

Table 1: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO1 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO1-T1	4.65e+01	4.68e+01 -	5.90e+01 -	1.36e+02 -	5.56e+01 -	1.41e+02 -	6.71e+02 -
CEC19-MaTSO1-T2	4.65e+01	5.27e+01 -	5.67e+01 -	1.55e+02 -	5.30e+01 -	1.46e+02 -	8.18e+02 -
CEC19-MaTSO1-T3	5.83e+01	4.96e+01 =	1.14e+02 -	1.49e+02 -	6.57e+01 -	1.90e+02 -	7.83e+02 -
CEC19-MaTSO1-T4	4.66e+01	4.69e+01 -	5.40e+01 -	1.16e+02 -	7.02e+01 -	1.99e+02 -	7.53e+02 -
CEC19-MaTSO1-T5	4.95e+01	5.29e+01 -	7.10e+01 -	1.36e+02 -	6.14e+01 -	1.73e+02 -	8.57e+02 -
CEC19-MaTSO1-T6	4.66e+01	4.69e+01 -	4.77e+01 -	2.12e+02 -	7.19e+01 -	2.02e+02 -	7.86e+02 -
CEC19-MaTSO1-T7	5.18e+01	5.00e+01 +	1.05e+02 -	1.84e+02 -	5.52e+01 -	1.21e+02 -	7.79e+02 -
CEC19-MaTSO1-T8	4.95e+01	4.96e+01 -	9.75e+01 -	2.63e+02 -	6.81e+01 -	2.97e+02 -	8.71e+02 -
CEC19-MaTSO1-T9	4.66e+01	4.70e+01 -	6.60e+01 -	1.41e+02 -	6.50e+01 -	2.10e+02 -	7.55e+02 -
CEC19-MaTSO1-T10	4.67e+01	4.68e+01 =	6.01e+01 -	1.77e+02 -	6.87e+01 -	1.67e+02 -	7.04e+02 -
CEC19-MaTSO1-T11	4.67e+01	4.70e+01 -	1.17e+02 -	1.12e+02 -	6.21e+01 -	1.58e+02 -	8.63e+02 -
CEC19-MaTSO1-T12	4.65e+01	4.67e+01 -	6.96e+01 -	7.29e+02 -	7.04e+01 -	1.98e+02 -	7.60e+02 -
CEC19-MaTSO1-T13	4.95e+01	4.68e+01 =	7.11e+01 -	1.49e+02 -	5.97e+01 -	1.50e+02 -	7.32e+02 -
CEC19-MaTSO1-T14	4.65e+01	4.68e+01 -	6.64e+01 -	1.69e+02 -	6.57e+01 -	1.78e+02 -	8.09e+02 -
CEC19-MaTSO1-T15	4.65e+01	4.70e+01 -	5.29e+01 -	1.56e+02 -	8.98e+01 -	2.02e+02 -	7.74e+02 -
CEC19-MaTSO1-T16	4.94e+01	4.68e+01 +	8.06e+01 -	1.27e+02 -	6.22e+01 -	2.12e+02 -	8.04e+02 -
CEC19-MaTSO1-T17	5.24e+01	6.39e+01 -	7.33e+01 -	1.84e+02 -	6.71e+01 -	2.66e+02 -	8.55e+02 -
CEC19-MaTSO1-T18	4.96e+01	4.69e+01 +	1.95e+02 -	2.41e+02 -	5.97e+01 -	1.66e+02 -	7.78e+02 -
CEC19-MaTSO1-T19	4.67e+01	4.69e+01 -	6.82e+01 -	2.17e+02 -	5.97e+01 -	1.87e+02 -	7.76e+02 -
CEC19-MaTSO1-T20	4.66e+01	4.67e+01 =	5.89e+01 -	2.26e+02 -	6.89e+01 -	1.96e+02 -	7.68e+02 -
CEC19-MaTSO1-T21	4.74e+01	5.27e+01 -	6.95e+01 -	1.24e+02 -	7.53e+01 -	2.75e+02 -	8.30e+02 -
CEC19-MaTSO1-T22	5.20e+01	4.65e+01 =	9.21e+01 -	1.12e+02 -	7.37e+01 -	1.77e+02 -	8.03e+02 -
CEC19-MaTSO1-T23	4.67e+01	4.67e+01 -	5.42e+01 -	1.46e+02 -	5.50e+01 -	1.84e+02 -	6.58e+02 -
CEC19-MaTSO1-T24	4.66e+01	4.69e+01 -	5.32e+01 -	1.32e+02 -	6.04e+01 -	1.40e+02 -	7.90e+02 -
CEC19-MaTSO1-T25	4.66e+01	4.70e+01 -	1.39e+02 -	2.34e+02 -	5.62e+01 -	1.71e+02 -	8.41e+02 -
CEC19-MaTSO1-T26	4.66e+01	4.68e+01 -	5.79e+01 -	2.15e+02 -	5.60e+01 -	1.51e+02 -	8.03e+02 -
CEC19-MaTSO1-T27	4.67e+01	4.68e+01 =	6.08e+01 -	1.30e+02 -	6.32e+01 -	1.68e+02 -	7.67e+02 -
CEC19-MaTSO1-T28	4.65e+01	4.68e+01 -	5.47e+01 -	1.29e+02 -	6.99e+01 -	1.58e+02 -	7.26e+02 -
CEC19-MaTSO1-T29	5.24e+01	5.55e+01 =	1.51e+02 -	2.66e+02 -	5.42e+01 -	2.85e+02 -	7.34e+02 -
CEC19-MaTSO1-T30	4.95e+01	5.02e+01 -	1.28e+02 -	1.78e+02 -	8.23e+01 -	3.83e+02 -	7.78e+02 -
CEC19-MaTSO1-T31	4.66e+01	4.68e+01 -	6.68e+01 -	1.81e+02 -	6.66e+01 -	1.33e+02 -	6.70e+02 -
CEC19-MaTSO1-T32	4.96e+01	4.70e+01 +	1.57e+02 -	1.33e+02 -	6.15e+01 -	1.69e+02 -	8.40e+02 -
CEC19-MaTSO1-T33	4.66e+01	4.67e+01 =	8.95e+01 -	1.34e+02 -	6.56e+01 -	1.54e+02 -	7.76e+02 -
CEC19-MaTSO1-T34	4.66e+01	4.69e+01 -	5.47e+01 -	1.11e+02 -	7.24e+01 -	1.83e+02 -	8.59e+02 -
CEC19-MaTSO1-T35	4.66e+01	4.67e+01 -	6.31e+01 -	1.33e+02 -	6.93e+01 -	2.07e+02 -	8.57e+02 -
CEC19-MaTSO1-T36	6.42e+01	4.69e+01 =	7.95e+01 -	1.41e+02 -	7.35e+01 -	2.89e+02 -	7.41e+02 -
CEC19-MaTSO1-T37	5.24e+01	4.98e+01 +	9.39e+01 -	1.34e+02 -	7.28e+01 -	2.31e+02 -	8.25e+02 -
CEC19-MaTSO1-T38	5.51e+01	5.86e+01 -	7.96e+01 -	1.55e+02 -	7.81e+01 -	2.25e+02 -	9.55e+02 -
CEC19-MaTSO1-T39	4.65e+01	4.68e+01 -	6.79e+01 -	1.46e+02 -	6.72e+01 -	1.66e+02 -	7.93e+02 -
CEC19-MaTSO1-T40	4.65e+01	4.68e+01 -	5.18e+01 -	1.50e+02 -	7.18e+01 -	2.02e+02 -	7.16e+02 -
CEC19-MaTSO1-T41	4.64e+01	5.26e+01 -	1.13e+02 -	1.52e+02 -	6.39e+01 -	2.00e+02 -	8.93e+02 -
CEC19-MaTSO1-T42	4.66e+01	4.69e+01 -	5.06e+01 -	1.03e+02 -	6.71e+01 -	1.11e+02 -	8.16e+02 -
CEC19-MaTSO1-T43	4.66e+01	4.68e+01 -	4.90e+01 -	1.09e+02 -	7.23e+01 -	1.45e+02 -	8.36e+02 -
CEC19-MaTSO1-T44	5.24e+01	5.55e+01 =	9.28e+01 -	1.24e+02 -	7.27e+01 -	2.54e+02 -	9.40e+02 -
CEC19-MaTSO1-T45	4.66e+01	4.69e+01 -	6.11e+01 -	2.06e+02 -	6.87e+01 -	1.80e+02 -	7.15e+02 -
CEC19-MaTSO1-T46	4.95e+01	4.69e+01 +	6.98e+01 -	1.54e+02 -	5.73e+01 -	2.11e+02 -	8.10e+02 -
CEC19-MaTSO1-T47	4.67e+01	4.69e+01 -	1.02e+02 -	1.28e+02 -	5.18e+01 -	2.03e+02 -	7.68e+02 -
CEC19-MaTSO1-T48	4.95e+01	4.99e+01 -	6.61e+01 -	2.24e+02 -	7.30e+01 -	2.35e+02 -	7.62e+02 -
CEC19-MaTSO1-T49	4.68e+01	4.69e+01 -	4.76e+01 -	1.30e+02 -	6.31e+01 -	1.73e+02 -	7.71e+02 -
CEC19-MaTSO1-T50	4.68e+01	4.71e+01 -	6.21e+01 -	1.72e+02 -	8.11e+01 -	1.96e+02 -	7.97e+02 -
+/-/=	Base	6/34/10	0/50/0	0/50/0	0/50/0	0/50/0	0/50/0

Table 2: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO2 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO2-T1	6.11e-13	1.32e-08 -	2.03e+01 -	8.70e-02 -	2.07e+00 -	2.76e-05 -	2.02e+01 -
CEC19-MaTSO2-T2	4.23e-13	2.06e-07 -	2.02e+01 -	8.70e-02 -	2.06e+00 -	2.62e-05 -	2.02e+01 -
CEC19-MaTSO2-T3	3.40e-13	1.53e-07 -	2.02e+01 -	8.47e-02 -	2.09e+00 -	2.81e-05 -	2.02e+01 -
CEC19-MaTSO2-T4	3.74e-13	2.29e-07 -	2.03e+01 -	8.85e-02 -	2.08e+00 -	2.67e-05 -	2.02e+01 -
CEC19-MaTSO2-T5	6.31e-13	1.61e-07 -	2.03e+01 -	8.51e-02 -	2.06e+00 -	2.90e-05 -	2.02e+01 -
CEC19-MaTSO2-T6	6.25e-13	3.16e-07 -	2.02e+01 -	8.32e-02 -	2.06e+00 -	2.44e-05 -	2.01e+01 -
CEC19-MaTSO2-T7	4.97e-13	2.90e-07 -	2.02e+01 -	8.35e-02 -	2.08e+00 -	2.55e-05 -	2.02e+01 -
CEC19-MaTSO2-T8	1.57e-10	4.57e-07 -	2.02e+01 -	8.70e-02 -	2.09e+00 -	2.36e-05 -	2.02e+01 -
CEC19-MaTSO2-T9	4.77e-13	4.95e-08 -	2.03e+01 -	8.65e-02 -	2.06e+00 -	2.58e-05 -	2.02e+01 -
CEC19-MaTSO2-T10	3.51e-13	1.13e-07 -	2.03e+01 -	8.30e-02 -	2.09e+00 -	3.05e-05 -	2.02e+01 -
CEC19-MaTSO2-T11	6.05e-13	1.79e-07 -	2.02e+01 -	8.31e-02 -	2.12e+00 -	3.18e-05 -	2.02e+01 -
CEC19-MaTSO2-T12	3.07e-13	5.58e-07 -	2.02e+01 -	8.55e-02 -	2.04e+00 -	2.49e-05 -	2.02e+01 -
CEC19-MaTSO2-T13	5.22e-13	1.05e-07 -	2.02e+01 -	8.30e-02 -	2.12e+00 -	2.50e-05 -	2.02e+01 -
CEC19-MaTSO2-T14	4.21e-13	8.49e-08 -	2.02e+01 -	8.82e-02 -	2.08e+00 -	2.70e-05 -	2.02e+01 -
