E+02	2.09E+02	+	4.52E+02	7.03E+01	+	3.86E+02	6.73E+01	2.75E+03	4.88E+02	+	2.10E+03	3.08E+02	+	1.75E+03	3.84E+02
F30	7.29E+05	5.51E+04	+	6.85E+05	8.35E+04	+	6.11E+05	3.57E+04	5.75E+03	7.44E+02	+	2.68E+03	2.52E+02	+	2.62E+03	9.90E+02
W	**23**			**16**					**23**			**13**				
T	**4**			**11**					**3**			**12**				
L	**2**			**2**					**3**			**4**				

TABLE S6 PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART STRATEGY UTILIZATION SCHEMES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (10-D)

	Sa			CSM			SCSS			ODF	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F5	1.67E+00	1.13E+00	+	8.72E-01	7.76E-01	=	9.41E-01	9.33E-01	=	8.63E-01	1.00E+00
F6	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F7	1.24E+01	1.03E+00	+	1.15E+01	6.75E-01	=	1.15E+01	6.58E-01	+	1.13E+01	5.15E-01
F8	1.61E+00	1.41E+00	+	6.83E-01	7.01E-01	=	7.65E-01	9.63E-01	=	6.98E-01	6.98E-01
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	3.52E+01	5.48E+01	=	4.64E+01	5.59E+01	=	2.27E+01	3.92E+01	=	2.74E+01	4.28E+01
F11	1.23E-01	4.70E-01	+	1.66E-01	3.77E-01	+	9.99E-10	5.47E-09	=	0.00E+00	0.00E+00
F12	1.13E+02	7.26E+01	+	2.96E+02	2.20E+02	+	4.32E+01	6.95E+01	-	6.70E+01	7.10E+01
F13	3.01E+00	2.50E+00	-	4.50E+00	1.79E+00	-	4.87E+00	1.50E+00	=	4.84E+00	1.69E+00
F14	2.41E-02	5.50E-02	=	2.00E+00	6.10E+00	=	1.65E-01	3.48E-01	+	6.74E-01	3.65E+00
F15	1.34E-01	1.86E-01	=	3.39E-01	1.98E-01	+	1.04E-01	1.91E-01	=	1.24E-01	1.80E-01
F16	8.73E-01	5.15E-01	=	7.94E-01	3.59E-01	=	5.56E-01	2.12E-01	-	8.10E-01	3.48E-01
F17	5.51E-01	2.40E-01	-	7.57E+00	9.72E+00	=	4.18E-01	2.66E-01	-	8.41E-01	3.97E-01
F18	2.21E+00	6.14E+00	-	1.05E+01	1.01E+01	+	1.52E-01	1.80E-01	-	3.00E+00	6.93E+00
F19	1.46E-02	2.73E-02	=	3.84E-01	5.32E-01	+	2.73E-02	2.22E-02	=	3.22E-02	4.53E-02
F20	2.08E-02	7.92E-02	-	5.34E+00	8.99E+00	-	3.12E-02	9.53E-02	-	2.79E-04	8.48E-04
F21	1.73E+02	4.79E+01	=	1.93E+02	2.59E+01	=	1.89E+02	3.56E+01	=	1.73E+02	4.73E+01
F22	1.00E+02	9.94E-02	=	1.00E+02	0.00E+00	-	1.00E+02	1.33E-01	=	1.00E+02	1.54E-01
F23	2.93E+02	5.54E+01	=	3.04E+02	1.89E+00	=	3.02E+02	1.78E+00	-	3.03E+02	1.36E+00
F24	2.93E+02	8.76E+01	=	3.18E+02	4.82E+01	=	2.92E+02	8.72E+01	=	3.16E+02	5.86E+01
F25	4.16E+02	2.27E+01	=	4.36E+02	1.73E+01	+	4.13E+02	2.20E+01	=	4.15E+02	2.26E+01
F26	3.00E+02	0.00E+00	=	3.02E+02	8.61E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00
F27	3.89E+02	1.34E-01	=	3.90E+02	1.66E+00	=	3.89E+02	2.08E-01	=	3.89E+02	1.56E-01
F28	4.59E+02	1.46E+02	=	5.68E+02	9.21E+01	+	4.39E+02	1.51E+02	=	4.33E+02	1.49E+02
F29	2.39E+02	7.23E+00	=	2.47E+02	8.50E+00	+	2.35E+02	3.44E+00	-	2.41E+02	5.51E+00
F30	1.09E+05	2.83E+05	-	1.51E+05	3.50E+05	=	5.49E+04	2.07E+05	-	2.77E+04	1.49E+05
W	**5**			**8**			**2**				
T	**19**			**18**			**19**				
L	**5**			**3**			**8**				

TABLE S6 (CONTINUED) PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART STRATEGY UTILIZATION SCHEMES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (30-D)

	Sa			CSM			SCSS			ODF	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	6.15E+03	1.37E+04
F4	5.57E+01	1.38E+01	-	3.58E+01	2.96E+01	-	5.62E+01	1.45E+01	-	5.90E+01	1.51E+00
F5	1.24E+01	2.97E+00	+	1.26E+01	4.02E+00	+	9.55E+00	2.59E+00	=	1.10E+01	4.85E+00
F6	4.73E-05	7.45E-05	+	1.60E-02	6.33E-02	+	2.02E-05	3.66E-05	+	1.75E-07	3.78E-07
F7	4.20E+01	2.56E+00	=	4.19E+01	3.07E+00	=	4.10E+01	3.04E+00	=	4.12E+01	4.94E+00
F8	1.28E+01	2.55E+00	=	1.40E+01	4.15E+00	+	1.13E+01	3.38E+00	=	1.24E+01	4.84E+00
F9	3.01E-02	9.19E-02	+	2.12E-02	6.92E-02	+	4.25E-02	1.11E-01	+	0.00E+00	0.00E+00
F10	1.45E+03	3.36E+02	=	1.67E+03	3.58E+02	+	1.59E+03	3.40E+02	=	1.49E+03	4.19E+02
F11	4.29E+01	2.80E+01	+	6.81E+01	2.76E+01	+	2.33E+01	1.94E+01	+	2.36E+01	2.78E+01
F12	1.24E+03	3.92E+02	+	1.33E+03	4.04E+02	+	1.08E+03	4.12E+02	+	5.00E+02	2.70E+02
F13	4.19E+01	1.79E+01	+	4.97E+01	2.82E+01	+	3.16E+01	2.80E+01	+	2.22E+01	1.56E+01
F14	3.42E+01	9.20E+00	+	7.60E+01	2.56E+01	+	2.38E+01	5.22E+00	=	2.37E+01	3.60E+00
F15	3.26E+01	1.86E+01	+	8.96E+01	5.20E+01	+	1.24E+01	8.45E+00	+	3.57E+00	1.95E+00
F16	2.82E+02	1.52E+02	+	3.14E+02	1.52E+02	+	2.15E+02	1.44E+02	=	1.82E+02	1.61E+02
F17	4.43E+01	2.44E+01	+	7.84E+01	5.31E+01	+	4.11E+01	1.69E+01	+	3.45E+01	2.81E+01
F18	1.11E+02	7.76E+01	+	1.66E+02	7.46E+01	+	3.10E+01	1.49E+01	+	2.44E+01	1.15E+01
F19	2.26E+01	1.90E+01	+	9.00E+01	4.14E+01	+	8.45E+00	2.22E+00	+	5.98E+00	2.79E+00
F20	7.53E+01	6.43E+01	=	8.59E+01	6.05E+01	=	5.78E+01	5.75E+01	=	7.76E+01	6.15E+01
F21	2.14E+02	3.44E+00	=	2.15E+02	4.50E+00	+	2.11E+02	3.19E+00	-	2.13E+02	4.56E+00
F22	1.00E+02	1.14E-13	=	1.00E+02	1.00E-13	=	1.00E+02	1.25E-13	=	1.00E+02	1.21E-13
F23	3.62E+02	4.84E+00	=	3.68E+02	8.55E+00	+	3.60E+02	6.23E+00	=	3.61E+02	7.07E+00
F24	4.35E+02	3.70E+00	=	4.39E+02	6.61E+00	+	4.34E+02	5.48E+00	-	4.36E+02	5.78E+00
F25	3.87E+02	8.04E-02	+	3.87E+02	5.29E-01	+	3.87E+02	5.08E-02	+	3.87E+02	1.92E-02
F26	1.06E+03	5.47E+01	=	1.13E+03	1.60E+02	+	1.07E+03	6.95E+01	=	1.07E+03	6.58E+01
F27	5.08E+02	7.13E+00	+	5.15E+02	1.04E+01	+	5.05E+02	7.25E+00	=	5.03E+02	5.63E+00
F28	3.47E+02	5.72E+01	+	3.38E+02	5.60E+01	+	3.26E+02	5.15E+01	=	3.24E+02	4.68E+01
F29	4.42E+02	2.09E+01	+	5.02E+02	5.62E+01	+	4.42E+02	1.87E+01	+	4.35E+02	1.55E+01
F30	2.13E+03	1.57E+02	+	2.20E+03	1.85E+02	+	2.11E+03	1.83E+02	+	2.02E+03	9.06E+01
W	**17**			**23**			**12**				
T	**10**			**4**			**13**				
L	**2**			**2**			**4**				

TABLE S6 (CONTINUED) PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART STRATEGY UTILIZATION SCHEMES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (50-D)

	Sa			CSM			SCSS			ODF	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	3.36E-09	2.40E-08	-	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	-	2.34E+04	4.54E+04
F4	5.72E+01	4.44E+01	=	3.96E+01	4.58E+01	-	5.16E+01	4.96E+01	=	5.79E+01	5.06E+01
F5	3.04E+01	5.56E+00	+	4.06E+01	8.92E+00	+	3.09E+01	7.97E+00	+	2.67E+01	5.95E+00
F6	1.49E-03	3.33E-03	+	2.72E-02	3.31E-02	+	6.61E-04	5.98E-04	+	1.37E-05	1.76E-05
F7	7.76E+01	5.80E+00	=	8.18E+01	7.04E+00	+	7.71E+01	6.04E+00	=	7.51E+01	7.98E+00
F8	3.11E+01	5.92E+00	+	3.75E+01	9.41E+00	+	3.04E+01	4.94E+00	+	2.70E+01	7.50E+00
F9	9.44E-01	6.14E-01	+	9.32E-01	1.02E+00	+	6.99E-01	6.38E-01	+	2.13E-02	9.01E-02
F10	2.95E+03	4.59E+02	-	3.56E+03	4.91E+02	+	3.40E+03	5.10E+02	=	3.38E+03	4.80E+02
F11	1.45E+02	4.12E+01	+	1.52E+02	3.49E+01	+	1.20E+02	3.17E+01	+	3.73E+01	8.59E+00
F12	5.26E+03	3.11E+03	=	4.49E+03	2.43E+03	=	5.62E+03	3.41E+03	=	6.83E+03	7.60E+03
F13	4.09E+02	2.70E+02	+	5.73E+02	5.61E+02	+	1.45E+02	7.62E+01	+	6.40E+01	5.19E+01
F14	2.46E+02	7.12E+01	+	2.39E+02	7.76E+01	+	8.44E+01	3.45E+01	+	3.89E+01	1.45E+01
F15	3.91E+02	1.66E+02	+	4.11E+02	1.22E+02	+	1.71E+02	1.00E+02	+	5.87E+01	4.01E+01
F16	6.38E+02	2.12E+02	=	6.61E+02	1.99E+02	=	5.26E+02	1.83E+02	-	6.07E+02	2.10E+02
F17	5.59E+02	1.65E+02	=	5.84E+02	1.82E+02	=	4.92E+02	1.98E+02	=	5.83E+02	2.29E+02
F18	1.90E+02	1.19E+02	+	1.92E+02	1.13E+02	+	1.76E+02	1.14E+02	+	7.42E+01	3.96E+01
F19	1.66E+02	5.13E+01	+	1.36E+02	4.42E+01	+	1.07E+02	4.35E+01	+	2.73E+01	1.22E+01
F20	3.93E+02	1.50E+02	=	3.55E+02	1.64E+02	=	3.78E+02	1.69E+02	=	3.73E+02	1.88E+02
F21	2.30E+02	5.31E+00	=	2.42E+02	9.84E+00	+	2.34E+02	7.15E+00	+	2.30E+02	7.59E+00
F22	2.95E+03	1.57E+03	=	3.90E+03	1.59E+03	+	3.30E+03	1.56E+03	=	3.35E+03	1.26E+03
F23	4.62E+02	1.18E+01	=	4.79E+02	1.39E+01	+	4.62E+02	1.47E+01	=	4.59E+02	1.57E+01
F24	5.32E+02	7.25E+00	=	5.45E+02	1.32E+01	+	5.34E+02	1.13E+01	=	5.30E+02	8.13E+00
F25	5.23E+02	3.33E+01	+	5.31E+02	3.34E+01	+	5.23E+02	3.85E+01	+	5.10E+02	3.58E+01
F26	1.41E+03	1.03E+02	=	1.58E+03	1.43E+02	+	1.47E+03	1.30E+02	+	1.40E+03	1.08E+02
F27	5.65E+02	3.76E+01	+	5.75E+02	3.59E+01	+	5.43E+02	2.57E+01	+	5.21E+02	9.76E+00
F28	4.92E+02	2.25E+01	+	4.97E+02	1.72E+01	+	4.79E+02	2.36E+01	+	4.67E+02	1.84E+01
F29	4.46E+02	8.77E+01	+	7.13E+02	1.57E+02	+	4.40E+02	1.03E+02	+	3.86E+02	6.73E+01
F30	6.87E+05	1.26E+05	+	6.58E+05	7.15E+04	+	6.93E+05	1.16E+05	+	6.11E+05	3.57E+04
W	**15**			**22**			**17**				
T	**12**			**5**			**10**				
L	**2**			**2**			**2**				

TABLE S6 (CONTINUED) PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART STRATEGY UTILIZATION SCHEMES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (100-D)

	Sa			CSM			SCSS			ODF	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	2.83E-09	1.39E-08	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	1.03E-06	7.21E-06	-	2.66E-07	1.90E-06	-	1.79E-05	1.19E-04	-	3.64E+04	8.74E+04
F4	1.16E+02	6.31E+01	=	7.71E+01	7.74E+01	-	1.07E+02	7.16E+01	=	1.12E+02	8.56E+01
F5	1.15E+02	1.79E+01	+	1.41E+02	1.87E+01	+	1.25E+02	2.14E+01	+	8.73E+01	1.51E+01
F6	1.86E-01	1.22E-01	+	9.92E-01	4.90E-01	+	6.44E-02	5.00E-02	+	1.39E-04	1.25E-04
F7	2.21E+02	1.93E+01	+	2.40E+02	2.12E+01	+	2.25E+02	1.96E+01	+	1.86E+02	1.48E+01
F8	1.12E+02	1.67E+01	+	1.38E+02	2.35E+01	+	1.21E+02	2.32E+01	+	9.06E+01	1.57E+01
F9	3.47E+01	2.07E+01	+	5.12E+01	4.84E+01	+	1.73E+01	7.47E+00	+	1.32E+00	1.13E+00
F10	8.89E+03	8.33E+02	-	1.05E+04	1.15E+03	+	9.69E+03	1.01E+03	+	9.37E+03	9.58E+02
F11	1.11E+03	2.63E+02	+	1.19E+03	2.26E+02	+	1.09E+03	2.37E+02	+	3.60E+02	1.10E+02
F12	2.02E+04	2.65E+04	-	1.51E+04	8.60E+03	-	1.98E+04	1.10E+04	-	3.16E+04	1.91E+04
F13	6.33E+02	9.45E+02	+	1.08E+03	1.36E+03	+	2.57E+02	1.69E+02	+	9.75E+01	5.43E+01
F14	5.84E+02	2.02E+02	+	4.68E+02	1.36E+02	+	6.59E+02	1.71E+02	+	2.13E+02	1.09E+02
F15	3.39E+02	8.47E+01	+	2.79E+02	6.61E+01	+	3.47E+02	1.11E+02	+	1.95E+02	2.11E+02
F16	2.16E+03	3.87E+02	=	2.57E+03	5.71E+02	+	2.19E+03	4.69E+02	=	2.21E+03	4.98E+02
F17	2.01E+03	2.83E+02	+	2.10E+03	3.63E+02	+	1.89E+03	3.49E+02	+	1.75E+03	3.60E+02
F18	1.60E+03	1.22E+03	-	1.06E+03	8.98E+02	-	2.12E+03	2.02E+03	-	4.26E+03	4.64E+03
F19	4.58E+02	6.82E+02	+	2.34E+02	4.58E+01	+	2.39E+02	5.38E+01	+	6.79E+02	1.76E+03
F20	1.80E+03	3.78E+02	=	1.89E+03	4.30E+02	=	1.80E+03	3.29E+02	=	1.81E+03	3.36E+02
F21	3.42E+02	1.68E+01	+	3.72E+02	1.82E+01	+	3.50E+02	2.32E+01	+	3.22E+02	1.76E+01
F22	1.02E+04	1.72E+03	=	1.20E+04	1.26E+03	+	1.09E+04	9.84E+02	+	1.02E+04	9.96E+02
F23	6.33E+02	2.54E+01	=	7.22E+02	3.57E+01	+	6.69E+02	3.62E+01	+	6.37E+02	2.98E+01
F24	1.02E+03	3.00E+01	+	1.07E+03	3.19E+01	+	1.02E+03	2.92E+01	+	9.90E+02	1.92E+01
F25	7.36E+02	5.20E+01	=	7.35E+02	5.90E+01	=	7.41E+02	4.42E+01	=	7.42E+02	4.14E+01
F26	4.63E+03	3.14E+02	+	5.08E+03	3.37E+02	+	4.56E+03	2.88E+02	+	4.18E+03	2.35E+02
F27	6.81E+02	2.83E+01	+	7.44E+02	4.82E+01	+	6.74E+02	2.90E+01	+	6.32E+02	2.49E+01
F28	5.20E+02	3.45E+01	=	5.28E+02	4.39E+01	=	5.12E+02	3.50E+01	=	5.13E+02	5.54E+01
F29	2.07E+03	3.85E+02	+	2.77E+03	4.70E+02	+	1.98E+03	3.73E+02	+	1.75E+03	3.84E+02
F30	2.76E+03	5.94E+02	+	2.63E+03	2.18E+02	+	2.60E+03	2.53E+02	=	2.62E+03	9.90E+02
W	**17**			**21**			**19**				
T	**8**			**4**			**7**				
L	**4**			**4**			**3**				

TABLE S7 PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART STRATEGY UTILIZATION SCHEMES ON TEN REAL-WORLD PROBLEMS OVER 30 INDEPENDENT RUNS

	Sa			CSM			SCSS			ODF	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
Parameter Estimation for Frequency Modulated (FM) Sound Waves	2.35E+00	3.89E+00	=	5.63E+00	5.79E+00	=	5.69E-01	2.09E+00	-	1.97E+00	3.97E+00
Tersoff Potential for model Si (C)	-2.90E+01	1.12E+00	+	-2.89E+01	5.97E-01	=	-2.89E+01	6.00E-01	+	-2.92E+01	1.02E-08
Spread Spectrum Radar Polly phase Code Design	1.04E+00	1.23E-01	=	9.80E-01	2.67E-01	=	1.09E+00	1.40E-01	=	1.06E+00	1.30E-01
Large Scale Transmission Pricing Problem	2.66E+03	7.93E+02	+	2.09E+03	1.05E+03	+	1.54E+03	4.90E+02	=	1.57E+03	4.33E+02
DED instance 1	5.21E+04	6.62E+02	=	5.24E+04	5.52E+02	+	5.23E+04	5.57E+02	+	5.19E+04	6.73E+02
DED instance 2	1.07E+06	2.18E+03	+	1.07E+06	1.83E+03	+	1.07E+06	2.17E+03	=	1.07E+06	2.13E+03
Hydrothermal Scheduling Instance 1	9.40E+05	2.69E+03	+	9.40E+05	2.79E+03	+	9.38E+05	3.32E+03	+	9.37E+05	2.02E+03
Hydrothermal Scheduling Instance 2	9.45E+05	5.41E+03	+	9.43E+05	2.74E+03	=	9.43E+05	3.22E+03	=	9.48E+05	3.48E+04
Hydrothermal Scheduling Instance 3	9.39E+05	2.54E+03	+	9.40E+05	2.47E+03	+	9.39E+05	2.64E+03	+	9.36E+05	2.07E+03
Cassini 2: Spacecraft Trajectory Optimization Problem	1.69E+01	2.41E+00	=	1.88E+01	2.24E+00	+	1.63E+01	2.66E+00	=	1.65E+01	2.84E+00
W	**6**			**6**			**4**				
T	**4**			**4**			**5**				
L	**0**			**0**			**1**				