CEC19-MaTSO2-T15	7.25e-13	3.78e-07 -	2.03e+01 -	8.32e-02 -	2.10e+00 -	2.71e-05 -	2.02e+01 -
CEC19-MaTSO2-T16	4.03e-13	6.98e-08 -	2.02e+01 -	8.35e-02 -	2.09e+00 -	2.89e-05 -	2.02e+01 -
CEC19-MaTSO2-T17	1.57e-11	4.23e-07 -	2.03e+01 -	8.74e-02 -	2.06e+00 -	2.70e-05 -	2.02e+01 -
CEC19-MaTSO2-T18	4.57e-13	1.23e-07 -	2.03e+01 -	8.77e-02 -	2.09e+00 -	3.26e-05 -	2.02e+01 -
CEC19-MaTSO2-T19	5.79e-13	6.90e-07 -	2.02e+01 -	8.66e-02 -	2.09e+00 -	2.83e-05 -	2.02e+01 -
CEC19-MaTSO2-T20	5.31e-13	8.70e-08 -	2.03e+01 -	8.29e-02 -	2.09e+00 -	2.51e-05 -	2.02e+01 -
CEC19-MaTSO2-T21	6.43e-13	1.38e-07 -	2.03e+01 -	8.53e-02 -	2.05e+00 -	2.92e-05 -	2.02e+01 -
CEC19-MaTSO2-T22	5.75e-13	3.63e-07 -	2.02e+01 -	8.34e-02 -	2.11e+00 -	2.44e-05 -	2.02e+01 -
CEC19-MaTSO2-T23	6.99e-13	3.29e-07 -	2.02e+01 -	8.82e-02 -	2.08e+00 -	2.51e-05 -	2.02e+01 -
CEC19-MaTSO2-T24	5.60e-13	2.19e-07 -	2.02e+01 -	8.19e-02 -	2.08e+00 -	2.73e-05 -	2.02e+01 -
CEC19-MaTSO2-T25	4.12e-13	1.58e-07 -	2.03e+01 -	8.38e-02 -	2.08e+00 -	2.58e-05 -	2.02e+01 -
CEC19-MaTSO2-T26	3.24e-13	2.14e-07 -	2.02e+01 -	8.74e-02 -	2.08e+00 -	2.46e-05 -	2.02e+01 -
CEC19-MaTSO2-T27	4.33e-13	9.68e-08 -	2.03e+01 -	8.42e-02 -	2.10e+00 -	2.86e-05 -	2.02e+01 -
CEC19-MaTSO2-T28	5.59e-13	2.42e-07 -	2.03e+01 -	8.61e-02 -	2.10e+00 -	2.82e-05 -	2.02e+01 -
CEC19-MaTSO2-T29	9.79e-10	4.68e-08 -	2.03e+01 -	8.38e-02 -	2.09e+00 -	2.74e-05 -	2.02e+01 -
CEC19-MaTSO2-T30	4.06e-13	4.19e-08 -	2.02e+01 -	8.56e-02 -	2.10e+00 -	2.52e-05 -	2.02e+01 -
CEC19-MaTSO2-T31	6.99e-10	1.72e-07 -	2.03e+01 -	8.30e-02 -	2.09e+00 -	2.73e-05 -	2.02e+01 -
CEC19-MaTSO2-T32	4.72e-13	6.30e-07 -	2.02e+01 -	8.67e-02 -	2.10e+00 -	2.55e-05 -	2.02e+01 -
CEC19-MaTSO2-T33	3.29e-13	1.01e-07 -	2.02e+01 -	8.76e-02 -	2.12e+00 -	2.61e-05 -	2.02e+01 -
CEC19-MaTSO2-T34	5.26e-13	2.85e-07 -	2.02e+01 -	8.38e-02 -	2.08e+00 -	2.55e-05 -	2.02e+01 -
CEC19-MaTSO2-T35	4.38e-13	5.03e-07 -	2.03e+01 -	8.58e-02 -	2.09e+00 -	2.89e-05 -	2.02e+01 -
CEC19-MaTSO2-T36	3.75e-13	9.76e-08 -	2.03e+01 -	8.31e-02 -	2.08e+00 -	2.67e-05 -	2.03e+01 -
CEC19-MaTSO2-T37	4.02e-13	3.07e-07 -	2.03e+01 -	8.34e-02 -	2.08e+00 -	2.50e-05 -	2.02e+01 -
CEC19-MaTSO2-T38	3.35e-13	6.98e-08 -	2.03e+01 -	8.57e-02 -	2.07e+00 -	2.73e-05 -	2.02e+01 -
CEC19-MaTSO2-T39	3.72e-13	7.51e-08 -	2.02e+01 -	8.71e-02 -	2.10e+00 -	2.86e-05 -	2.02e+01 -
CEC19-MaTSO2-T40	4.07e-13	9.04e-07 -	2.03e+01 -	8.34e-02 -	2.06e+00 -	2.40e-05 -	2.02e+01 -
CEC19-MaTSO2-T41	3.98e-13	9.55e-08 -	2.03e+01 -	8.85e-02 -	2.08e+00 -	2.78e-05 -	2.02e+01 -
CEC19-MaTSO2-T42	3.85e-13	7.00e-07 -	2.02e+01 -	8.77e-02 -	2.07e+00 -	2.74e-05 -	2.02e+01 -
CEC19-MaTSO2-T43	3.55e-13	1.22e-07 -	2.03e+01 -	8.59e-02 -	2.09e+00 -	2.56e-05 -	2.02e+01 -
CEC19-MaTSO2-T44	3.48e-13	7.23e-07 -	2.03e+01 -	8.32e-02 -	2.10e+00 -	2.66e-05 -	2.02e+01 -
CEC19-MaTSO2-T45	5.50e-13	1.14e-07 -	2.02e+01 -	8.38e-02 -	2.09e+00 -	2.77e-05 -	2.02e+01 -
CEC19-MaTSO2-T46	4.36e-13	1.25e-07 -	2.02e+01 -	8.39e-02 -	2.10e+00 -	2.46e-05 -	2.02e+01 -
CEC19-MaTSO2-T47	4.58e-13	3.79e-08 -	2.03e+01 -	8.67e-02 -	2.10e+00 -	2.55e-05 -	2.02e+01 -
CEC19-MaTSO2-T48	4.06e-13	1.59e-07 -	2.02e+01 -	8.33e-02 -	2.08e+00 -	2.53e-05 -	2.02e+01 -
CEC19-MaTSO2-T49	3.38e-13	2.37e-08 -	2.02e+01 -	8.58e-02 -	2.07e+00 -	2.25e-05 -	2.02e+01 -
CEC19-MaTSO2-T50	7.65e-13	3.13e-07 -	2.03e+01 -	8.38e-02 -	2.12e+00 -	2.97e-05 -	2.02e+01 -
+/-/=	Base	0/50/0	0/50/0	0/50/0	0/50/0	0/50/0	0/50/0

Table 3: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO3 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO3-T1	3.77e+02	3.76e+02 =	3.38e+02 +	2.34e+02 +	2.11e+02 +	3.58e+02 +	4.49e+02 -
CEC19-MaTSO3-T2	3.75e+02	3.72e+02 =	3.39e+02 +	1.96e+02 +	1.95e+02 +	3.46e+02 =	4.57e+02 -
CEC19-MaTSO3-T3	3.73e+02	3.73e+02 =	3.40e+02 +	2.66e+02 +	1.69e+02 +	3.67e+02 =	4.62e+02 -
CEC19-MaTSO3-T4	3.75e+02	3.72e+02 =	3.42e+02 +	2.50e+02 +	2.04e+02 +	3.39e+02 +	4.54e+02 -
CEC19-MaTSO3-T5	3.73e+02	3.74e+02 =	3.41e+02 +	2.28e+02 +	1.97e+02 +	3.58e+02 =	4.59e+02 -
CEC19-MaTSO3-T6	3.75e+02	3.74e+02 =	3.37e+02 +	2.11e+02 +	2.07e+02 +	3.56e+02 +	4.58e+02 -
CEC19-MaTSO3-T7	3.74e+02	3.81e+02 =	3.44e+02 +	2.08e+02 +	1.93e+02 +	3.46e+02 +	4.59e+02 -
CEC19-MaTSO3-T8	3.72e+02	3.74e+02 =	3.46e+02 +	2.11e+02 +	1.98e+02 +	3.47e+02 +	4.60e+02 -
CEC19-MaTSO3-T9	3.73e+02	3.74e+02 =	3.39e+02 +	2.49e+02 +	2.10e+02 +	3.43e+02 +	4.57e+02 -
CEC19-MaTSO3-T10	3.74e+02	3.79e+02 =	3.40e+02 +	2.18e+02 +	1.67e+02 +	3.53e+02 =	4.58e+02 -
CEC19-MaTSO3-T11	3.72e+02	3.76e+02 =	3.45e+02 +	2.19e+02 +	2.01e+02 +	3.48e+02 +	4.59e+02 -
CEC19-MaTSO3-T12	3.75e+02	3.73e+02 =	3.40e+02 +	2.10e+02 +	1.85e+02 +	3.56e+02 +	4.59e+02 -
CEC19-MaTSO3-T13	3.80e+02	3.77e+02 =	3.35e+02 +	2.18e+02 +	1.66e+02 +	3.54e+02 +	4.57e+02 -
CEC19-MaTSO3-T14	3.79e+02	3.75e+02 =	3.42e+02 +	2.27e+02 +	1.63e+02 +	3.44e+02 +	4.60e+02 -
CEC19-MaTSO3-T15	3.74e+02	3.81e+02 =	3.39e+02 +	1.97e+02 +	1.76e+02 +	3.68e+02 =	4.57e+02 -
CEC19-MaTSO3-T16	3.72e+02	3.78e+02 =	3.41e+02 +	2.36e+02 +	1.74e+02 +	3.64e+02 =	4.52e+02 -
CEC19-MaTSO3-T17	3.73e+02	3.76e+02 =	3.43e+02 +	2.20e+02 +	1.91e+02 +	3.44e+02 =	4.57e+02 -
CEC19-MaTSO3-T18	3.70e+02	3.73e+02 =	3.39e+02 +	2.27e+02 +	1.94e+02 +	3.36e+02 =	4.61e+02 -
CEC19-MaTSO3-T19	3.75e+02	3.75e+02 =	3.42e+02 +	2.41e+02 +	1.90e+02 +	3.38e+02 +	4.63e+02 -
CEC19-MaTSO3-T20	3.71e+02	3.77e+02 =	3.40e+02 +	1.97e+02 +	1.81e+02 +	3.43e+02 =	4.59e+02 -
CEC19-MaTSO3-T21	3.75e+02	3.73e+02 =	3.41e+02 +	2.35e+02 +	1.70e+02 +	3.62e+02 =	4.61e+02 -
CEC19-MaTSO3-T22	3.72e+02	3.78e+02 =	3.43e+02 +	2.11e+02 +	1.64e+02 +	3.57e+02 =	4.55e+02 -
CEC19-MaTSO3-T23	3.78e+02	3.77e+02 =	3.46e+02 +	2.18e+02 +	2.00e+02 +	3.61e+02 =	4.56e+02 -
CEC19-MaTSO3-T24	3.77e+02	3.76e+02 =	3.41e+02 +	2.21e+02 +	1.77e+02 +	3.42e+02 +	4.54e+02 -
CEC19-MaTSO3-T25	3.72e+02	3.79e+02 =	3.47e+02 +	2.38e+02 +	1.84e+02 +	3.50e+02 +	4.58e+02 -
CEC19-MaTSO3-T26	3.77e+02	3.69e+02 +	3.43e+02 +	2.21e+02 +	2.04e+02 +	3.62e+02 =	4.54e+02 -
CEC19-MaTSO3-T27	3.76e+02	3.73e+02 =	3.44e+02 +	2.50e+02 +	1.60e+02 +	3.47e+02 +	4.53e+02 -
CEC19-MaTSO3-T28	3.68e+02	3.77e+02 -	3.41e+02 +	2.00e+02 +	1.89e+02 +	3.67e+02 =	4.55e+02 -
CEC19-MaTSO3-T29	3.75e+02	3.78e+02 =	3.46e+02 +	2.58e+02 +	1.68e+02 +	3.43e+02 +	4.59e+02 -
CEC19-MaTSO3-T30	3.72e+02	3.78e+02 =	3.41e+02 +	2.37e+02 +	1.80e+02 +	3.42e+02 +	4.55e+02 -