TABLE S8 CONTRIBUTION OF SEiLER MECHANISM IN THE REAL-WORLD OPTIMIZATION

	reverse			random			ODF	
	mean	std	sig	mean	std	sig	mean	std
Parameter Estimation for Frequency Modulated (FM) Sound Waves	2.02E+00	4.09E+00	=	1.82E+00	4.11E+00	=	1.97E+00	3.97E+00
Tersoff Potential for model Si (C)	-2.91E+01	3.20E-01	+	-2.91E+01	4.41E-01	=	-2.92E+01	1.02E-08
Spread Spectrum Radar Polly phase Code Design	1.16E+00	1.28E-01	+	1.12E+00	1.03E-01	+	1.06E+00	1.30E-01
Large Scale Transmission Pricing Problem	2.04E+03	6.77E+02	+	1.62E+03	3.22E+02	=	1.57E+03	4.33E+02
DED instance 1	5.20E+04	5.78E+02	=	5.21E+04	4.61E+02	+	5.19E+04	6.73E+02
DED instance 2	1.07E+06	2.05E+03	+	1.07E+06	1.55E+03	=	1.07E+06	2.13E+03
Hydrothermal Scheduling Instance 1	9.38E+05	2.74E+03	+	9.38E+05	3.05E+03	+	9.37E+05	2.02E+03
Hydrothermal Scheduling Instance 2	9.42E+05	3.32E+03	=	9.50E+05	3.41E+04	=	9.48E+05	3.48E+04
Hydrothermal Scheduling Instance 3	9.39E+05	2.47E+03	+	9.38E+05	3.22E+03	+	9.36E+05	2.07E+03
Cassini 2: Spacecraft Trajectory Optimization Problem	1.68E+01	3.01E+00	=	1.65E+01	2.78E+00	=	1.65E+01	2.84E+00
W	**6**			**4**				
T	**4**			**6**				
L	**0**			**0**				

TABLE S9 PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (10-D)

	L-SHADE			SCSS-L-SHADE			ODF-SCSS-L-SHADE		jSO			SCSS-jSO			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F5	2.69E+00	9.10E-01	+	3.12E+00	1.16E+00	+	9.95E-01	9.42E-01	1.63E+00	7.15E-01	+	1.60E+00	4.91E-01	+	8.78E-01	7.87E-01
F6	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	2.79E-08	1.99E-07
F7	1.22E+01	6.87E-01	+	1.27E+01	1.14E+00	+	1.15E+01	6.66E-01	1.19E+01	5.58E-01	=	1.22E+01	6.95E-01	+	1.15E+01	4.65E-01
F8	2.59E+00	1.06E+00	+	2.59E+00	8.06E-01	+	1.09E+00	1.18E+00	1.96E+00	8.05E-01	+	1.39E+00	5.29E-01	=	1.17E+00	9.46E-01
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	2.20E+01	3.76E+01	=	1.88E+01	3.73E+01	-	3.15E+01	4.47E+01	4.71E+01	8.02E+01	=	1.30E+01	1.04E+01	=	1.57E+01	4.21E+01
F11	3.03E-01	6.31E-01	=	3.76E-01	6.58E-01	=	2.03E-01	4.35E-01	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F12	2.20E+01	4.98E+01	-	1.00E+00	2.83E+00	-	2.54E+01	5.02E+01	8.35E+00	3.04E+01	=	4.90E-01	1.00E-01	+	3.06E-01	1.58E-01
F13	3.92E+00	2.08E+00	=	3.38E+00	2.31E+00	=	3.31E+00	2.58E+00	2.51E+00	2.33E+00	-	1.90E+00	2.39E+00	-	3.74E+00	2.04E+00
F14	3.31E-01	6.55E-01	=	3.74E-01	7.07E-01	=	3.03E-02	6.32E-02	1.66E-01	3.77E-01	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F15	1.51E-01	2.03E-01	=	5.43E-02	1.23E-01	-	2.09E-01	2.21E-01	3.64E-01	2.03E-01	=	2.91E-01	2.26E-01	=	3.39E-01	1.93E-01
F16	3.79E-01	2.35E-01	=	4.58E-01	1.66E-01	=	4.29E-01	1.87E-01	6.12E-01	2.92E-01	+	4.01E-01	2.80E-01	-	6.19E-01	1.70E-01
F17	1.73E-01	1.40E-01	=	1.89E-01	1.39E-01	=	1.28E-01	3.10E-01	4.16E-01	4.68E-01	-	4.86E-01	3.89E-01	-	1.02E+00	2.89E+00
F18	2.29E-01	2.16E-01	=	2.83E-01	2.15E-01	=	2.12E-01	2.01E-01	2.52E-01	2.30E-01	-	3.05E-01	1.01E-01	-	7.35E-01	2.77E+00
F19	8.45E-03	1.03E-02	=	9.96E-03	9.04E-03	=	1.10E-02	1.40E-02	9.76E-03	1.33E-02	+	9.98E-03	1.72E-02	+	1.26E-02	1.47E-02
F20	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	3.43E-01	1.50E-01	-	3.86E-01	1.34E-01	-	4.47E-01	2.09E-01
F21	1.55E+02	5.26E+01	=	1.45E+02	5.25E+01	=	1.38E+02	5.24E+01	1.55E+02	5.04E+01	-	1.43E+02	5.21E+01	=	1.62E+02	5.06E+01
F22	1.00E+02	8.30E-14	=	9.34E+01	2.54E+01	=	1.00E+02	8.30E-14	1.00E+02	2.27E-13	=	1.00E+02	1.95E-13	=	1.00E+02	4.06E-02
F23	3.03E+02	1.46E+00	=	3.03E+02	1.68E+00	=	3.03E+02	1.54E+00	3.01E+02	1.64E+00	-	3.01E+02	1.30E+00	=	3.01E+02	1.41E+00
F24	3.08E+02	7.03E+01	=	3.01E+02	8.00E+01	+	2.84E+02	9.38E+01	3.00E+02	7.96E+01	+	2.76E+02	9.85E+01	+	3.11E+02	6.22E+01
F25	4.10E+02	2.04E+01	=	4.13E+02	2.20E+01	=	4.15E+02	2.25E+01	4.09E+02	1.95E+01	=	3.98E+02	1.15E-02	-	4.13E+02	2.16E+01
F26	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00
F27	3.89E+02	2.12E-01	=	3.89E+02	1.59E-01	=	3.89E+02	5.05E-01	3.89E+02	1.79E-01	+	3.90E+02	0.00E+00	+	3.89E+02	1.39E-01
F28	3.59E+02	1.19E+02	=	3.51E+02	1.16E+02	+	3.10E+02	5.69E+01	3.50E+02	1.14E+02	-	4.28E+02	1.55E+02	=	3.93E+02	1.40E+02
F29	2.34E+02	2.63E+00	=	2.32E+02	2.41E+00	-	2.35E+02	3.55E+00	2.35E+02	4.06E+00	=	2.36E+02	4.11E+00	=	2.35E+02	3.00E+00
F30	4.07E+02	2.38E+01	-	3.96E+02	8.79E+00	-	4.10E+02	2.39E+01	3.95E+02	6.60E-02	=	3.95E+02	3.99E-04	-	1.64E+04	1.14E+05
W	**3**			**5**					**7**			**6**				
T	**24**			**19**					**15**			**16**				
L	**2**			**5**					**7**			**7**				

TABLE S9 (CONTINUED) PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (30-D)

	L-SHADE			SCSS-L-SHADE			ODF-SCSS-L-SHADE		jSO			SCSS-jSO			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	5.86E+01	2.35E-14	+	5.86E+01	2.17E-14	+	5.86E+01	3.63E-13	5.86E+01	1.83E-14	+	5.86E+01	2.67E-14	+	5.86E+01	0.00E+00
F5	6.41E+00	1.71E+00	+	6.62E+00	1.43E+00	+	2.70E+00	2.89E+00	9.05E+00	1.97E+00	+	7.43E+00	2.27E+00	+	4.24E+00	1.86E+00
F6	4.56E-09	2.50E-08	=	0.00E+00	0.00E+00	=	6.93E-09	2.63E-08	1.37E-08	4.18E-08	-	1.74E-08	4.45E-08	=	7.61E-08	2.28E-07
F7	3.81E+01	1.68E+00	+	3.85E+01	1.86E+00	+	3.69E+01	3.02E+00	3.89E+01	1.89E+00	+	3.77E+01	1.67E+00	+	3.61E+01	1.27E+00
F8	8.40E+00	2.12E+00	+	7.14E+00	2.26E+00	+	3.06E+00	2.62E+00	8.82E+00	2.15E+00	+	8.47E+00	1.97E+00	+	4.54E+00	2.37E+00
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	1.48E+03	2.26E+02	=	1.48E+03	1.67E+02	+	1.36E+03	3.94E+02	1.57E+03	2.15E+02	=	1.48E+03	2.49E+02	=	1.47E+03	2.26E+02
F11	2.71E+01	2.90E+01	=	2.73E+01	2.87E+01	=	2.60E+01	2.89E+01	8.60E+00	1.79E+01	=	4.21E+00	8.21E+00	=	1.05E+01	2.02E+01
F12	6.21E+02	2.81E+02	+	5.46E+02	2.58E+02	+	2.68E+02	1.90E+02	1.63E+02	1.15E+02	+	9.58E+01	5.98E+01	=	1.40E+02	1.14E+02
F13	1.53E+01	5.74E+00	=	1.53E+01	5.41E+00	-	1.78E+01	5.53E+00	1.58E+01	5.51E+00	=	1.64E+01	4.90E+00	=	1.67E+01	3.89E+00
F14	2.10E+01	6.41E+00	=	2.09E+01	6.40E+00	=	2.09E+01	5.75E+00	2.20E+01	1.14E+00	+	2.10E+01	3.60E+00	+	2.05E+01	3.04E+00
F15	1.90E+00	1.38E+00	=	1.90E+00	1.58E+00	=	1.70E+00	1.28E+00	1.49E+00	9.75E-01	+	1.09E+00	6.67E-01	+	5.86E-01	4.97E-01
F16	3.11E+01	2.42E+01	=	4.51E+01	5.64E+01	+	8.40E+01	1.47E+02	8.32E+01	8.90E+01	+	4.95E+01	6.42E+01	+	2.54E+01	3.60E+01
F17	3.46E+01	5.69E+00	+	3.50E+01	4.84E+00	+	2.87E+01	1.08E+01	3.26E+01	8.37E+00	=	3.31E+01	7.22E+00	+	3.06E+01	6.27E+00
F18	2.10E+01	6.59E-01	-	2.10E+01	6.43E-01	-	2.20E+01	1.76E+00	2.08E+01	3.78E-01	=	2.04E+01	2.86E+00	=	2.08E+01	2.93E-01
F19	5.17E+00	1.94E+00	=	4.72E+00	1.06E+00	=	5.99E+00	2.54E+00	4.48E+00	1.45E+00	+	3.92E+00	1.53E+00	+	3.55E+00	1.21E+00
F20	3.03E+01	6.43E+00	+	2.91E+01	6.33E+00	+	2.83E+01	2.38E+01	2.97E+01	8.35E+00	=	2.94E+01	7.48E+00	=	3.00E+01	4.72E+00
F21	2.08E+02	2.16E+00	+	2.08E+02	2.10E+00	+	2.04E+02	1.61E+00	2.09E+02	1.94E+00	+	2.08E+02	2.02E+00	+	2.05E+02	2.24E+00
F22	1.00E+02	0.00E+00	+	1.00E+02	0.00E+00	+	1.00E+02	1.96E-13	1.00E+02	8.30E-14	=	1.00E+02	6.39E-14	=	1.00E+02	1.44E-14
F23	3.50E+02	2.11E+00	=	3.51E+02	3.21E+00	=	3.50E+02	5.89E+00	3.51E+02	2.63E+00	=	3.50E+02	3.21E+00	=	3.49E+02	3.02E+00
F24	4.25E+02	2.00E+00	-	4.26E+02	1.89E+00	-	4.28E+02	3.26E+00	4.27E+02	2.40E+00	+	4.26E+02	2.72E+00	+	4.25E+02	1.85E+00
F25	3.87E+02	1.54E-02	=	3.87E+02	1.47E-02	=	3.87E+02	1.68E-02	3.87E+02	6.80E-03	=	3.87E+02	7.28E-03	-	3.87E+02	6.39E-03
F26	9.17E+02	3.83E+01	-	9.06E+02	3.72E+01	-	9.48E+02	4.81E+01	9.16E+02	2.87E+01	-	9.47E+02	4.84E+01	=	9.48E+02	5.41E+01
F27	5.01E+02	6.56E+00	=	5.02E+02	7.05E+00	=	5.01E+02	6.12E+00	4.94E+02	7.27E+00	-	4.95E+02	7.49E+00	-	4.99E+02	4.91E+00
F28	3.36E+02	5.22E+01	+	3.21E+02	4.35E+01	+	3.07E+02	2.76E+01	3.04E+02	2.08E+01	=	3.04E+02	2.23E+01	=	3.07E+02	2.71E+01
F29	4.36E+02	5.96E+00	+	4.36E+02	5.38E+00	+	4.29E+02	7.66E+00	4.36E+02	9.74E+00	=	4.33E+02	1.76E+01	=	4.36E+02	7.96E+00
F30	1.98E+03	4.54E+01	=	1.96E+03	2.50E+01	=	1.96E+03	4.84E+01	1.97E+03	1.05E+01	=	1.97E+03	1.06E+01	-	1.98E+03	2.65E+01
W	**11**			**13**					**11**			**11**				
T	**15**			**12**					**15**			**15**				
L	**3**			**4**					**3**			**3**				

TABLE S9 (CONTINUED)PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (50-D)

	L-SHADE			SCSS-L-SHADE			ODF-SCSS-L-SHADE		jSO			SCSS-jSO			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	7.06E+01	5.10E+01	=	9.41E+01	4.75E+01	=	8.44E+01	5.15E+01	5.35E+01	4.59E+01	=	5.12E+01	4.54E+01	=	3.43E+01	2.87E+01
F5	1.18E+01	1.86E+00	+	1.18E+01	2.69E+00	+	6.90E+00	4.06E+00	1.52E+01	3.41E+00	+	1.25E+01	2.10E+00	+	7.55E+00	2.39E+00
F6	8.81E-05	2.75E-04	+	1.39E-08	2.26E-08	=	6.36E-08	1.04E-07	5.94E-07	9.67E-07	=	2.54E-07	6.70E-07	-	9.24E-07	1.54E-06
F7	6.36E+01	2.28E+00	=	6.29E+01	1.79E+00	=	6.38E+01	5.00E+00	6.59E+01	3.00E+00	+	6.31E+01	2.26E+00	+	6.04E+01	1.80E+00
F8	1.25E+01	1.82E+00	+	1.18E+01	1.99E+00	+	6.86E+00	3.74E+00	1.61E+01	2.91E+00	+	1.20E+01	2.85E+00	+	7.59E+00	2.87E+00
F9	0.00E+00	0.00E+00	=	3.41E-14	5.30E-14	+	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	3.16E+03	3.35E+02	=	3.25E+03	3.40E+02	=	3.12E+03	5.59E+02	3.14E+03	4.18E+02	+	3.15E+03	3.13E+02	+	3.02E+03	2.76E+02
F11	5.00E+01	7.92E+00	+	3.19E+01	5.70E+00	+	2.64E+01	3.64E+00	2.83E+01	3.18E+00	+	2.46E+01	3.96E+00	+	2.37E+01	3.85E+00
F12	2.01E+03	6.39E+02	+	2.17E+03	5.01E+02	+	1.55E+03	6.47E+02	1.55E+03	4.93E+02	+	1.43E+03	3.88E+02	+	1.16E+03	3.34E+02
F13	6.21E+01	3.17E+01	+	5.39E+01	3.14E+01	+	2.41E+01	1.54E+01	3.20E+01	2.61E+01	+	2.80E+01	1.71E+01	+	1.59E+01	1.57E+01
F14	2.89E+01	3.21E+00	+	2.61E+01	2.53E+00	=	2.53E+01	2.30E+00	2.43E+01	2.24E+00	+	2.45E+01	1.94E+00	+	2.33E+01	1.67E+00
F15	4.22E+01	1.18E+01	+	2.65E+01	3.25E+00	+	2.43E+01	2.91E+00	2.33E+01	2.66E+00	+	2.10E+01	2.03E+00	+	1.90E+01	1.29E+00
F16	3.71E+02	1.17E+02	=	3.88E+02	1.11E+02	=	4.32E+02	2.31E+02	4.37E+02	1.41E+02	+	3.68E+02	1.37E+02	=	3.04E+02	1.38E+02
F17	2.22E+02	7.31E+01	=	2.37E+02	8.19E+01	=	2.09E+02	1.37E+02	2.82E+02	1.11E+02	+	2.63E+02	9.68E+01	+	1.97E+02	9.01E+01
F18	3.99E+01	9.47E+00	+	2.76E+01	3.62E+00	-	3.56E+01	1.00E+01	2.48E+01	2.07E+00	+	2.25E+01	1.21E+00	=	2.22E+01	1.30E+00
F19	2.57E+01	7.84E+00	+	1.52E+01	2.67E+00	=	1.40E+01	3.22E+00	1.31E+01	3.21E+00	+	1.07E+01	2.57E+00	+	9.29E+00	2.19E+00
F20	1.58E+02	6.92E+01	-	1.77E+02	7.25E+01	=	2.61E+02	1.76E+02	1.22E+02	5.46E+01	=	1.26E+02	7.16E+01	=	1.24E+02	5.74E+01
F21	2.12E+02	2.36E+00	+	2.12E+02	2.30E+00	+	2.07E+02	3.45E+00	2.17E+02	3.54E+00	+	2.14E+02	3.00E+00	+	2.08E+02	2.43E+00
F22	2.30E+03	1.61E+03	-	2.04E+03	1.80E+03	=	3.18E+03	1.32E+03	2.26E+03	1.81E+03	=	2.30E+03	1.73E+03	=	2.55E+03	1.61E+03
F23	4.30E+02	3.76E+00	=	4.27E+02	5.32E+00	-	4.33E+02	8.25E+00	4.32E+02	6.93E+00	=	4.29E+02	5.64E+00	-	4.32E+02	8.35E+00
F24	5.07E+02	2.63E+00	-	5.06E+02	2.79E+00	-	5.09E+02	3.54E+00	5.07E+02	3.50E+00	=	5.06E+02	4.45E+00	=	5.08E+02	3.28E+00
F25	4.87E+02	2.08E+01	+	4.84E+02	1.52E+01	=	4.81E+02	2.11E+00	4.82E+02	4.00E+00	=	4.81E+02	3.48E+00	-	4.81E+02	2.27E+00
F26	1.14E+03	5.27E+01	=	1.14E+03	5.99E+01	=	1.12E+03	5.13E+01	1.13E+03	4.36E+01	=	1.12E+03	5.46E+01	=	1.12E+03	5.50E+01
F27	5.32E+02	1.63E+01	=	5.30E+02	1.84E+01	=	5.24E+02	1.23E+01	5.15E+02	1.92E+01	+	5.10E+02	1.06E+01	+	5.05E+02	6.72E+00
F28	4.72E+02	2.20E+01	+	4.62E+02	1.24E+01	=	4.62E+02	1.24E+01	4.59E+02	3.47E-13	-	4.59E+02	1.95E-13	-	4.59E+02	2.10E-13
F29	3.53E+02	8.37E+00	=	3.61E+02	1.27E+01	+	3.53E+02	1.59E+01	3.64E+02	1.83E+01	=	3.67E+02	1.69E+01	+	3.63E+02	1.23E+01
F30	6.62E+05	7.24E+04	=	6.41E+05	4.70E+04	=	6.44E+05	6.78E+04	6.13E+05	3.88E+04	=	6.05E+05	2.67E+04	=	5.98E+05	2.40E+04
W	**13**			**9**					**15**			**14**				
T	**13**			**17**					**13**			**11**				
L	**3**			**3**					**1**			**4**				