CEC19-MaTSO3-T31	3.72e+02	3.76e+02 =	3.43e+02 +	1.93e+02 +	1.75e+02 +	3.49e+02 +	4.57e+02 -
CEC19-MaTSO3-T32	3.75e+02	3.74e+02 =	3.40e+02 +	2.08e+02 +	1.95e+02 +	3.37e+02 +	4.58e+02 -
CEC19-MaTSO3-T33	3.76e+02	3.72e+02 =	3.39e+02 +	2.43e+02 +	2.19e+02 +	3.37e+02 +	4.49e+02 -
CEC19-MaTSO3-T34	3.76e+02	3.75e+02 =	3.38e+02 +	2.35e+02 +	1.97e+02 +	3.46e+02 +	4.54e+02 -
CEC19-MaTSO3-T35	3.73e+02	3.80e+02 =	3.48e+02 +	2.51e+02 +	1.73e+02 +	3.55e+02 +	4.59e+02 -
CEC19-MaTSO3-T36	3.65e+02	3.75e+02 -	3.42e+02 +	2.13e+02 +	1.69e+02 +	3.69e+02 =	4.60e+02 -
CEC19-MaTSO3-T37	3.76e+02	3.73e+02 =	3.47e+02 +	2.30e+02 +	1.82e+02 +	3.59e+02 +	4.56e+02 -
CEC19-MaTSO3-T38	3.71e+02	3.79e+02 =	3.46e+02 +	2.11e+02 +	1.67e+02 +	3.63e+02 =	4.62e+02 -
CEC19-MaTSO3-T39	3.73e+02	3.75e+02 =	3.45e+02 +	2.82e+02 +	1.64e+02 +	3.55e+02 +	4.56e+02 -
CEC19-MaTSO3-T40	3.68e+02	3.78e+02 =	3.42e+02 +	2.44e+02 +	1.92e+02 +	3.62e+02 =	4.58e+02 -
CEC19-MaTSO3-T41	3.70e+02	3.75e+02 =	3.42e+02 +	2.12e+02 +	1.88e+02 +	3.61e+02 =	4.54e+02 -
CEC19-MaTSO3-T42	3.73e+02	3.79e+02 =	3.41e+02 +	2.55e+02 +	1.92e+02 +	3.62e+02 =	4.57e+02 -
CEC19-MaTSO3-T43	3.66e+02	3.84e+02 -	3.42e+02 +	2.52e+02 +	2.08e+02 +	3.67e+02 =	4.57e+02 -
CEC19-MaTSO3-T44	3.74e+02	3.76e+02 =	3.44e+02 +	2.23e+02 +	1.90e+02 +	3.57e+02 =	4.58e+02 -
CEC19-MaTSO3-T45	3.76e+02	3.76e+02 =	3.40e+02 +	2.47e+02 +	1.76e+02 +	3.42e+02 +	4.59e+02 -
CEC19-MaTSO3-T46	3.78e+02	3.73e+02 =	3.38e+02 +	2.01e+02 +	1.93e+02 +	3.51e+02 +	4.51e+02 -
CEC19-MaTSO3-T47	3.76e+02	3.74e+02 =	3.44e+02 +	1.87e+02 +	2.11e+02 +	3.47e+02 +	4.59e+02 -
CEC19-MaTSO3-T48	3.68e+02	3.78e+02 =	3.37e+02 +	2.26e+02 +	1.87e+02 +	3.59e+02 =	4.62e+02 -
CEC19-MaTSO3-T49	3.68e+02	3.80e+02 -	3.44e+02 +	2.34e+02 +	1.91e+02 +	3.51e+02 =	4.60e+02 -
CEC19-MaTSO3-T50	3.70e+02	3.80e+02 -	3.44e+02 +	2.05e+02 +	1.97e+02 +	3.57e+02 =	4.59e+02 -
+/-/=	Base	1/5/44	50/0/0	50/0/0	50/0/0	26/0/24	0/50/0

Table 4: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO4 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO4-T1	7.62e-09	3.19e-07 -	1.25e-07 -	5.21e-03 -	7.82e-04 -	5.48e-03 -	3.15e-01 -
CEC19-MaTSO4-T2	1.22e-08	2.64e-07 -	3.04e-07 =	7.92e-03 -	1.31e-03 -	6.00e-03 -	3.33e-01 -
CEC19-MaTSO4-T3	7.60e-09	2.32e-07 -	2.69e-07 =	1.42e-02 -	1.19e-03 -	5.87e-03 -	3.24e-01 -
CEC19-MaTSO4-T4	1.28e-08	2.14e-07 -	2.28e-06 =	1.05e-02 -	1.82e-03 -	1.38e-02 -	3.37e-01 -
CEC19-MaTSO4-T5	8.03e-09	1.43e-07 -	6.63e-08 -	7.97e-03 -	7.59e-04 -	8.09e-03 -	3.23e-01 -
CEC19-MaTSO4-T6	1.15e-08	2.78e-07 -	1.26e-06 =	4.65e-03 -	1.18e-03 -	8.61e-03 -	3.40e-01 -
CEC19-MaTSO4-T7	1.29e-08	1.43e-07 -	1.03e-07 -	9.69e-03 -	1.06e-03 -	5.13e-03 -	3.31e-01 -
CEC19-MaTSO4-T8	1.70e-08	2.53e-07 -	1.14e-06 =	9.29e-03 -	8.09e-04 -	5.68e-03 -	3.38e-01 -
CEC19-MaTSO4-T9	1.51e-08	1.81e-07 -	4.29e-07 =	3.36e-03 -	1.18e-03 -	9.82e-03 -	3.24e-01 -
CEC19-MaTSO4-T10	1.30e-08	2.49e-07 -	3.41e-07 -	2.88e-03 -	8.77e-04 -	7.93e-03 -	3.36e-01 -
CEC19-MaTSO4-T11	7.90e-09	1.72e-07 -	2.76e-07 =	8.99e-03 -	1.05e-03 -	4.09e-03 -	3.19e-01 -
CEC19-MaTSO4-T12	9.38e-09	3.18e-07 -	1.57e-07 -	3.57e-03 -	8.62e-04 -	7.32e-03 -	3.27e-01 -
CEC19-MaTSO4-T13	1.71e-08	4.87e-07 -	2.09e-07 -	3.02e-03 -	1.46e-03 -	9.10e-03 -	3.44e-01 -
CEC19-MaTSO4-T14	1.34e-08	2.00e-07 -	6.29e-08 -	4.55e-03 -	6.31e-04 -	7.39e-03 -	3.18e-01 -
CEC19-MaTSO4-T15	1.12e-08	3.06e-07 -	3.71e-04 =	1.39e-03 -	1.18e-03 -	7.18e-03 -	3.27e-01 -
CEC19-MaTSO4-T16	9.77e-09	2.58e-07 -	1.60e-07 -	4.32e-03 -	8.70e-04 -	5.15e-03 -	3.41e-01 -
CEC19-MaTSO4-T17	1.48e-08	1.34e-07 -	1.81e-09 +	4.50e-03 -	7.50e-04 -	6.46e-03 -	3.20e-01 -
CEC19-MaTSO4-T18	9.01e-09	9.90e-08 -	2.58e-07 =	3.97e-03 -	1.44e-03 -	6.99e-03 -	3.19e-01 -
CEC19-MaTSO4-T19	1.44e-08	4.00e-07 -	4.39e-07 =	1.03e-02 -	1.38e-03 -	3.29e-03 -	3.36e-01 -
CEC19-MaTSO4-T20	1.50e-08	1.95e-07 -	4.40e-07 =	7.06e-03 -	1.12e-03 -	7.71e-03 -	3.07e-01 -
CEC19-MaTSO4-T21	1.34e-08	5.15e-07 -	3.80e-07 -	4.01e-03 -	1.28e-03 -	8.48e-03 -	3.33e-01 -
CEC19-MaTSO4-T22	8.26e-09	2.41e-07 -	1.42e-07 =	7.19e-03 -	1.33e-03 -	8.72e-03 -	3.17e-01 -
CEC19-MaTSO4-T23	8.65e-09	1.80e-07 -	9.49e-08 =	9.04e-04 -	7.44e-04 -	9.67e-03 -	3.20e-01 -
CEC19-MaTSO4-T24	4.79e-09	7.52e-08 -	4.94e-04 =	6.87e-03 -	1.06e-03 -	7.19e-03 -	3.24e-01 -
CEC19-MaTSO4-T25	9.98e-09	1.81e-07 -	9.46e-07 =	4.97e-03 -	1.12e-03 -	4.14e-03 -	3.11e-01 -
CEC19-MaTSO4-T26	1.41e-08	2.37e-07 -	8.24e-07 -	6.97e-03 -	9.81e-04 -	5.87e-03 -	3.24e-01 -
CEC19-MaTSO4-T27	8.25e-09	2.72e-07 -	2.21e-07 =	4.42e-03 -	1.07e-03 -	2.56e-03 -	3.29e-01 -
CEC19-MaTSO4-T28	1.53e-08	1.49e-07 -	4.93e-04 -	1.57e-03 -	2.32e-03 -	8.98e-03 -	3.32e-01 -
CEC19-MaTSO4-T29	7.20e-09	1.25e-07 -	3.69e-07 =	4.20e-03 -	1.20e-03 -	1.12e-02 -	3.16e-01 -
CEC19-MaTSO4-T30	9.59e-09	9.82e-08 -	6.62e-07 =	5.33e-03 -	7.08e-04 -	2.72e-03 -	3.19e-01 -
CEC19-MaTSO4-T31	1.01e-08	3.37e-07 -	4.89e-07 =	5.17e-03 -	7.37e-04 -	4.57e-03 -	3.11e-01 -
CEC19-MaTSO4-T32	1.65e-08	1.04e-07 -	2.67e-07 -	3.75e-03 -	9.37e-04 -	1.11e-02 -	3.29e-01 -
CEC19-MaTSO4-T33	1.20e-08	2.56e-07 -	3.70e-04 =	4.69e-03 -	1.39e-03 -	7.42e-03 -	3.35e-01 -
CEC19-MaTSO4-T34	1.18e-08	2.33e-07 -	1.54e-07 -	5.10e-03 -	9.57e-04 -	3.51e-03 -	3.17e-01 -
CEC19-MaTSO4-T35	8.62e-09	1.25e-07 -	3.70e-04 =	1.91e-03 -	1.55e-03 -	4.40e-03 -	3.41e-01 -
CEC19-MaTSO4-T36	1.07e-08	4.71e-07 -	9.21e-08 =	5.77e-03 -	7.51e-04 -	4.05e-03 -	3.25e-01 -
CEC19-MaTSO4-T37	1.09e-08	3.37e-07 -	3.51e-07 -	2.84e-03 -	1.33e-03 -	6.45e-03 -	3.18e-01 -
CEC19-MaTSO4-T38	1.73e-08	4.26e-07 -	3.80e-07 -	1.60e-03 -	9.47e-04 -	5.77e-03 -	3.35e-01 -
CEC19-MaTSO4-T39	1.41e-08	1.29e-07 -	6.41e-07 =	4.81e-03 -	8.57e-04 -	5.20e-03 -	3.27e-01 -
CEC19-MaTSO4-T40	1.13e-08	1.05e-07 -	2.58e-07 =	5.76e-03 -	7.13e-04 -	4.24e-03 -	3.13e-01 -
CEC19-MaTSO4-T41	1.45e-08	2.38e-07 -	1.05e-07 -	3.15e-03 -	1.86e-03 -	3.85e-03 -	3.12e-01 -
CEC19-MaTSO4-T42	2.11e-08	3.90e-07 -	3.61e-08 -	2.50e-03 -	1.18e-03 -	6.97e-03 -	3.12e-01 -
CEC19-MaTSO4-T43	1.88e-08	2.95e-07 -	1.31e-07 -	1.01e-02 -	9.71e-04 -	7.31e-03 -	3.25e-01 -
CEC19-MaTSO4-T44	5.60e-09	1.75e-07 -	2.27e-07 =	5.26e-03 -	1.02e-03 -	4.94e-03 -	3.40e-01 -
CEC19-MaTSO4-T45	8.94e-09	2.87e-07 -	7.24e-07 -	1.29e-02 -	7.62e-04 -	2.85e-03 -	3.52e-01 -
CEC19-MaTSO4-T46	1.25e-08	1.43e-07 -	5.49e-07 =	9.21e-03 -	1.59e-03 -	4.39e-03 -	3.35e-01 -
CEC19-MaTSO4-T47	1.15e-08	1.16e-07 -	1.37e-06 =	2.93e-02 -	8.16e-04 -	8.68e-03 -	3.33e-01 -
CEC19-MaTSO4-T48	1.31e-08	2.81e-07 -	2.35e-08 -	5.55e-03 -	1.47e-03 -	9.59e-03 -	3.39e-01 -
CEC19-MaTSO4-T49	4.93e-04	3.82e-07 +	3.70e-04 =	1.41e-02 -	9.40e-04 -	9.66e-03 -	3.38e-01 -
CEC19-MaTSO4-T50	8.74e-09	4.08e-07 -	7.46e-08 =	2.96e-03 -	1.58e-03 -	7.78e-03 -	3.17e-01 -
+/-/=	Base	1/49/0	1/20/29	0/50/0	0/50/0	0/50/0	0/50/0

Table 5: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO5 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO5-T1	2.23e-05	2.83e-03 -	6.18e-02 =	2.07e-02 -	2.93e-01 -	1.06e-01 -	1.09e+00 -
CEC19-MaTSO5-T2	2.04e-04	5.64e-03 -	8.14e-02 =	2.49e-02 -	2.71e-01 -	1.11e-01 -	1.11e+00 -
CEC19-MaTSO5-T3	5.12e-04	3.27e-03 -	1.62e-02 =	1.10e-02 -	2.74e-01 -	2.91e-01 -	1.14e+00 -
CEC19-MaTSO5-T4	1.35e-04	3.20e-03 -	9.16e-03 =	2.03e-02 -	2.66e-01 -	1.60e-01 -	1.12e+00 -
CEC19-MaTSO5-T5	1.82e-04	5.29e-03 -	4.41e-03 =	1.88e-02 -	2.77e-01 -	2.13e-01 -	1.10e+00 -
CEC19-MaTSO5-T6	4.12e-04	5.46e-03 -	2.06e-02 =	3.74e-02 -	2.46e-01 -	2.15e-01 -	1.11e+00 -
CEC19-MaTSO5-T7	4.55e-04	9.78e-03 -	2.74e-02 =	4.31e-02 -	2.77e-01 -	1.11e-01 -	1.09e+00 -
CEC19-MaTSO5-T8	3.85e-04	4.31e-03 -	1.47e-02 =	8.38e-02 -	2.46e-01 -	8.77e-02 -	1.15e+00 -
CEC19-MaTSO5-T9	4.90e-04	6.53e-03 -	3.17e-02 =	1.70e-02 -	2.73e-01 -	2.24e-01 -	1.13e+00 -
CEC19-MaTSO5-T10	1.84e-04	5.96e-03 -	8.42e-03 =	7.60e-02 -	2.60e-01 -	1.33e-01 -	1.11e+00 -
CEC19-MaTSO5-T11	3.68e-04	5.71e-03 -	1.13e-02 =	5.80e-02 -	2.46e-01 -	2.55e-01 -	1.16e+00 -
CEC19-MaTSO5-T12	1.52e-04	3.95e-03 -	5.63e-03 =	2.93e-02 -	2.52e-01 -	2.03e-01 -	1.13e+00 -
CEC19-MaTSO5-T13	6.42e-05	2.00e-03 -	5.27e-03 -	6.53e-02 -	2.64e-01 -	1.29e-01 -	1.11e+00 -
CEC19-MaTSO5-T14	6.32e-05	5.57e-03 -	2.08e-02 =	2.63e-02 -	2.52e-01 -	1.63e-01 -	1.12e+00 -
CEC19-MaTSO5-T15	1.98e-04	3.49e-03 -	2.35e-02 =	7.62e-02 -	2.81e-01 -	9.67e-02 -	1.09e+00 -
CEC19-MaTSO5-T16	1.52e-05	1.96e-03 -	8.00e-02 =	3.49e-02 -	2.73e-01 -	1.99e-01 -	1.11e+00 -
CEC19-MaTSO5-T17	4.47e-05	3.58e-03 -	2.67e-02 =	1.05e-02 -	2.47e-01 -	1.99e-01 -	1.10e+00 -
CEC19-MaTSO5-T18	7.09e-05	5.56e-03 -	8.35e-02 =	1.67e-02 -	2.53e-01 -	1.29e-01 -	1.09e+00 -
CEC19-MaTSO5-T19	3.86e-04	6.83e-03 -	2.23e-02 =	1.20e-02 =	2.60e-01 -	1.37e-01 -	1.09e+00 -
CEC19-MaTSO5-T20	8.76e-05	3.70e-03 -	1.86e-02 =	1.56e-02 -	2.47e-01 -	2.18e-01 -	1.16e+00 -
CEC19-MaTSO5-T21	1.78e-04	3.21e-03 -	1.45e-02 =	2.09e-02 -	2.45e-01 -	1.63e-01 -	1.13e+00 -
CEC19-MaTSO5-T22	7.10e-05	3.76e-03 -	3.93e-02 =	5.07e-02 -	2.53e-01 -	1.76e-01 -	1.14e+00 -
CEC19-MaTSO5-T23	8.01e-05	3.01e-03 -	1.01e-02 -	2.58e-02 -	2.49e-01 -	3.28e-01 -	1.10e+00 -
CEC19-MaTSO5-T24	2.23e-04	4.06e-03 -	1.91e-02 =	3.14e-02 -	2.45e-01 -	6.22e-02 -	1.08e+00 -
CEC19-MaTSO5-T25	2.73e-04	6.38e-03 -	1.17e-02 =	1.45e-02 -	2.38e-01 -	2.49e-01 -	1.09e+00 -
CEC19-MaTSO5-T26	5.29e-05	2.53e-03 -	2.83e-02 =	1.87e-03 -	2.76e-01 -	1.68e-01 -	1.12e+00 -
CEC19-MaTSO5-T27	3.59e-04	4.62e-03 -	2.31e-02 =	7.31e-02 -	2.60e-01 -	2.14e-01 -	1.11e+00 -
CEC19-MaTSO5-T28	2.22e-04	6.00e-03 -	4.20e-03 -	3.31e-02 -	2.53e-01 -	2.28e-01 -	1.14e+00 -
CEC19-MaTSO5-T29	2.54e-04	6.37e-03 -	1.04e-02 =	6.53e-02 -	2.60e-01 -	2.31e-01 -	1.13e+00 -
CEC19-MaTSO5-T30	2.53e-04	5.06e-03 -	2.89e-04 -	3.62e-02 -	2.68e-01 -	1.45e-01 -	1.12e+00 -
CEC19-MaTSO5-T31	5.87e-05	2.24e-03 -	1.60e-02 =	1.98e-02 -	2.80e-01 -	1.48e-01 -	1.12e+00 -
CEC19-MaTSO5-T32	2.11e-04	1.67e-03 -	3.20e-02 =	2.72e-02 -	2.51e-01 -	1.50e-01 -	1.10e+00 -
CEC19-MaTSO5-T33	8.09e-05	3.56e-03 -	7.49e-03 -	1.30e-02 -	2.80e-01 -	1.67e-01 -	1.12e+00 -
CEC19-MaTSO5-T34	3.81e-04	3.16e-03 -	1.66e-02 =	4.40e-02 -	2.41e-01 -	2.80e-01 -	1.14e+00 -
CEC19-MaTSO5-T35	7.14e-05	2.10e-03 -	2.49e-03 =	1.55e-02 -	2.62e-01 -	1.18e-01 -	1.16e+00 -
CEC19-MaTSO5-T36	6.56e-04	3.81e-03 -	3.76e-02 =	3.09e-02 -	2.78e-01 -	1.30e-01 -	1.17e+00 -
CEC19-MaTSO5-T37	2.23e-04	3.83e-03 -	4.60e-03 -	7.58e-02 -	2.33e-01 -	1.75e-01 -	1.06e+00 -
CEC19-MaTSO5-T38	1.17e-04	1.17e-03 -	2.41e-02 =	1.36e-02 -	2.40e-01 -	1.65e-01 -	1.10e+00 -
CEC19-MaTSO5-T39	4.26e-05	4.07e-03 -	1.33e-02 =	4.53e-02 -	2.38e-01 -	1.71e-01 -	1.10e+00 -
CEC19-MaTSO5-T40	5.76e-04	3.92e-03 -	6.97e-02 =	3.18e-02 -	2.47e-01 -	1.60e-01 -	1.11e+00 -
CEC19-MaTSO5-T41	1.84e-05	4.63e-03 -	8.73e-03 =	2.98e-02 -	2.41e-01 -	2.08e-01 -	1.10e+00 -
CEC19-MaTSO5-T42	2.46e-04	2.36e-03 -	4.49e-02 =	5.64e-02 -	2.53e-01 -	1.50e-01 -	1.10e+00 -
CEC19-MaTSO5-T43	7.15e-05	2.61e-03 -	1.24e-02 =	1.38e-02 -	2.63e-01 -	1.88e-01 -	1.14e+00 -
CEC19-MaTSO5-T44	5.52e-05	6.14e-03 -	3.16e-02 -	9.44e-03 -	2.61e-01 -	1.87e-01 -	1.15e+00 -
CEC19-MaTSO5-T45	5.02e-04	2.68e-03 -	5.05e-03 =	5.21e-02 -	2.60e-01 -	1.46e-01 -	1.12e+00 -
CEC19-MaTSO5-T46	2.87e-04	3.23e-03 -	2.28e-02 =	5.03e-02 -	2.77e-01 -	1.76e-01 -	1.09e+00 -
CEC19-MaTSO5-T47	5.23e-05	3.22e-03 -	7.89e-03 =	2.88e-02 -	2.47e-01 -	1.57e-01 -	1.14e+00 -
CEC19-MaTSO5-T48	4.87e-04	3.19e-03 -	1.12e-02 =	5.72e-02 -	2.63e-01 -	2.37e-01 -	1.12e+00 -
CEC19-MaTSO5-T49	9.02e-05	6.22e-03 -	2.56e-02 =	6.26e-02 -	2.66e-01 -	9.74e-02 -	1.11e+00 -
CEC19-MaTSO5-T50	1.45e-05	3.87e-03 -	3.30e-02 =	1.32e-02 -	2.78e-01 -	1.58e-01 -	1.11e+00 -
+/-/=	Base	0/50/0	0/7/43	0/49/1	0/50/0	0/50/0	0/50/0

Table 6: The comparison results of MTEA-HKTS with other six algorithms on CEC19-MaTSO6 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
CEC19-MaTSO6-T1	6.36e-04	8.19e+01 -	1.20e+04 -	2.14e+02 -	1.35e+03 -	2.53e-03 -	9.03e+03 -
CEC19-MaTSO6-T2	6.36e-04	1.55e-01 -	1.25e+04 -	2.46e+02 -	1.13e+03 -	2.24e-03 -	1.01e+04 -
CEC19-MaTSO6-T3	6.36e-04	9.76e-01 -	1.20e+04 -	2.40e+02 -	1.25e+03 -	2.01e-03 -	9.54e+03 -
CEC19-MaTSO6-T4	6.36e-04	1.84e+02 -	1.20e+04 -	1.94e+02 -	1.24e+03 -	2.46e-03 -	9.09e+03 -
CEC19-MaTSO6-T5	6.36e-04	3.17e+01 -	1.17e+04 -	2.38e+02 -	1.25e+03 -	2.53e-03 -	8.47e+03 -
CEC19-MaTSO6-T6	6.36e-04	3.19e-02 -	1.21e+04 -	1.93e+02 -	1.35e+03 -	2.23e-03 -	9.32e+03 -
CEC19-MaTSO6-T7	6.36e-04	8.45e+00 -	1.14e+04 -	1.71e+02 -	1.28e+03 -	2.29e-03 -	8.23e+03 -
CEC19-MaTSO6-T8	6.36e-04	1.19e-02 -	1.27e+04 -	2.75e+02 -	1.24e+03 -	2.06e-03 -	1.04e+04 -
CEC19-MaTSO6-T9	6.36e-04	4.63e-02 -	1.24e+04 -	2.64e+02 -	1.28e+03 -	1.76e-03 -	1.04e+04 -