TABLE S9 (CONTINUED) PERFORMANCE COMPARISONS OF ODF WITH STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (100-D)

	L-SHADE			SCSS-L-SHADE			ODF-SCSS-L-SHADE		jSO			SCSS-jSO			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	1.12E-06	1.56E-06	-	1.07E-04	1.39E-04	+	4.25E-05	6.54E-05	2.01E-06	1.94E-06	+	1.18E-04	1.15E-04	+	2.16E-07	2.79E-07
F4	1.96E+02	1.85E+01	=	1.98E+02	8.34E+00	=	1.98E+02	6.39E+00	1.96E+02	1.52E+01	=	2.01E+02	1.13E+01	=	2.03E+02	9.86E+00
F5	3.79E+01	5.07E+00	+	2.96E+01	3.89E+00	+	1.85E+01	4.30E+00	3.95E+01	6.67E+00	+	2.91E+01	4.88E+00	+	1.83E+01	5.20E+00
F6	6.65E-03	4.89E-03	+	2.51E-03	1.66E-03	+	1.59E-03	1.10E-03	2.78E-04	5.65E-04	+	3.01E-05	9.55E-05	-	2.86E-05	1.53E-05
F7	1.42E+02	3.93E+00	+	1.31E+02	3.73E+00	+	1.25E+02	6.87E+00	1.41E+02	5.69E+00	+	1.25E+02	3.79E+00	+	1.20E+02	3.72E+00
F8	3.95E+01	3.99E+00	+	2.71E+01	3.98E+00	+	1.91E+01	5.89E+00	4.29E+01	6.01E+00	+	2.80E+01	5.87E+00	+	1.68E+01	2.96E+00
F9	4.91E-01	4.97E-01	+	1.57E-01	2.62E-01	+	6.63E-02	1.37E-01	3.90E-02	9.11E-02	+	3.51E-03	1.76E-02	=	0.00E+00	0.00E+00
F10	1.03E+04	4.66E+02	+	1.00E+04	4.94E+02	=	9.65E+03	1.32E+03	9.60E+03	6.55E+02	+	9.26E+03	5.30E+02	+	9.04E+03	5.91E+02
F11	4.60E+02	1.06E+02	+	1.68E+02	5.94E+01	+	7.05E+01	2.80E+01	1.09E+02	3.57E+01	+	6.93E+01	2.96E+01	+	2.80E+01	1.98E+01
F12	2.14E+04	9.24E+03	+	1.56E+04	6.30E+03	+	1.11E+04	4.55E+03	1.81E+04	7.11E+03	+	1.17E+04	4.97E+03	=	1.16E+04	4.00E+03
F13	5.38E+02	3.65E+02	+	1.67E+02	4.39E+01	-	3.27E+02	1.35E+02	1.56E+02	3.72E+01	+	1.10E+02	2.93E+01	+	6.33E+01	2.65E+01
F14	2.51E+02	3.34E+01	+	9.13E+01	2.14E+01	=	8.93E+01	1.89E+01	6.34E+01	1.00E+01	+	3.95E+01	4.80E+00	+	3.44E+01	4.11E+00
F15	2.43E+02	4.95E+01	+	2.47E+02	5.78E+01	+	1.23E+02	4.91E+01	1.58E+02	3.57E+01	+	8.82E+01	3.01E+01	+	4.51E+01	2.42E+01
F16	1.77E+03	2.23E+02	+	1.56E+03	2.50E+02	=	1.41E+03	4.47E+02	1.83E+03	3.84E+02	+	1.67E+03	3.19E+02	+	1.47E+03	2.91E+02
F17	1.18E+03	2.21E+02	-	1.03E+03	1.89E+02	-	1.37E+03	4.15E+02	1.28E+03	2.79E+02	+	1.11E+03	2.68E+02	=	9.79E+02	2.28E+02
F18	2.23E+02	4.86E+01	=	2.19E+02	4.67E+01	=	2.39E+02	5.50E+01	1.76E+02	3.81E+01	+	1.15E+02	3.36E+01	+	6.85E+01	2.15E+01
F19	1.77E+02	1.92E+01	+	1.68E+02	2.58E+01	+	5.98E+01	1.09E+01	1.08E+02	1.75E+01	+	5.13E+01	6.23E+00	+	4.20E+01	4.51E+00
F20	1.56E+03	2.19E+02	=	1.50E+03	1.84E+02	=	1.44E+03	3.98E+02	1.44E+03	2.57E+02	+	1.29E+03	1.87E+02	=	1.18E+03	2.23E+02
F21	2.59E+02	7.65E+00	+	2.51E+02	4.11E+00	+	2.44E+02	6.34E+00	2.64E+02	5.99E+00	+	2.50E+02	5.30E+00	+	2.44E+02	4.00E+00
F22	1.13E+04	4.09E+02	+	1.09E+04	4.72E+02	+	9.84E+03	1.07E+03	1.04E+04	2.03E+03	+	1.01E+04	7.59E+02	+	9.71E+03	6.13E+02
F23	5.70E+02	8.49E+00	+	5.61E+02	9.69E+00	=	5.58E+02	9.60E+00	5.65E+02	1.42E+01	=	5.69E+02	1.04E+01	=	5.65E+02	1.01E+01
F24	9.10E+02	6.00E+00	+	9.04E+02	6.86E+00	=	9.02E+02	6.55E+00	9.02E+02	8.60E+00	+	8.97E+02	8.81E+00	=	8.95E+02	6.51E+00
F25	7.37E+02	3.95E+01	=	7.33E+02	3.43E+01	=	7.27E+02	3.62E+01	7.38E+02	4.31E+01	+	7.01E+02	4.37E+01	=	7.05E+02	3.96E+01
F26	3.31E+03	9.05E+01	+	3.22E+03	8.21E+01	=	3.21E+03	9.62E+01	3.22E+03	1.02E+02	+	3.10E+03	9.54E+01	=	3.11E+03	7.81E+01
F27	6.28E+02	2.03E+01	=	6.19E+02	1.94E+01	=	6.20E+02	2.11E+01	5.82E+02	2.15E+01	+	5.75E+02	2.10E+01	+	5.67E+02	1.61E+01
F28	5.27E+02	2.75E+01	-	5.30E+02	2.22E+01	=	5.35E+02	2.69E+01	5.36E+02	2.74E+01	+	5.21E+02	2.57E+01	=	5.19E+02	1.27E+01
F29	1.18E+03	1.81E+02	=	1.30E+03	1.65E+02	=	1.26E+03	2.79E+02	1.27E+03	1.91E+02	+	1.23E+03	1.90E+02	+	1.09E+03	1.57E+02
F30	2.44E+03	1.51E+02	=	2.33E+03	1.15E+02	-	2.47E+03	2.03E+02	2.27E+03	1.02E+02	=	2.28E+03	1.03E+02	=	2.34E+03	1.56E+02
W	**18**			**12**					**25**			**16**				
T	**8**			**14**					**4**			**12**				
L	**3**			**3**					**0**			**1**				

TABLE S10 THE BEST, WORST, MEDIAN, MEAN AND STANDARD DEVIATION VALUES OBTAINED BY ODF-SCSS-JSO ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS

	10-D					30-D				
	best	worst	median	mean	std	best	worst	median	mean	std
F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.86E+01	5.86E+01	5.86E+01	5.86E+01	0.00E+00
F5	0.00E+00	1.99E+00	9.95E-01	8.78E-01	7.87E-01	1.50E-08	8.08E+00	3.99E+00	4.24E+00	1.86E+00
F6	0.00E+00	1.42E-06	0.00E+00	2.79E-08	1.99E-07	0.00E+00	1.09E-06	0.00E+00	7.61E-08	2.28E-07
F7	1.07E+01	1.26E+01	1.14E+01	1.15E+01	4.65E-01	3.34E+01	4.00E+01	3.61E+01	3.61E+01	1.27E+00
F8	0.00E+00	2.99E+00	9.95E-01	1.17E+00	9.46E-01	0.00E+00	9.36E+00	4.00E+00	4.54E+00	2.37E+00
F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F10	1.87E-01	2.29E+02	3.66E+00	1.57E+01	4.21E+01	1.01E+03	1.90E+03	1.51E+03	1.47E+03	2.26E+02
F11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E+01	3.99E+00	1.05E+01	2.02E+01
F12	0.00E+00	6.24E-01	2.08E-01	3.06E-01	1.58E-01	3.79E+00	5.41E+02	1.30E+02	1.40E+02	1.14E+02
F13	0.00E+00	5.39E+00	4.84E+00	3.74E+00	2.04E+00	9.97E-01	2.33E+01	1.69E+01	1.67E+01	3.89E+00
F14	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.70E-02	2.28E+01	2.10E+01	2.05E+01	3.04E+00
F15	1.69E-02	5.00E-01	4.82E-01	3.39E-01	1.93E-01	2.75E-01	2.41E+00	4.07E-01	5.86E-01	4.97E-01
F16	2.71E-01	1.09E+00	5.59E-01	6.19E-01	1.70E-01	4.70E+00	2.64E+02	1.80E+01	2.54E+01	3.60E+01
F17	3.18E-02	2.10E+01	6.39E-01	1.02E+00	2.89E+00	1.12E+01	4.56E+01	3.12E+01	3.06E+01	6.27E+00
F18	5.55E-06	2.01E+01	4.83E-01	7.35E-01	2.77E+00	2.05E+01	2.21E+01	2.07E+01	2.08E+01	2.93E-01
F19	0.00E+00	3.92E-02	2.35E-05	1.26E-02	1.47E-02	2.06E+00	7.32E+00	3.29E+00	3.55E+00	1.21E+00
F20	0.00E+00	6.24E-01	6.24E-01	4.47E-01	2.09E-01	1.26E+01	3.97E+01	3.00E+01	3.00E+01	4.72E+00
F21	1.00E+02	2.05E+02	2.02E+02	1.62E+02	5.06E+01	2.00E+02	2.09E+02	2.05E+02	2.05E+02	2.24E+00
F22	1.00E+02	1.00E+02	1.00E+02	1.00E+02	4.06E-02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.44E-14
F23	3.00E+02	3.04E+02	3.00E+02	3.01E+02	1.41E+00	3.42E+02	3.56E+02	3.49E+02	3.49E+02	3.02E+00
F24	1.00E+02	3.33E+02	3.30E+02	3.11E+02	6.22E+01	4.21E+02	4.28E+02	4.25E+02	4.25E+02	1.85E+00
F25	3.98E+02	4.46E+02	3.98E+02	4.13E+02	2.16E+01	3.87E+02	3.87E+02	3.87E+02	3.87E+02	6.39E-03
F26	3.00E+02	3.00E+02	3.00E+02	3.00E+02	0.00E+00	8.55E+02	1.10E+03	9.47E+02	9.48E+02	5.41E+01
F27	3.89E+02	3.90E+02	3.90E+02	3.89E+02	1.39E-01	4.91E+02	5.08E+02	4.99E+02	4.99E+02	4.91E+00
F28	3.00E+02	6.12E+02	3.00E+02	3.93E+02	1.40E+02	3.00E+02	4.14E+02	3.00E+02	3.07E+02	2.71E+01
F29	2.30E+02	2.42E+02	2.35E+02	2.35E+02	3.00E+00	4.16E+02	4.54E+02	4.37E+02	4.36E+02	7.96E+00
F30	3.95E+02	8.18E+05	3.95E+02	1.64E+04	1.14E+05	1.94E+03	2.09E+03	1.97E+03	1.98E+03	2.65E+01
	50-D					100-D				
	best	worst	median	mean	std	best	worst	median	mean	std
F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.57E-06	1.10E-07	2.16E-07	2.79E-07
F4	3.72E+00	1.42E+02	2.85E+01	3.43E+01	2.87E+01	1.92E+02	2.12E+02	2.12E+02	2.03E+02	9.86E+00
F5	2.98E+00	1.50E+01	7.30E+00	7.55E+00	2.39E+00	8.95E+00	3.59E+01	1.79E+01	1.83E+01	5.20E+00
F6	0.00E+00	9.28E-06	4.07E-07	9.24E-07	1.54E-06	6.23E-06	7.73E-05	2.75E-05	2.86E-05	1.53E-05
F7	5.71E+01	6.51E+01	6.04E+01	6.04E+01	1.80E+00	1.13E+02	1.29E+02	1.20E+02	1.20E+02	3.72E+00
F8	1.99E+00	1.60E+01	7.01E+00	7.59E+00	2.87E+00	9.95E+00	2.29E+01	1.69E+01	1.68E+01	2.96E+00
F9	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F10	2.15E+03	3.50E+03	3.02E+03	3.02E+03	2.76E+02	7.68E+03	1.03E+04	8.98E+03	9.04E+03	5.91E+02
F11	1.83E+01	3.01E+01	2.52E+01	2.37E+01	3.85E+00	8.05E+00	8.91E+01	2.27E+01	2.80E+01	1.98E+01
F12	5.27E+02	1.78E+03	1.17E+03	1.16E+03	3.34E+02	6.06E+03	2.34E+04	1.02E+04	1.16E+04	4.00E+03
F13	1.00E+00	4.13E+01	6.91E+00	1.59E+01	1.57E+01	2.55E+01	1.35E+02	6.43E+01	6.33E+01	2.65E+01
F14	2.11E+01	2.72E+01	2.31E+01	2.33E+01	1.67E+00	2.80E+01	4.82E+01	3.31E+01	3.44E+01	4.11E+00
F15	1.70E+01	2.21E+01	1.91E+01	1.90E+01	1.29E+00	1.73E+01	1.07E+02	3.81E+01	4.51E+01	2.42E+01
F16	1.30E+02	5.97E+02	3.04E+02	3.04E+02	1.38E+02	8.85E+02	2.03E+03	1.45E+03	1.47E+03	2.91E+02
F17	6.74E+01	4.34E+02	2.03E+02	1.97E+02	9.01E+01	4.05E+02	1.33E+03	1.02E+03	9.79E+02	2.28E+02
F18	2.05E+01	2.82E+01	2.19E+01	2.22E+01	1.30E+00	4.08E+01	1.30E+02	6.17E+01	6.85E+01	2.15E+01
F19	5.58E+00	1.36E+01	9.17E+00	9.29E+00	2.19E+00	3.24E+01	5.51E+01	4.16E+01	4.20E+01	4.51E+00
F20	7.47E+01	3.24E+02	1.06E+02	1.24E+02	5.74E+01	7.01E+02	1.61E+03	1.25E+03	1.18E+03	2.23E+02
F21	2.03E+02	2.14E+02	2.08E+02	2.08E+02	2.43E+00	2.35E+02	2.54E+02	2.44E+02	2.44E+02	4.00E+00
F22	1.00E+02	4.09E+03	3.47E+03	2.55E+03	1.61E+03	7.93E+03	1.06E+04	9.83E+03	9.71E+03	6.13E+02
F23	4.14E+02	4.51E+02	4.30E+02	4.32E+02	8.35E+00	5.46E+02	5.82E+02	5.65E+02	5.65E+02	1.01E+01
F24	5.01E+02	5.15E+02	5.08E+02	5.08E+02	3.28E+00	8.80E+02	9.12E+02	8.94E+02	8.95E+02	6.51E+00
F25	4.80E+02	4.92E+02	4.80E+02	4.81E+02	2.27E+00	6.37E+02	7.62E+02	6.98E+02	7.05E+02	3.96E+01
F26	9.68E+02	1.28E+03	1.12E+03	1.12E+03	5.50E+01	2.90E+03	3.26E+03	3.11E+03	3.11E+03	7.81E+01
F27	4.92E+02	5.20E+02	5.06E+02	5.05E+02	6.72E+00	5.39E+02	6.11E+02	5.64E+02	5.67E+02	1.61E+01
F28	4.59E+02	4.59E+02	4.59E+02	4.59E+02	2.10E-13	4.78E+02	5.74E+02	5.19E+02	5.19E+02	1.27E+01
F29	3.35E+02	3.88E+02	3.63E+02	3.63E+02	1.23E+01	8.62E+02	1.48E+03	1.08E+03	1.09E+03	1.57E+02
F30	5.79E+05	6.70E+05	5.90E+05	5.98E+05	2.40E+04	2.10E+03	2.75E+03	2.28E+03	2.34E+03	1.56E+02

TABLE S11 PERFORMANCE COMPARISONS OF ODF-SCSS-JSO WITH OTHER STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (10-D)

	PaDE			L-SHADE-SP			EBL-SHADE			EaDE			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F5	3.96E+00	1.00E+00	+	1.54E+00	9.81E-01	+	2.40E+00	8.01E-01	+	2.26E+00	1.70E+00	+	8.78E-01	7.87E-01
F6	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	2.79E-08	1.99E-07
F7	1.25E+01	4.45E-01	+	1.17E+01	6.78E-01	-	1.21E+01	7.28E-01	=	1.21E+01	8.79E-01	+	1.15E+01	4.65E-01
F8	2.50E+00	5.04E-01	+	1.56E+00	9.39E-01	+	2.38E+00	7.47E-01	+	1.66E+00	1.52E+00	+	1.17E+00	9.46E-01
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	1.35E+01	3.22E+01	-	2.09E+01	4.60E+01	-	1.43E+01	2.31E+01	-	3.18E+01	5.88E+01	=	1.57E+01	4.21E+01
F11	4.39E-01	7.99E-01	+	0.00E+00	0.00E+00	=	2.53E-01	5.44E-01	+	1.12E-01	3.90E-01	+	0.00E+00	0.00E+00
F12	2.08E-01	0.00E+00	-	2.95E+00	1.68E+01	-	2.52E+01	5.02E+01	-	5.29E-01	1.53E+00	+	3.06E-01	1.58E-01
F13	2.24E+00	2.60E+00	-	3.86E+00	2.08E+00	-	3.35E+00	2.33E+00	-	3.47E+00	2.38E+00	-	3.74E+00	2.04E+00
F14	1.76E-01	3.83E-01	+	3.90E-02	1.95E-01	+	4.16E-01	7.31E-01	+	5.39E-01	7.70E-01	+	0.00E+00	0.00E+00
F15	2.18E-03	2.87E-03	-	2.16E-01	2.25E-01	-	1.94E-01	2.15E-01	-	1.45E-01	2.05E-01	-	3.39E-01	1.93E-01
F16	3.24E-01	9.41E-02	-	5.63E-01	2.98E-01	=	3.45E-01	2.28E-01	-	3.41E-01	2.28E-01	-	6.19E-01	1.70E-01
F17	6.27E-01	4.92E-01	+	7.31E-01	3.88E-01	+	1.32E-01	1.46E-01	-	1.76E-01	2.48E-01	-	1.02E+00	2.89E+00
F18	2.65E-01	2.49E-01	-	1.99E-01	2.00E-01	-	1.99E-01	2.26E-01	-	1.79E-01	2.07E-01	-	7.35E-01	2.77E+00
F19	8.53E-03	9.84E-03	+	1.11E-02	1.05E-02	+	6.35E-03	9.21E-03	+	1.18E-02	1.06E-02	=	1.26E-02	1.47E-02
F20	0.00E+00	0.00E+00	-	4.41E-01	1.55E-01	-	6.12E-03	4.37E-02	-	6.12E-03	4.37E-02	-	4.47E-01	2.09E-01
F21	1.88E+02	3.83E+01	+	1.40E+02	5.07E+01	-	1.60E+02	5.08E+01	=	1.41E+02	5.10E+01	-	1.62E+02	5.06E+01
F22	1.00E+02	0.00E+00	=	1.00E+02	4.01E-02	+	1.00E+02	8.80E-05	+	9.81E+01	1.40E+01	-	1.00E+02	4.06E-02
F23	3.00E+02	1.72E-01	=	3.01E+02	1.66E+00	-	3.03E+02	1.63E+00	=	3.03E+02	1.72E+00	=	3.01E+02	1.41E+00
F24	2.97E+02	7.93E+01	+	3.11E+02	6.24E+01	+	2.99E+02	7.88E+01	+	3.01E+02	7.63E+01	-	3.11E+02	6.22E+01
F25	4.43E+02	4.63E-07	+	4.09E+02	1.95E+01	=	4.16E+02	2.27E+01	=	4.05E+02	1.68E+01	=	4.13E+02	2.16E+01
F26	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00	=	3.00E+02	0.00E+00
F27	3.94E+02	5.74E-14	+	3.89E+02	1.88E-01	=	3.89E+02	4.11E-01	=	3.89E+02	2.05E-01	=	3.89E+02	1.39E-01
F28	4.11E+02	1.40E+02	+	3.37E+02	9.75E+01	=	3.58E+02	1.20E+02	=	3.24E+02	8.28E+01	-	3.93E+02	1.40E+02
F29	2.32E+02	1.61E+00	=	2.34E+02	2.48E+00	=	2.33E+02	2.67E+00	=	2.32E+02	2.58E+00	=	2.35E+02	3.00E+00
F30	3.95E+02	7.09E-03	=	3.95E+02	3.21E-02	+	3.24E+04	1.60E+05	+	1.64E+04	1.14E+05	+	1.64E+04	1.14E+05
W	**12**			**8**			**8**			**7**				
T	**10**			**12**			**13**			**12**				
L	**7**			**9**			**8**			**10**				