CEC19-MaTSO6-T10	6.36e-04	1.12e+02 -	1.10e+04 -	2.14e+02 -	1.27e+03 -	2.44e-03 -	7.46e+03 -
CEC19-MaTSO6-T11	6.36e-04	8.68e-03 -	1.30e+04 -	1.95e+02 -	1.24e+03 -	1.67e-03 -	1.13e+04 -
CEC19-MaTSO6-T12	6.36e-04	1.11e+02 -	1.20e+04 -	2.09e+02 -	1.23e+03 -	2.75e-03 -	8.97e+03 -
CEC19-MaTSO6-T13	6.36e-04	1.73e+00 -	1.20e+04 -	2.04e+02 -	1.39e+03 -	2.42e-03 -	9.00e+03 -
CEC19-MaTSO6-T14	6.36e-04	1.41e-01 -	1.23e+04 -	2.44e+02 -	1.17e+03 -	2.52e-03 -	9.79e+03 -
CEC19-MaTSO6-T15	6.36e-04	1.61e-01 -	1.23e+04 -	2.27e+02 -	1.27e+03 -	1.96e-03 -	1.01e+04 -
CEC19-MaTSO6-T16	6.36e-04	2.64e+00 -	1.14e+04 -	2.48e+02 -	1.40e+03 -	2.66e-03 -	8.51e+03 -
CEC19-MaTSO6-T17	6.36e-04	1.51e-01 -	1.17e+04 -	2.43e+02 -	1.30e+03 -	2.55e-03 -	9.23e+03 -
CEC19-MaTSO6-T18	6.36e-04	1.16e+01 -	1.16e+04 -	2.31e+02 -	1.18e+03 -	2.59e-03 -	8.88e+03 -
CEC19-MaTSO6-T19	6.36e-04	1.12e-02 -	1.20e+04 -	2.78e+02 -	1.31e+03 -	2.39e-03 -	9.15e+03 -
CEC19-MaTSO6-T20	6.36e-04	9.03e-01 -	1.04e+04 -	1.96e+02 -	1.29e+03 -	2.79e-03 -	7.24e+03 -
CEC19-MaTSO6-T21	6.36e-04	1.72e+02 -	1.15e+04 -	2.31e+02 -	1.29e+03 -	2.49e-03 -	8.90e+03 -
CEC19-MaTSO6-T22	6.36e-04	1.02e+00 -	1.19e+04 -	2.44e+02 -	1.34e+03 -	1.68e-03 -	9.73e+03 -
CEC19-MaTSO6-T23	6.36e-04	1.07e-01 -	1.19e+04 -	2.18e+02 -	1.48e+03 -	2.15e-03 -	9.73e+03 -
CEC19-MaTSO6-T24	6.36e-04	1.87e+02 -	1.17e+04 -	2.45e+02 -	1.23e+03 -	2.02e-03 -	9.21e+03 -
CEC19-MaTSO6-T25	6.36e-04	8.06e-01 -	1.17e+04 -	2.29e+02 -	1.32e+03 -	2.32e-03 -	9.29e+03 -
CEC19-MaTSO6-T26	6.36e-04	1.89e+02 -	1.28e+04 -	2.20e+02 -	1.34e+03 -	2.23e-03 -	1.10e+04 -
CEC19-MaTSO6-T27	6.36e-04	1.39e+00 -	1.21e+04 -	2.66e+02 -	1.21e+03 -	2.14e-03 -	9.38e+03 -
CEC19-MaTSO6-T28	6.36e-04	1.70e+01 -	1.08e+04 -	2.08e+02 -	1.35e+03 -	2.79e-03 -	8.10e+03 -
CEC19-MaTSO6-T29	6.36e-04	1.57e+02 -	1.14e+04 -	2.77e+02 -	1.23e+03 -	2.38e-03 -	8.73e+03 -
CEC19-MaTSO6-T30	6.36e-04	2.61e-01 -	1.15e+04 -	2.40e+02 -	1.12e+03 -	2.35e-03 -	9.11e+03 -
CEC19-MaTSO6-T31	6.36e-04	1.61e+00 -	1.18e+04 -	2.43e+02 -	1.37e+03 -	2.41e-03 -	9.15e+03 -
CEC19-MaTSO6-T32	6.36e-04	1.77e+01 -	1.21e+04 -	2.26e+02 -	1.31e+03 -	2.25e-03 -	9.88e+03 -
CEC19-MaTSO6-T33	6.36e-04	5.10e-02 -	1.19e+04 -	2.07e+02 -	1.32e+03 -	2.56e-03 -	9.40e+03 -
CEC19-MaTSO6-T34	6.36e-04	3.99e-02 -	1.24e+04 -	1.90e+02 -	1.25e+03 -	2.22e-03 -	1.05e+04 -
CEC19-MaTSO6-T35	6.36e-04	1.53e-01 -	1.19e+04 -	2.23e+02 -	1.17e+03 -	2.36e-03 -	9.57e+03 -
CEC19-MaTSO6-T36	6.36e-04	1.92e-02 -	1.05e+04 -	2.21e+02 -	1.32e+03 -	2.20e-03 -	8.22e+03 -
CEC19-MaTSO6-T37	6.36e-04	9.61e-02 -	1.16e+04 -	1.88e+02 -	1.13e+03 -	2.17e-03 -	9.74e+03 -
CEC19-MaTSO6-T38	6.36e-04	2.75e+01 -	1.18e+04 -	1.99e+02 -	1.23e+03 -	2.37e-03 -	9.74e+03 -
CEC19-MaTSO6-T39	6.36e-04	2.01e+01 -	1.20e+04 -	2.09e+02 -	1.24e+03 -	2.10e-03 -	9.68e+03 -
CEC19-MaTSO6-T40	6.36e-04	8.36e-01 -	1.19e+04 -	2.46e+02 -	1.26e+03 -	2.62e-03 -	9.73e+03 -
CEC19-MaTSO6-T41	6.36e-04	1.20e+02 -	1.12e+04 -	2.31e+02 -	1.41e+03 -	2.38e-03 -	8.91e+03 -
CEC19-MaTSO6-T42	6.36e-04	1.15e-02 -	1.25e+04 -	1.87e+02 -	1.38e+03 -	1.83e-03 -	1.06e+04 -
CEC19-MaTSO6-T43	6.36e-04	1.06e+02 -	1.09e+04 -	2.02e+02 -	1.39e+03 -	2.05e-03 -	8.81e+03 -
CEC19-MaTSO6-T44	6.36e-04	9.72e-01 -	1.16e+04 -	2.24e+02 -	1.28e+03 -	2.84e-03 -	9.60e+03 -
CEC19-MaTSO6-T45	6.36e-04	2.80e+01 -	1.08e+04 -	1.95e+02 -	1.15e+03 -	2.90e-03 -	8.63e+03 -
CEC19-MaTSO6-T46	6.36e-04	9.54e+00 -	1.04e+04 -	2.28e+02 -	1.22e+03 -	2.74e-03 -	8.29e+03 -
CEC19-MaTSO6-T47	6.36e-04	8.76e+01 -	1.22e+04 -	2.45e+02 -	1.29e+03 -	2.92e-03 -	1.02e+04 -
CEC19-MaTSO6-T48	6.36e-04	1.99e+00 -	1.14e+04 -	2.18e+02 -	1.17e+03 -	2.16e-03 -	9.33e+03 -
CEC19-MaTSO6-T49	6.36e-04	2.28e+00 -	1.10e+04 -	2.46e+02 -	1.24e+03 -	3.04e-03 -	8.66e+03 -
CEC19-MaTSO6-T50	6.36e-04	3.03e-02 -	1.16e+04 -	1.89e+02 -	1.18e+03 -	2.44e-03 -	9.50e+03 -
+/-/=	Base	0/50/0	0/50/0	0/50/0	0/50/0	0/50/0	0/50/0

Table 7: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO1 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO1-T1	3.05e-18	4.98e-09 -	2.16e-26 +	4.06e-06 -	7.79e-04 -	7.93e-07 -	1.78e-02 -
WCCI20-MaTSO1-T2	2.04e-22	2.27e-10 -	2.18e-09 -	2.60e-05 -	9.95e-04 -	6.85e-07 -	1.86e-02 -
WCCI20-MaTSO1-T3	5.07e-23	5.84e-10 -	5.52e-11 -	2.81e-04 -	7.43e-04 -	8.81e-07 -	1.95e-02 -
WCCI20-MaTSO1-T4	5.86e-23	2.37e-09 -	3.79e-10 -	2.03e-01 -	7.87e-04 -	1.06e-06 -	1.98e-02 -
WCCI20-MaTSO1-T5	1.18e-22	2.50e-10 -	5.07e-07 -	1.69e-03 -	9.26e-04 -	6.41e-07 -	1.96e-02 -
WCCI20-MaTSO1-T6	1.98e-20	2.00e-09 -	5.29e-26 +	9.51e-03 -	6.93e-04 -	1.13e-06 -	1.81e-02 -
WCCI20-MaTSO1-T7	1.53e-22	2.27e-09 -	2.35e-08 -	1.93e-03 -	7.28e-04 -	1.00e-06 -	2.03e-02 -
WCCI20-MaTSO1-T8	1.83e-22	2.56e-08 -	2.07e-06 -	1.41e-03 -	8.07e-04 -	1.21e-06 -	1.87e-02 -
WCCI20-MaTSO1-T9	6.47e-23	3.71e-09 -	2.90e-11 -	1.26e-06 -	8.78e-04 -	1.42e-06 -	1.97e-02 -
WCCI20-MaTSO1-T10	2.37e-20	1.06e-08 -	6.82e-26 +	8.28e-04 -	8.32e-04 -	1.08e-06 -	1.94e-02 -
WCCI20-MaTSO1-T11	4.85e-23	2.16e-09 -	1.33e-08 -	3.49e-03 -	9.56e-04 -	9.31e-07 -	1.88e-02 -
WCCI20-MaTSO1-T12	6.56e-23	3.38e-09 -	1.38e-06 =	1.08e-04 -	9.65e-04 -	8.08e-07 -	1.69e-02 -
WCCI20-MaTSO1-T13	6.10e-22	5.77e-10 -	1.11e-21 -	1.53e-03 -	9.58e-04 -	1.07e-06 -	1.86e-02 -
WCCI20-MaTSO1-T14	2.32e-23	9.23e-09 -	2.95e-09 -	1.73e-03 -	6.75e-04 -	1.25e-06 -	2.03e-02 -
WCCI20-MaTSO1-T15	1.84e-23	2.31e-07 -	2.58e-08 -	2.90e-05 -	9.42e-04 -	9.48e-07 -	1.98e-02 -
WCCI20-MaTSO1-T16	3.30e-23	4.05e-08 -	2.62e-22 -	5.21e-04 -	7.68e-04 -	1.09e-06 -	1.95e-02 -
WCCI20-MaTSO1-T17	1.01e-22	1.79e-09 -	1.13e-15 -	2.96e-04 -	8.86e-04 -	1.04e-06 -	1.75e-02 -
WCCI20-MaTSO1-T18	3.02e-22	3.52e-09 -	1.72e-16 -	4.97e-03 -	9.28e-04 -	7.51e-07 -	1.91e-02 -
WCCI20-MaTSO1-T19	1.78e-22	1.54e-09 -	3.21e-11 -	1.69e-04 -	7.14e-04 -	1.09e-06 -	1.91e-02 -
WCCI20-MaTSO1-T20	5.20e-23	6.36e-09 -	7.29e-22 -	6.85e-05 -	9.39e-04 -	1.48e-06 -	1.93e-02 -
WCCI20-MaTSO1-T21	4.72e-23	6.64e-08 -	6.96e-14 -	1.56e-04 -	8.00e-04 -	6.79e-07 -	1.96e-02 -
WCCI20-MaTSO1-T22	6.22e-23	2.04e-09 -	2.27e-12 -	2.95e-03 -	1.10e-03 -	1.28e-06 -	1.89e-02 -
WCCI20-MaTSO1-T23	5.13e-21	7.20e-09 -	5.95e-10 -	1.07e-03 -	7.74e-04 -	1.31e-06 -	1.88e-02 -
WCCI20-MaTSO1-T24	2.29e-22	2.25e-10 -	1.87e-08 -	3.46e-02 -	6.92e-04 -	7.16e-07 -	1.90e-02 -
WCCI20-MaTSO1-T25	4.23e-23	5.86e-10 -	7.01e-12 -	2.29e-03 -	7.74e-04 -	8.23e-07 -	1.92e-02 -
WCCI20-MaTSO1-T26	3.13e-22	2.10e-09 -	1.61e-18 -	1.73e-04 -	7.80e-04 -	7.27e-07 -	2.08e-02 -
WCCI20-MaTSO1-T27	5.15e-23	7.18e-09 -	5.71e-22 -	7.60e-04 -	8.59e-04 -	9.09e-07 -	1.74e-02 -
WCCI20-MaTSO1-T28	4.74e-23	2.64e-10 -	4.12e-06 -	1.11e-10 -	7.17e-04 -	9.89e-07 -	1.82e-02 -
WCCI20-MaTSO1-T29	1.73e-22	8.44e-09 -	1.46e-20 -	1.53e-02 -	8.18e-04 -	8.44e-07 -	1.73e-02 -
WCCI20-MaTSO1-T30	8.89e-23	3.00e-09 -	5.87e-08 -	9.85e-04 -	8.82e-04 -	1.10e-06 -	1.72e-02 -
WCCI20-MaTSO1-T31	3.71e-22	1.34e-09 -	1.05e-07 -	8.00e-05 -	9.18e-04 -	1.06e-06 -	1.96e-02 -
WCCI20-MaTSO1-T32	6.00e-23	7.70e-09 -	8.72e-09 =	3.59e-03 -	8.44e-04 -	8.68e-07 -	1.88e-02 -
WCCI20-MaTSO1-T33	1.39e-22	8.54e-10 -	4.18e-09 -	1.09e-02 -	8.52e-04 -	6.84e-07 -	1.83e-02 -
WCCI20-MaTSO1-T34	1.88e-22	7.58e-10 -	1.02e-21 -	4.29e-05 -	8.71e-04 -	1.01e-06 -	1.86e-02 -
WCCI20-MaTSO1-T35	5.63e-23	5.71e-10 -	4.75e-26 +	7.32e-05 -	7.23e-04 -	6.92e-07 -	2.01e-02 -
WCCI20-MaTSO1-T36	1.30e-22	3.61e-09 -	2.37e-09 -	3.22e-06 -	7.86e-04 -	1.39e-06 -	2.03e-02 -
WCCI20-MaTSO1-T37	1.23e-22	3.22e-10 -	2.14e-18 -	2.74e-03 -	8.44e-04 -	6.90e-07 -	1.87e-02 -
WCCI20-MaTSO1-T38	2.14e-23	1.62e-08 -	2.10e-07 -	1.29e-02 -	8.17e-04 -	1.51e-06 -	1.77e-02 -
WCCI20-MaTSO1-T39	4.57e-23	4.27e-10 -	3.06e-22 -	9.20e-06 -	9.61e-04 -	7.94e-07 -	1.91e-02 -
WCCI20-MaTSO1-T40	5.00e-23	5.33e-09 -	5.16e-11 -	1.24e-05 -	7.30e-04 -	1.26e-06 -	1.88e-02 -
WCCI20-MaTSO1-T41	3.44e-22	5.32e-10 -	1.63e-16 -	2.94e-03 -	8.78e-04 -	1.12e-06 -	1.87e-02 -
WCCI20-MaTSO1-T42	1.03e-22	4.30e-09 -	2.10e-08 -	3.79e-03 -	7.55e-04 -	1.03e-06 -	1.89e-02 -
WCCI20-MaTSO1-T43	1.97e-22	2.04e-10 -	2.82e-20 -	1.88e-04 -	8.49e-04 -	1.02e-06 -	1.95e-02 -
WCCI20-MaTSO1-T44	4.07e-23	2.74e-08 -	2.38e-26 +	1.13e-04 -	7.93e-04 -	8.68e-07 -	1.85e-02 -
WCCI20-MaTSO1-T45	9.42e-23	1.18e-08 -	4.55e-17 -	1.19e-01 -	8.09e-04 -	1.34e-06 -	2.02e-02 -
WCCI20-MaTSO1-T46	8.89e-23	3.75e-10 -	1.71e-08 -	2.69e-02 -	7.09e-04 -	6.33e-07 -	2.01e-02 -
WCCI20-MaTSO1-T47	7.92e-23	6.05e-09 -	1.67e-08 -	2.58e-03 -	9.15e-04 -	1.41e-06 -	1.79e-02 -
WCCI20-MaTSO1-T48	1.31e-17	2.09e-09 -	4.09e-07 -	1.57e-03 -	8.01e-04 -	6.71e-07 -	2.04e-02 -
WCCI20-MaTSO1-T49	4.83e-23	8.11e-09 -	4.01e-08 -	1.19e-06 -	7.17e-04 -	9.59e-07 -	2.03e-02 -
WCCI20-MaTSO1-T50	7.84e-23	1.62e-09 -	9.61e-12 -	3.19e-03 -	8.96e-04 -	1.18e-06 -	1.75e-02 -
+/-/=	Base	0/50/0	5/43/2	0/50/0	0/50/0	0/50/0	0/50/0

Table 8: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO2 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO2-T1	4.76e+01	4.79e+01 =	1.24e+02 =	1.67e+02 -	9.22e+01 -	9.50e+01 -	4.42e+03 -
WCCI20-MaTSO2-T2	9.40e+01	7.46e+01 =	1.23e+02 -	2.35e+02 =	5.94e+02 =	3.76e+02 -	3.08e+03 -
WCCI20-MaTSO2-T3	4.77e+01	5.47e+01 =	1.00e+02 -	2.82e+02 -	2.12e+02 -	1.59e+02 -	4.41e+03 -
WCCI20-MaTSO2-T4	4.71e+01	4.72e+01 =	1.27e+02 -	3.26e+02 -	1.10e+02 -	1.53e+02 -	2.80e+03 -
WCCI20-MaTSO2-T5	6.66e+01	6.05e+01 =	1.13e+02 -	2.05e+02 =	5.41e+02 -	1.60e+02 -	5.22e+03 -
WCCI20-MaTSO2-T6	4.74e+01	5.08e+01 =	9.10e+01 -	1.59e+02 -	1.71e+02 -	1.05e+02 -	5.19e+03 -
WCCI20-MaTSO2-T7	4.73e+01	5.10e+01 =	1.11e+02 -	9.57e+01 -	2.67e+02 -	1.12e+02 -	4.60e+03 -
WCCI20-MaTSO2-T8	4.76e+01	4.77e+01 =	6.84e+01 -	1.07e+02 -	3.83e+02 -	9.06e+01 -	4.91e+03 -
WCCI20-MaTSO2-T9	5.05e+01	6.41e+01 -	1.06e+02 -	4.72e+02 -	7.03e+02 -	1.81e+02 -	2.49e+03 -
WCCI20-MaTSO2-T10	4.71e+01	4.77e+01 -	1.48e+02 -	2.74e+02 -	2.37e+02 -	6.57e+01 -	4.50e+03 -
WCCI20-MaTSO2-T11	4.74e+01	4.79e+01 -	8.50e+01 -	2.38e+02 -	4.02e+02 -	8.94e+01 -	1.42e+03 -
WCCI20-MaTSO2-T12	4.77e+01	4.80e+01 =	8.63e+01 -	3.04e+02 =	1.87e+02 -	7.63e+01 -	1.82e+03 -
WCCI20-MaTSO2-T13	5.98e+01	5.59e+01 =	1.53e+02 -	3.33e+02 =	9.80e+01 -	1.39e+02 -	5.52e+03 -
WCCI20-MaTSO2-T14	4.72e+01	4.75e+01 =	7.42e+01 -	2.00e+02 -	3.77e+02 -	1.00e+02 -	1.69e+03 -
WCCI20-MaTSO2-T15	5.65e+01	6.21e+01 -	1.29e+02 -	4.08e+02 -	5.21e+02 -	2.52e+02 -	3.42e+03 -
WCCI20-MaTSO2-T16	4.71e+01	4.77e+01 -	1.32e+02 -	2.74e+02 -	5.83e+02 -	8.78e+01 -	1.93e+03 -
WCCI20-MaTSO2-T17	4.75e+01	4.76e+01 =	8.10e+01 -	2.38e+02 -	2.26e+02 -	1.05e+02 -	1.35e+03 -
WCCI20-MaTSO2-T18	5.34e+01	5.70e+01 =	1.78e+02 -	3.23e+02 -	2.88e+02 -	1.41e+02 -	2.18e+03 -
WCCI20-MaTSO2-T19	4.74e+01	4.75e+01 =	5.32e+01 =	2.55e+02 -	5.27e+01 -	7.47e+01 -	1.13e+03 -
WCCI20-MaTSO2-T20	4.76e+01	4.77e+01 =	8.12e+01 -	9.31e+01 -	1.82e+02 -	1.39e+02 -	1.90e+03 -
WCCI20-MaTSO2-T21	5.11e+01	5.31e+01 =	1.01e+02 -	1.02e+02 -	2.87e+02 -	1.22e+02 -	2.56e+03 -
WCCI20-MaTSO2-T22	4.73e+01	4.74e+01 =	7.10e+01 -	2.75e+02 -	2.24e+02 -	1.19e+02 -	1.28e+03 -
WCCI20-MaTSO2-T23	5.40e+01	4.79e+01 =	8.12e+01 -	2.17e+02 -	1.40e+02 -	1.10e+02 -	3.53e+03 -
WCCI20-MaTSO2-T24	4.74e+01	5.23e+01 -	7.19e+01 -	1.80e+02 -	7.72e+01 -	1.08e+02 -	2.15e+03 -
WCCI20-MaTSO2-T25	4.74e+01	4.74e+01 =	7.56e+01 -	2.38e+02 -	3.77e+02 -	1.20e+02 -	3.07e+03 -
WCCI20-MaTSO2-T26	4.76e+01	5.09e+01 =	5.83e+01 -	1.89e+02 -	8.51e+01 -	9.48e+01 -	3.82e+03 -
WCCI20-MaTSO2-T27	5.04e+01	5.53e+01 -	1.71e+02 -	1.09e+02 -	3.91e+02 -	1.24e+02 -	4.63e+03 -
WCCI20-MaTSO2-T28	4.78e+01	5.10e+01 =	1.29e+02 -	2.21e+02 -	1.60e+02 -	9.52e+01 -	1.49e+03 -
WCCI20-MaTSO2-T29	4.77e+01	5.08e+01 =	6.66e+01 -	8.89e+01 -	4.19e+02 -	6.69e+01 -	5.77e+03 -
WCCI20-MaTSO2-T30	5.01e+01	5.71e+01 =	3.79e+02 -	5.54e+02 -	2.77e+02 -	4.05e+02 -	4.49e+03 -
WCCI20-MaTSO2-T31	5.00e+01	4.72e+01 =	2.11e+02 -	2.18e+02 -	5.41e+02 -	1.94e+02 -	2.56e+03 -
WCCI20-MaTSO2-T32	5.35e+01	5.95e+01 =	1.74e+02 -	8.84e+01 -	4.02e+02 -	2.02e+02 -	2.17e+03 -
WCCI20-MaTSO2-T33	4.75e+01	4.78e+01 -	8.91e+01 -	1.01e+02 -	2.97e+02 -	7.72e+01 -	2.75e+03 -
WCCI20-MaTSO2-T34	4.77e+01	4.75e+01 =	9.75e+01 =	3.21e+02 =	2.37e+02 -	7.34e+01 -	8.55e+03 -
WCCI20-MaTSO2-T35	4.73e+01	4.76e+01 -	1.18e+02 -	1.37e+02 -	2.57e+02 -	1.09e+02 -	3.87e+03 -
WCCI20-MaTSO2-T36	4.75e+01	4.77e+01 =	6.72e+01 -	4.22e+02 -	1.44e+02 -	1.15e+02 -	7.42e+03 -
WCCI20-MaTSO2-T37	4.76e+01	5.12e+01 =	7.31e+01 -	2.04e+02 -	2.31e+02 -	7.98e+01 -	2.40e+03 -
WCCI20-MaTSO2-T38	5.06e+01	5.66e+01 =	2.05e+02 -	1.38e+02 -	6.42e+02 -	1.93e+02 -	5.05e+03 -