TABLE S11 (CONTINUED) PERFORMANCE COMPARISONS OF ODF-SCSS-JSO WITH OTHER STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (30-D)

	PaDE			L-SHADE-SP			EBL-SHADE			EaDE			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	4.30E+01	2.68E+01	-	5.86E+01	1.97E-14	=	5.86E+01	2.27E-14	=	5.86E+01	4.66E-13	+	5.86E+01	0.00E+00
F5	6.61E+00	1.30E+00	+	7.27E+00	2.01E+00	+	6.47E+00	1.41E+00	+	3.52E+00	2.38E+00	=	4.24E+00	1.86E+00
F6	0.00E+00	0.00E+00	-	1.14E-08	3.73E-08	=	0.00E+00	0.00E+00	-	8.05E-09	3.25E-08	-	7.61E-08	2.28E-07
F7	4.02E+01	1.09E+00	+	3.84E+01	2.07E+00	+	3.70E+01	8.35E-01	+	3.66E+01	1.59E+00	=	3.61E+01	1.27E+00
F8	1.08E+01	1.65E+00	+	6.80E+00	2.22E+00	+	6.68E+00	1.67E+00	+	4.20E+00	2.32E+00	=	4.54E+00	2.37E+00
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	1.50E+03	5.06E+01	=	1.57E+03	2.94E+02	+	1.39E+03	1.96E+02	=	1.34E+03	2.98E+02	=	1.47E+03	2.26E+02
F11	6.68E+00	8.79E-01	-	6.43E+00	1.37E+01	=	1.46E+01	2.15E+01	+	1.81E+01	2.43E+01	+	1.05E+01	2.02E+01
F12	7.18E+02	2.44E+02	+	1.39E+02	1.09E+02	=	9.09E+02	3.48E+02	+	5.48E+02	2.68E+02	+	1.40E+02	1.14E+02
F13	1.79E+01	9.23E-01	=	1.80E+01	4.30E+00	=	1.39E+01	6.85E+00	-	1.64E+01	5.24E+00	=	1.67E+01	3.89E+00
F14	2.27E+01	4.31E-01	+	2.17E+01	1.40E+00	+	2.12E+01	4.24E+00	=	2.12E+01	5.49E+00	=	2.05E+01	3.04E+00
F15	2.60E+00	1.09E+00	+	1.11E+00	7.29E-01	+	2.65E+00	1.42E+00	+	2.07E+00	1.21E+00	+	5.86E-01	4.97E-01
F16	1.99E+02	4.44E+01	+	2.09E+01	1.60E+01	=	4.69E+01	4.44E+01	+	3.20E+01	3.24E+01	+	2.54E+01	3.60E+01
F17	2.65E+01	3.64E+00	-	3.44E+01	6.92E+00	+	3.26E+01	5.05E+00	+	3.47E+01	7.69E+00	+	3.06E+01	6.27E+00
F18	2.23E+01	2.47E-01	+	2.08E+01	2.32E-01	+	2.11E+01	2.99E+00	=	2.05E+01	2.92E+00	=	2.08E+01	2.93E-01
F19	5.25E+00	1.35E+00	+	3.59E+00	9.09E-01	=	4.67E+00	1.37E+00	+	5.21E+00	1.88E+00	+	3.55E+00	1.21E+00
F20	5.65E+01	1.47E+01	+	3.20E+01	5.48E+00	=	3.12E+01	5.80E+00	=	2.88E+01	7.59E+00	-	3.00E+01	4.72E+00
F21	2.09E+02	6.88E-01	+	2.07E+02	2.18E+00	+	2.07E+02	1.43E+00	+	2.06E+02	2.14E+00	+	2.05E+02	2.24E+00
F22	1.00E+02	1.44E-14	=	1.00E+02	1.44E-14	=	1.00E+02	1.44E-14	=	1.00E+02	2.00E-13	=	1.00E+02	1.44E-14
F23	3.48E+02	2.29E+00	=	3.51E+02	3.19E+00	+	3.49E+02	2.76E+00	=	3.50E+02	2.86E+00	=	3.49E+02	3.02E+00
F24	4.23E+02	2.56E+00	-	4.27E+02	2.66E+00	+	4.25E+02	1.55E+00	=	4.25E+02	1.55E+00	=	4.25E+02	1.85E+00
F25	3.87E+02	6.60E-03	=	3.87E+02	5.57E-03	=	3.87E+02	2.29E-02	+	3.87E+02	1.43E-02	+	3.87E+02	6.39E-03
F26	8.59E+02	1.06E+01	-	9.42E+02	4.66E+01	=	8.97E+02	3.26E+01	-	9.24E+02	3.78E+01	=	9.48E+02	5.41E+01
F27	5.06E+02	3.97E+00	+	4.98E+02	7.12E+00	=	5.01E+02	6.01E+00	+	5.01E+02	6.11E+00	+	4.99E+02	4.91E+00
F28	3.00E+02	0.00E+00	-	3.04E+02	2.23E+01	=	3.32E+02	5.12E+01	+	3.21E+02	4.36E+01	+	3.07E+02	2.71E+01
F29	4.21E+02	1.09E+01	-	4.41E+02	1.03E+01	+	4.30E+02	5.70E+00	=	4.34E+02	1.12E+01	=	4.36E+02	7.96E+00
F30	2.00E+03	6.15E+00	+	1.97E+03	1.32E+01	=	1.99E+03	3.76E+01	=	1.97E+03	2.37E+01	=	1.98E+03	2.65E+01
W	**13**			**12**			**13**			**11**				
T	**8**			**17**			**13**			**16**				
L	**8**			**0**			**3**			**2**				

TABLE S11 (CONTINUED)PERFORMANCE COMPARISONS OF ODF-SCSS-JSO WITH OTHER STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (50-D)

	PaDE			L-SHADE-SP			EBL-SHADE			EaDE			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F4	3.68E+01	5.18E+01	-	5.30E+01	4.50E+01	+	8.00E+01	5.06E+01	+	8.67E+01	4.92E+01	+	3.43E+01	2.87E+01
F5	1.84E+01	1.89E+00	+	1.22E+01	3.00E+00	+	1.25E+01	2.24E+00	+	7.93E+00	3.40E+00	=	7.55E+00	2.39E+00
F6	6.79E-10	2.74E-10	-	1.36E-07	2.62E-07	-	4.22E-07	6.08E-07	=	1.69E-07	8.56E-07	-	9.24E-07	1.54E-06
F7	6.57E+01	1.72E+00	+	6.65E+01	3.92E+00	+	6.28E+01	1.91E+00	+	6.11E+01	2.38E+00	+	6.04E+01	1.80E+00
F8	1.42E+01	1.50E+00	+	1.26E+01	3.11E+00	+	1.29E+01	2.30E+00	+	7.41E+00	3.42E+00	=	7.59E+00	2.87E+00
F9	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	3.51E-03	1.76E-02	+	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F10	3.12E+03	3.96E+02	+	3.46E+03	3.98E+02	+	3.20E+03	2.88E+02	+	2.89E+03	4.47E+02	=	3.02E+03	2.76E+02
F11	5.90E+01	5.99E+00	+	2.49E+01	3.67E+00	=	4.26E+01	6.21E+00	+	3.21E+01	4.60E+00	+	2.37E+01	3.85E+00
F12	1.77E+03	4.68E+02	+	1.54E+03	4.12E+02	+	2.19E+03	5.22E+02	+	2.09E+03	5.34E+02	+	1.16E+03	3.34E+02
F13	7.46E+01	6.36E+00	+	3.78E+01	2.41E+01	+	4.85E+01	1.99E+01	+	5.35E+01	2.74E+01	+	1.59E+01	1.57E+01
F14	2.85E+01	1.59E+00	+	2.32E+01	1.58E+00	=	2.85E+01	3.39E+00	+	2.62E+01	3.73E+00	+	2.33E+01	1.67E+00
F15	5.56E+01	7.41E+00	+	2.14E+01	1.56E+00	+	3.40E+01	7.09E+00	+	2.63E+01	4.01E+00	+	1.90E+01	1.29E+00
F16	4.26E+02	6.20E+01	+	3.35E+02	1.68E+02	=	3.14E+02	1.27E+02	=	3.62E+02	1.42E+02	=	3.04E+02	1.38E+02
F17	3.65E+02	2.06E+01	+	2.25E+02	1.03E+02	+	2.29E+02	7.63E+01	=	2.34E+02	1.09E+02	+	1.97E+02	9.01E+01
F18	3.58E+01	9.59E+00	+	2.27E+01	1.52E+00	=	3.27E+01	6.75E+00	+	2.60E+01	2.26E+00	+	2.22E+01	1.30E+00
F19	3.05E+01	4.52E+00	+	1.03E+01	2.42E+00	+	1.90E+01	3.65E+00	+	1.57E+01	3.11E+00	+	9.29E+00	2.19E+00
F20	2.09E+02	1.87E+01	+	1.41E+02	6.22E+01	+	1.81E+02	7.96E+01	+	1.70E+02	1.22E+02	+	1.24E+02	5.74E+01
F21	2.19E+02	1.89E+00	+	2.14E+02	4.33E+00	+	2.12E+02	2.47E+00	+	2.09E+02	3.12E+00	=	2.08E+02	2.43E+00
F22	1.00E+02	1.95E-13	-	2.22E+03	1.97E+03	=	2.71E+03	1.52E+03	+	2.64E+03	1.45E+03	+	2.55E+03	1.61E+03
F23	4.35E+02	5.68E+00	+	4.33E+02	5.49E+00	=	4.28E+02	3.98E+00	-	4.28E+02	4.01E+00	-	4.32E+02	8.35E+00
F24	5.08E+02	4.13E+00	=	5.08E+02	3.39E+00	=	5.06E+02	2.96E+00	-	5.07E+02	3.79E+00	=	5.08E+02	3.28E+00
F25	4.89E+02	5.11E+00	+	4.81E+02	2.28E+00	=	4.84E+02	8.73E+00	+	4.82E+02	4.30E+00	=	4.81E+02	2.27E+00
F26	1.13E+03	1.41E+01	=	1.13E+03	4.08E+01	=	1.12E+03	4.89E+01	=	1.14E+03	5.13E+01	=	1.12E+03	5.50E+01
F27	5.44E+02	4.44E+00	+	5.12E+02	9.74E+00	+	5.24E+02	9.79E+00	+	5.32E+02	1.70E+01	+	5.05E+02	6.72E+00
F28	5.08E+02	2.43E-13	+	4.59E+02	1.72E-13	=	4.76E+02	2.36E+01	+	4.61E+02	9.58E+00	+	4.59E+02	2.10E-13
F29	3.49E+02	9.37E+00	-	3.64E+02	1.10E+01	=	3.51E+02	9.12E+00	-	3.59E+02	1.27E+01	=	3.63E+02	1.23E+01
F30	5.91E+05	1.74E+02	=	6.13E+05	3.55E+04	=	6.48E+05	5.97E+04	+	6.53E+05	6.62E+04	+	5.98E+05	2.40E+04
W	**19**			**13**			**20**			**15**				
T	**6**			**15**			**6**			**12**				
L	**4**			**1**			**3**			**2**				