WCCI20-MaTSO2-T39	5.74e+01	6.69e+01 -	2.90e+02 -	5.95e+02 -	6.97e+02 -	4.39e+02 -	2.58e+03 -
WCCI20-MaTSO2-T40	5.06e+01	5.10e+01 =	9.39e+01 -	3.56e+02 =	1.81e+02 -	1.28e+02 -	1.64e+03 -
WCCI20-MaTSO2-T41	9.88e+01	1.01e+02 =	1.62e+02 -	8.64e+01 =	1.18e+02 =	2.57e+02 -	2.77e+03 -
WCCI20-MaTSO2-T42	4.75e+01	4.80e+01 -	1.76e+02 -	3.29e+02 -	5.13e+02 -	1.80e+02 -	2.08e+03 -
WCCI20-MaTSO2-T43	4.77e+01	4.79e+01 =	5.88e+01 -	7.62e+01 -	1.14e+02 -	8.91e+01 -	1.92e+03 -
WCCI20-MaTSO2-T44	5.03e+01	5.39e+01 =	8.97e+01 -	2.09e+02 =	1.47e+02 -	9.43e+01 -	1.73e+03 -
WCCI20-MaTSO2-T45	5.70e+01	6.03e+01 =	9.34e+01 =	2.61e+02 -	5.28e+02 -	1.28e+02 -	2.04e+03 -
WCCI20-MaTSO2-T46	5.06e+01	5.18e+01 =	1.37e+02 -	2.20e+02 -	3.13e+02 -	1.40e+02 -	3.39e+03 -
WCCI20-MaTSO2-T47	6.01e+01	8.39e+01 =	2.79e+02 -	1.94e+02 -	1.88e+02 -	2.18e+02 -	3.20e+03 -
WCCI20-MaTSO2-T48	4.74e+01	5.26e+01 =	1.67e+02 -	4.16e+02 -	9.84e+01 -	2.40e+02 -	1.54e+03 -
WCCI20-MaTSO2-T49	4.77e+01	4.82e+01 -	1.31e+02 -	2.30e+02 =	1.77e+02 -	9.01e+01 -	1.68e+03 -
WCCI20-MaTSO2-T50	5.12e+01	4.78e+01 +	7.82e+01 -	1.81e+02 =	1.33e+02 -	1.13e+02 -	2.46e+03 -
+/-/=	Base	1/12/37	0/46/4	0/40/10	0/48/2	0/50/0	0/50/0

Table 9: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO3 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO3-T1	3.61e+02	3.76e+02 -	3.38e+02 +	2.29e+02 +	1.89e+02 +	3.04e+02 +	4.56e+02 -
WCCI20-MaTSO3-T2	3.63e+02	3.69e+02 =	3.41e+02 +	1.98e+02 +	1.81e+02 +	2.95e+02 +	4.58e+02 -
WCCI20-MaTSO3-T3	3.69e+02	3.69e+02 =	3.42e+02 +	2.33e+02 +	1.98e+02 +	3.00e+02 +	4.59e+02 -
WCCI20-MaTSO3-T4	3.70e+02	3.69e+02 =	3.41e+02 +	2.29e+02 +	1.85e+02 +	2.87e+02 +	4.63e+02 -
WCCI20-MaTSO3-T5	3.67e+02	3.74e+02 =	3.36e+02 +	2.07e+02 +	1.72e+02 +	2.76e+02 +	4.59e+02 -
WCCI20-MaTSO3-T6	3.75e+02	3.73e+02 =	3.42e+02 +	2.25e+02 +	1.96e+02 +	3.11e+02 +	4.57e+02 -
WCCI20-MaTSO3-T7	3.73e+02	3.74e+02 =	3.38e+02 +	2.26e+02 +	1.84e+02 +	3.18e+02 +	4.59e+02 -
WCCI20-MaTSO3-T8	3.72e+02	3.78e+02 =	3.38e+02 +	2.29e+02 +	1.87e+02 +	3.00e+02 +	4.57e+02 -
WCCI20-MaTSO3-T9	3.68e+02	3.79e+02 -	3.39e+02 +	2.48e+02 +	1.67e+02 +	3.09e+02 +	4.57e+02 -
WCCI20-MaTSO3-T10	3.66e+02	3.70e+02 =	3.39e+02 +	2.00e+02 +	1.96e+02 +	3.09e+02 +	4.59e+02 -
WCCI20-MaTSO3-T11	3.70e+02	3.69e+02 =	3.43e+02 +	2.27e+02 +	1.93e+02 +	3.02e+02 +	4.63e+02 -
WCCI20-MaTSO3-T12	3.71e+02	3.69e+02 =	3.41e+02 +	2.13e+02 +	1.99e+02 +	3.00e+02 +	4.52e+02 -
WCCI20-MaTSO3-T13	3.74e+02	3.70e+02 =	3.44e+02 +	2.41e+02 +	1.83e+02 +	3.07e+02 +	4.54e+02 -
WCCI20-MaTSO3-T14	3.69e+02	3.72e+02 =	3.40e+02 +	2.20e+02 +	1.97e+02 +	3.08e+02 +	4.63e+02 -
WCCI20-MaTSO3-T15	3.73e+02	3.77e+02 =	3.37e+02 +	2.14e+02 +	1.91e+02 +	2.98e+02 +	4.56e+02 -
WCCI20-MaTSO3-T16	3.66e+02	3.71e+02 =	3.36e+02 +	2.72e+02 +	1.79e+02 +	3.10e+02 +	4.62e+02 -
WCCI20-MaTSO3-T17	3.66e+02	3.79e+02 -	3.43e+02 +	1.97e+02 +	1.75e+02 +	3.17e+02 +	4.60e+02 -
WCCI20-MaTSO3-T18	3.71e+02	3.69e+02 =	3.37e+02 +	2.06e+02 +	1.87e+02 +	3.07e+02 +	4.55e+02 -
WCCI20-MaTSO3-T19	3.65e+02	3.70e+02 =	3.44e+02 +	2.34e+02 +	1.94e+02 +	2.98e+02 +	4.57e+02 -
WCCI20-MaTSO3-T20	3.70e+02	3.62e+02 =	3.40e+02 +	2.39e+02 +	1.81e+02 +	3.20e+02 +	4.56e+02 -
WCCI20-MaTSO3-T21	3.72e+02	3.71e+02 =	3.44e+02 +	2.11e+02 +	1.86e+02 +	2.93e+02 +	4.59e+02 -
WCCI20-MaTSO3-T22	3.77e+02	3.74e+02 =	3.41e+02 +	2.06e+02 +	1.87e+02 +	3.17e+02 +	4.58e+02 -
WCCI20-MaTSO3-T23	3.64e+02	3.69e+02 =	3.41e+02 +	2.05e+02 +	1.80e+02 +	3.19e+02 +	4.56e+02 -
WCCI20-MaTSO3-T24	3.63e+02	3.73e+02 =	3.41e+02 +	2.19e+02 +	1.98e+02 +	3.08e+02 +	4.57e+02 -
WCCI20-MaTSO3-T25	3.69e+02	3.74e+02 =	3.38e+02 +	2.11e+02 +	2.01e+02 +	3.13e+02 +	4.60e+02 -
WCCI20-MaTSO3-T26	3.71e+02	3.77e+02 =	3.41e+02 +	2.39e+02 +	2.05e+02 +	2.99e+02 +	4.55e+02 -
WCCI20-MaTSO3-T27	3.74e+02	3.74e+02 =	3.44e+02 +	2.42e+02 +	1.93e+02 +	3.04e+02 +	4.63e+02 -
WCCI20-MaTSO3-T28	3.72e+02	3.69e+02 =	3.43e+02 +	2.35e+02 +	2.09e+02 +	3.00e+02 +	4.54e+02 -
WCCI20-MaTSO3-T29	3.75e+02	3.75e+02 =	3.40e+02 +	2.13e+02 +	2.03e+02 +	3.01e+02 +	4.59e+02 -
WCCI20-MaTSO3-T30	3.73e+02	3.72e+02 =	3.46e+02 +	2.13e+02 +	1.80e+02 +	3.14e+02 +	4.58e+02 -
WCCI20-MaTSO3-T31	3.69e+02	3.76e+02 =	3.45e+02 +	2.57e+02 +	1.89e+02 +	2.95e+02 +	4.58e+02 -
WCCI20-MaTSO3-T32	3.69e+02	3.73e+02 =	3.41e+02 +	2.31e+02 +	2.02e+02 +	2.99e+02 +	4.58e+02 -
WCCI20-MaTSO3-T33	3.65e+02	3.71e+02 =	3.45e+02 +	2.17e+02 +	1.87e+02 +	3.01e+02 +	4.62e+02 -
WCCI20-MaTSO3-T34	3.63e+02	3.78e+02 -	3.39e+02 +	2.50e+02 +	1.99e+02 +	2.95e+02 +	4.57e+02 -
WCCI20-MaTSO3-T35	3.69e+02	3.71e+02 =	3.41e+02 +	2.01e+02 +	1.87e+02 +	3.11e+02 +	4.54e+02 -
WCCI20-MaTSO3-T36	3.66e+02	3.69e+02 =	3.48e+02 +	2.08e+02 +	2.00e+02 +	3.09e+02 +	4.55e+02 -
WCCI20-MaTSO3-T37	3.71e+02	3.79e+02 =	3.37e+02 +	2.60e+02 +	1.86e+02 +	2.96e+02 +	4.59e+02 -
WCCI20-MaTSO3-T38	3.71e+02	3.69e+02 =	3.44e+02 +	2.23e+02 +	2.04e+02 +	3.11e+02 +	4.54e+02 -
WCCI20-MaTSO3-T39	3.67e+02	3.74e+02 =	3.41e+02 +	2.37e+02 +	1.80e+02 +	3.04e+02 +	4.62e+02 -
WCCI20-MaTSO3-T40	3.72e+02	3.76e+02 =	3.40e+02 +	2.50e+02 +	1.87e+02 +	3.02e+02 +	4.57e+02 -
WCCI20-MaTSO3-T41	3.69e+02	3.71e+02 =	3.41e+02 +	2.31e+02 +	1.76e+02 +	2.96e+02 +	4.59e+02 -
WCCI20-MaTSO3-T42	3.74e+02	3.75e+02 =	3.47e+02 +	2.10e+02 +	1.76e+02 +	3.16e+02 +	4.61e+02 -
WCCI20-MaTSO3-T43	3.68e+02	3.67e+02 =	3.45e+02 +	2.55e+02 +	1.93e+02 +	3.05e+02 +	4.59e+02 -
WCCI20-MaTSO3-T44	3.76e+02	3.74e+02 =	3.46e+02 +	2.32e+02 +	2.19e+02 +	3.09e+02 +	4.57e+02 -
WCCI20-MaTSO3-T45	3.70e+02	3.61e+02 =	3.40e+02 +	2.38e+02 +	1.94e+02 +	2.90e+02 +	4.59e+02 -
WCCI20-MaTSO3-T46	3.69e+02	3.74e+02 =	3.41e+02 +	2.26e+02 +	1.98e+02 +	3.09e+02 +	4.59e+02 -
WCCI20-MaTSO3-T47	3.71e+02	3.76e+02 =	3.44e+02 +	2.28e+02 +	1.81e+02 +	2.94e+02 +	4.61e+02 -
WCCI20-MaTSO3-T48	3.67e+02	3.65e+02 =	3.45e+02 +	2.30e+02 +	1.89e+02 +	3.11e+02 +	4.55e+02 -
WCCI20-MaTSO3-T49	3.71e+02	3.68e+02 =	3.44e+02 +	2.27e+02 +	1.87e+02 +	3.05e+02 +	4.60e+02 -
WCCI20-MaTSO3-T50	3.68e+02	3.70e+02 =	3.38e+02 +	1.91e+02 +	1.95e+02 +	2.95e+02 +	4.60e+02 -
+/-/=	Base	0/4/46	50/0/0	50/0/0	50/0/0	50/0/0	0/50/0

Table 10: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO4 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO4-T1	8.29e-23	1.24e-08 -	3.34e-21 -	1.07e-02 -	4.51e-04 -	3.67e-06 -	1.94e-02 -