TABLE S11 (CONTINUED) PERFORMANCE COMPARISONS OF ODF-SCSS-JSO WITH OTHER STATE-OF-THE-ART DES ON 10-D, 30-D, 50-D AND 100-D CEC2017 BENCHMARK SET OVER 51 INDEPENDENT RUNS (100-D)

	PaDE			L-SHADE-SP			EBL-SHADE			EaDE			ODF-SCSS-jSO	
	mean	std	sig	mean	std	sig	mean	std	sig	mean	std	sig	mean	std
F1	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00	=	0.00E+00	0.00E+00
F3	6.56E-08	5.24E-08	-	2.03E-07	2.26E-07	=	1.37E-06	1.59E-06	+	1.24E-04	1.66E-04	+	2.16E-07	2.79E-07
F4	1.82E+02	4.45E+00	-	2.01E+02	1.05E+01	=	1.53E+02	5.36E+01	-	1.99E+02	1.30E+01	=	2.03E+02	9.86E+00
F5	4.31E+01	3.10E+00	+	3.07E+01	7.80E+00	+	3.99E+01	5.74E+00	+	2.39E+01	5.99E+00	+	1.83E+01	5.20E+00
F6	1.18E-02	2.37E-03	+	5.01E-05	1.35E-04	+	1.02E-02	7.28E-03	+	1.97E-03	1.71E-03	+	2.86E-05	1.53E-05
F7	1.44E+02	1.56E+00	+	1.37E+02	7.50E+00	+	1.39E+02	3.99E+00	+	1.30E+02	5.64E+00	+	1.20E+02	3.72E+00
F8	5.03E+01	3.77E+00	+	3.03E+01	7.56E+00	+	4.27E+01	5.56E+00	+	2.28E+01	6.15E+00	+	1.68E+01	2.96E+00
F9	1.18E+00	2.91E-01	+	1.76E-03	1.25E-02	+	8.41E-01	5.80E-01	+	9.54E-02	1.49E-01	+	0.00E+00	0.00E+00
F10	8.58E+03	5.34E+02	-	1.06E+04	8.11E+02	+	1.02E+04	6.59E+02	+	9.51E+03	8.17E+02	+	9.04E+03	5.91E+02
F11	6.12E+02	5.15E+01	+	7.98E+01	3.42E+01	+	4.15E+02	1.14E+02	+	1.86E+02	5.50E+01	+	2.80E+01	1.98E+01
F12	2.04E+04	8.14E+03	+	1.23E+04	4.72E+03	+	1.95E+04	9.46E+03	+	1.79E+04	7.82E+03	+	1.16E+04	4.00E+03
F13	4.08E+02	1.92E+01	+	1.28E+02	3.21E+01	+	2.38E+02	6.31E+01	+	1.69E+02	4.16E+01	+	6.33E+01	2.65E+01
F14	3.10E+02	4.84E+01	+	4.29E+01	5.82E+00	+	2.26E+02	2.80E+01	+	8.62E+01	1.69E+01	+	3.44E+01	4.11E+00
F15	2.40E+02	2.67E+01	+	1.19E+02	3.12E+01	+	2.58E+02	5.28E+01	+	2.47E+02	5.25E+01	+	4.51E+01	2.42E+01
F16	1.76E+03	2.13E+02	+	1.60E+03	2.74E+02	+	1.50E+03	2.73E+02	=	1.43E+03	3.12E+02	=	1.47E+03	2.91E+02
F17	1.18E+03	9.13E+01	+	1.16E+03	2.39E+02	+	1.09E+03	1.76E+02	=	1.07E+03	2.75E+02	=	9.79E+02	2.28E+02
F18	2.71E+02	5.49E+01	+	1.49E+02	3.11E+01	+	2.35E+02	4.72E+01	+	2.15E+02	4.33E+01	+	6.85E+01	2.15E+01
F19	1.52E+02	2.57E+01	+	6.35E+01	1.14E+01	+	1.79E+02	2.21E+01	+	1.66E+02	2.42E+01	+	4.20E+01	4.51E+00
F20	1.45E+03	6.36E+01	+	1.31E+03	3.29E+02	+	1.55E+03	1.98E+02	+	1.46E+03	3.13E+02	+	1.18E+03	2.23E+02
F21	2.71E+02	2.38E+00	+	2.51E+02	6.96E+00	+	2.59E+02	6.06E+00	+	2.50E+02	5.04E+00	+	2.44E+02	4.00E+00
F22	1.07E+04	1.96E+02	+	1.12E+04	6.95E+02	+	1.13E+04	5.46E+02	+	1.03E+04	6.41E+02	+	9.71E+03	6.13E+02
F23	5.91E+02	2.22E+00	+	5.65E+02	9.04E+00	=	5.72E+02	9.16E+00	+	5.62E+02	9.78E+00	=	5.65E+02	1.01E+01
F24	9.32E+02	1.09E+01	+	9.00E+02	6.88E+00	+	9.02E+02	8.61E+00	+	9.05E+02	9.19E+00	+	8.95E+02	6.51E+00
F25	7.65E+02	2.03E+01	+	7.19E+02	4.52E+01	+	7.45E+02	3.04E+01	+	7.40E+02	3.63E+01	+	7.05E+02	3.96E+01
F26	3.39E+03	9.07E+01	+	3.16E+03	8.08E+01	+	3.24E+03	8.52E+01	+	3.20E+03	8.46E+01	+	3.11E+03	7.81E+01
F27	6.50E+02	3.71E+01	+	5.82E+02	1.78E+01	+	6.19E+02	1.94E+01	+	6.20E+02	2.19E+01	+	5.67E+02	1.61E+01
F28	5.41E+02	2.45E+00	+	5.20E+02	2.23E+01	=	5.28E+02	2.92E+01	=	5.26E+02	2.58E+01	+	5.19E+02	1.27E+01
F29	1.13E+03	1.23E+02	=	1.23E+03	2.04E+02	+	1.15E+03	1.64E+02	=	1.24E+03	1.98E+02	+	1.09E+03	1.57E+02
F30	2.56E+03	2.39E+01	+	2.35E+03	1.76E+02	+	2.38E+03	1.50E+02	+	2.36E+03	1.32E+02	+	2.34E+03	1.56E+02
W	**24**			**24**			**23**			**24**				
T	**2**			**5**			**5**			**5**				
L	**3**			**0**			**1**			**0**				

TABLE S12 THE BEST, WORST, MEDIAN, MEAN AND STANDARD DEVIATION VALUES OBTAINED BY ODF-SCSS-JSO ON 10-D AND 20-D CEC2022 BENCHMARK SET OVER 30 INDEPENDENT RUNS

	10-D					20-D				
	best	worst	median	mean	std	best	worst	median	mean	std
F1	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F2	3.99E+00	8.92E+00	8.92E+00	7.27E+00	2.36E+00	4.49E+01	4.91E+01	4.91E+01	4.84E+01	1.59E+00
F3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F4	0.00E+00	2.99E+00	1.99E+00	1.43E+00	1.13E+00	0.00E+00	5.97E+00	4.97E+00	4.34E+00	1.68E+00
F5	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
F6	8.23E-03	4.94E-01	2.91E-01	2.76E-01	1.59E-01	4.48E-01	5.00E-01	4.96E-01	4.90E-01	1.38E-02
F7	0.00E+00	6.24E-01	6.24E-01	3.95E-01	3.06E-01	1.20E-04	2.06E+01	2.15E+00	4.51E+00	6.18E+00
F8	1.42E-01	2.03E+01	3.71E-01	1.48E+00	3.77E+00	4.31E+00	2.10E+01	2.03E+01	1.87E+01	3.67E+00
F9	2.29E+02	2.29E+02	2.29E+02	2.29E+02	0.00E+00	1.81E+02	1.81E+02	1.81E+02	1.81E+02	8.67E-14
F10	1.00E+02	1.00E+02	1.00E+02	1.00E+02	4.22E-02	1.00E+02	1.00E+02	1.00E+02	1.00E+02	1.61E-02
F11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+02	3.00E+02	3.00E+02	3.00E+02	8.44E-14
F12	1.63E+02	1.65E+02	1.63E+02	1.64E+02	1.12E+00	2.31E+02	2.34E+02	2.32E+02	2.32E+02	8.97E-01