WCCI20-MaTSO4-T2	5.08e+01	4.78e+01 =	1.89e+03 -	8.82e+01 =	2.15e+02 -	1.15e+02 -	1.41e+03 -
WCCI20-MaTSO4-T3	1.03e-11	6.37e-06 -	2.43e-12 +	7.74e-02 -	1.97e-02 -	2.47e+00 -	2.11e+01 -
WCCI20-MaTSO4-T4	4.00e-22	1.16e-09 -	1.69e-21 -	5.99e-06 -	5.57e-04 -	4.71e-06 -	1.77e-02 -
WCCI20-MaTSO4-T5	4.77e+01	5.14e+01 -	1.15e+03 -	2.17e+02 -	9.82e+01 -	1.47e+02 -	2.88e+03 -
WCCI20-MaTSO4-T6	4.42e-12	4.03e-05 -	9.05e-06 -	1.99e-01 -	1.86e-02 -	2.62e+00 -	2.12e+01 -
WCCI20-MaTSO4-T7	8.40e-23	1.11e-08 -	1.34e-21 -	3.92e-01 -	6.71e-04 -	4.39e-06 -	1.89e-02 -
WCCI20-MaTSO4-T8	5.73e+01	5.79e+01 =	5.26e+02 -	2.17e+02 -	1.43e+02 -	1.87e+02 -	3.36e+03 -
WCCI20-MaTSO4-T9	7.29e-12	1.53e-05 -	2.20e-12 +	2.08e-01 -	1.83e-02 -	2.78e+00 -	2.11e+01 -
WCCI20-MaTSO4-T10	1.94e-22	7.56e-08 -	2.19e-21 -	2.92e-03 -	6.12e-04 -	4.99e-06 -	1.65e-02 -
WCCI20-MaTSO4-T11	4.75e+01	4.77e+01 =	3.11e+03 -	2.65e+02 -	2.28e+02 -	1.50e+02 -	2.36e+03 -
WCCI20-MaTSO4-T12	5.00e-12	2.57e-05 -	1.85e-05 =	6.77e-02 -	1.97e-02 -	2.56e+00 -	2.11e+01 -
WCCI20-MaTSO4-T13	8.96e-23	7.88e-09 -	1.28e-21 -	7.38e-04 -	5.63e-04 -	4.51e-06 -	1.73e-02 -
WCCI20-MaTSO4-T14	6.56e+01	8.21e+01 =	1.17e+03 -	5.09e+02 -	4.89e+02 -	3.78e+02 -	4.08e+03 -
WCCI20-MaTSO4-T15	6.69e-12	2.76e-05 -	1.76e-04 -	1.35e-01 -	2.06e-02 -	2.64e+00 -	2.11e+01 -
WCCI20-MaTSO4-T16	6.79e-23	4.01e-07 -	1.11e-21 -	2.31e-01 -	6.51e-04 -	5.37e-06 -	1.93e-02 -
WCCI20-MaTSO4-T17	8.71e+01	7.91e+01 =	3.51e+02 -	3.14e+02 -	4.01e+02 -	2.79e+02 -	1.93e+03 -
WCCI20-MaTSO4-T18	5.37e-12	5.74e-05 -	2.29e-04 -	1.18e-01 -	1.86e-02 -	2.53e+00 -	2.11e+01 -
WCCI20-MaTSO4-T19	1.08e-22	1.01e-08 -	1.82e-21 -	7.49e-02 -	6.13e-04 -	4.94e-06 -	1.81e-02 -
WCCI20-MaTSO4-T20	5.09e+01	4.79e+01 =	2.67e+03 -	9.70e+01 -	3.87e+02 -	1.22e+02 -	4.83e+03 -
WCCI20-MaTSO4-T21	7.61e-12	9.10e-06 -	1.63e-07 -	3.06e-01 -	1.93e-02 -	2.67e+00 -	2.12e+01 -
WCCI20-MaTSO4-T22	8.52e-23	1.15e-09 -	1.37e-21 -	1.87e-01 -	5.04e-04 -	3.83e-06 -	1.93e-02 -
WCCI20-MaTSO4-T23	1.06e+02	9.17e+01 =	5.28e+02 -	5.66e+02 -	6.19e+02 =	4.41e+02 -	4.47e+03 -
WCCI20-MaTSO4-T24	7.42e-12	2.31e-05 -	2.39e-12 +	2.82e-01 -	1.70e-02 -	2.63e+00 -	2.11e+01 -
WCCI20-MaTSO4-T25	9.70e-23	2.75e-08 -	1.34e-21 -	4.10e-04 -	5.21e-04 -	4.37e-06 -	1.78e-02 -
WCCI20-MaTSO4-T26	4.76e+01	6.07e+01 -	1.04e+03 -	3.30e+02 -	3.08e+02 -	1.25e+02 -	2.33e+03 -
WCCI20-MaTSO4-T27	5.07e-12	3.40e-05 -	5.32e-06 =	6.47e-02 -	1.77e-02 -	2.50e+00 -	2.11e+01 -
WCCI20-MaTSO4-T28	5.26e-23	4.66e-08 -	1.30e-21 -	2.18e-03 -	6.59e-04 -	4.65e-06 -	1.88e-02 -
WCCI20-MaTSO4-T29	1.28e+02	1.33e+02 =	4.16e+02 -	7.08e+02 -	5.58e+02 =	3.32e+02 -	2.53e+03 -
WCCI20-MaTSO4-T30	7.28e-12	8.09e-06 -	2.45e-06 -	5.05e-02 -	1.66e-02 -	2.77e+00 -	2.11e+01 -
WCCI20-MaTSO4-T31	2.79e-19	2.27e-10 -	1.33e-21 +	2.80e-02 -	5.31e-04 -	3.10e-06 -	1.72e-02 -
WCCI20-MaTSO4-T32	1.57e+02	2.74e+02 -	6.86e+02 -	8.74e+02 -	8.23e+02 -	7.64e+02 -	6.05e+03 -
WCCI20-MaTSO4-T33	7.41e-12	2.87e-05 -	1.94e-04 -	1.24e-02 -	1.46e-02 -	2.50e+00 -	2.11e+01 -
WCCI20-MaTSO4-T34	3.46e-22	6.40e-09 -	1.19e-21 -	1.06e-03 -	5.52e-04 -	5.70e-06 -	1.78e-02 -
WCCI20-MaTSO4-T35	1.42e+02	2.29e+02 =	3.12e+02 -	5.88e+02 -	9.02e+02 -	8.00e+02 -	5.77e+03 -
WCCI20-MaTSO4-T36	7.28e-12	8.06e-06 -	8.15e-08 =	6.41e-02 -	1.44e-02 -	2.66e+00 -	2.11e+01 -
WCCI20-MaTSO4-T37	4.08e-23	7.64e-08 -	2.33e-21 -	7.04e-02 -	6.55e-04 -	4.76e-06 -	1.92e-02 -
WCCI20-MaTSO4-T38	7.52e+01	9.91e+01 =	8.53e+02 -	8.41e+02 -	8.91e+02 -	1.18e+03 -	6.68e+03 -
WCCI20-MaTSO4-T39	4.90e-12	9.53e-06 -	4.08e-07 =	1.03e-01 -	1.47e-02 -	2.36e+00 -	2.11e+01 -
WCCI20-MaTSO4-T40	1.33e-23	2.46e-07 -	1.80e-21 -	4.90e-03 -	6.11e-04 -	4.52e-06 -	2.06e-02 -
WCCI20-MaTSO4-T41	6.05e+01	6.60e+01 =	4.77e+02 -	1.68e+02 -	2.46e+02 -	2.43e+02 -	1.62e+03 -
WCCI20-MaTSO4-T42	8.64e-12	2.01e-05 -	2.44e-12 +	2.21e-01 -	1.83e-02 -	2.59e+00 -	2.12e+01 -
WCCI20-MaTSO4-T43	2.33e-22	2.84e-09 -	4.87e-09 -	3.55e-02 -	5.58e-04 -	5.89e-06 -	1.82e-02 -
WCCI20-MaTSO4-T44	8.35e+01	5.14e+01 =	2.28e+02 -	1.28e+02 -	4.80e+02 -	2.36e+02 -	5.27e+03 -
WCCI20-MaTSO4-T45	2.79e-10	4.75e-06 -	5.58e-07 -	1.44e-01 -	2.00e-02 -	2.65e+00 -	2.11e+01 -
WCCI20-MaTSO4-T46	1.05e-15	1.12e-09 -	1.21e-21 +	1.34e-05 -	5.50e-04 -	4.01e-06 -	1.83e-02 -
WCCI20-MaTSO4-T47	5.09e+01	4.82e+01 +	5.09e+03 -	7.75e+01 -	3.36e+02 -	1.30e+02 -	5.40e+03 -
WCCI20-MaTSO4-T48	5.94e-12	2.04e-05 -	1.71e-07 -	1.23e-01 -	1.77e-02 -	2.56e+00 -	2.11e+01 -
WCCI20-MaTSO4-T49	4.65e-23	2.42e-08 -	1.13e-21 -	9.41e-02 -	6.62e-04 -	4.13e-06 -	1.84e-02 -
WCCI20-MaTSO4-T50	2.12e+02	1.02e+02 =	3.75e+02 -	5.72e+02 -	7.84e+02 -	5.95e+02 -	4.65e+03 -
+/-/=	Base	1/36/13	6/40/4	0/49/1	0/48/2	0/50/0	0/50/0

Table 11: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO5 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO5-T1	3.61e+02	3.51e+02 +	2.29e+02 +	2.58e+02 +	1.51e+02 +	3.57e+02 =	4.66e+02 -
WCCI20-MaTSO5-T2	6.58e-09	1.10e-07 -	6.58e-07 -	2.75e-02 -	2.30e-03 -	8.61e-03 -	3.29e-01 -
WCCI20-MaTSO5-T3	5.31e-02	6.22e-02 -	1.75e+00 -	7.56e+00 -	3.30e+01 -	1.51e+01 -	6.75e+01 -
WCCI20-MaTSO5-T4	3.38e+02	3.57e+02 =	2.70e+02 +	2.10e+02 +	2.27e+02 +	3.42e+02 =	4.57e+02 -
WCCI20-MaTSO5-T5	1.10e-08	2.20e-07 -	1.36e-05 -	3.70e-03 -	1.23e-03 -	4.52e-03 -	3.33e-01 -
WCCI20-MaTSO5-T6	8.32e-02	3.80e-02 +	1.29e+00 -	5.87e+00 -	2.95e+01 -	1.46e+01 -	6.72e+01 -
WCCI20-MaTSO5-T7	3.62e+02	3.56e+02 =	2.67e+02 +	2.51e+02 +	2.55e+02 +	3.77e+02 =	4.60e+02 -
WCCI20-MaTSO5-T8	7.14e-09	1.86e-07 -	1.52e-05 -	1.38e-02 -	2.33e-03 -	1.18e-02 -	3.29e-01 -
WCCI20-MaTSO5-T9	1.32e-01	3.95e-02 +	1.96e+00 -	5.69e+00 -	2.99e+01 -	1.56e+01 -	6.72e+01 -
WCCI20-MaTSO5-T10	3.61e+02	3.53e+02 =	2.91e+02 +	2.44e+02 +	1.73e+02 +	3.80e+02 -	4.61e+02 -
WCCI20-MaTSO5-T11	1.16e-08	2.83e-07 -	3.18e-05 -	5.56e-03 -	5.20e-04 -	4.93e-03 -	3.37e-01 -
WCCI20-MaTSO5-T12	3.64e-02	9.35e-02 -	1.14e+00 -	6.71e+00 -	3.04e+01 -	1.49e+01 -	6.77e+01 -
WCCI20-MaTSO5-T13	3.52e+02	3.52e+02 =	2.85e+02 +	2.20e+02 +	2.52e+02 +	3.77e+02 -	4.56e+02 -
WCCI20-MaTSO5-T14	6.13e-09	2.12e-07 -	1.49e-05 -	7.64e-03 -	8.97e-04 -	3.80e-03 -	3.35e-01 -
WCCI20-MaTSO5-T15	2.32e-01	6.26e-02 +	1.60e+00 -	6.73e+00 -	2.64e+01 -	1.55e+01 -	6.75e+01 -
WCCI20-MaTSO5-T16	3.60e+02	3.55e+02 =	2.75e+02 +	2.45e+02 +	2.04e+02 +	3.88e+02 -	4.57e+02 -
WCCI20-MaTSO5-T17	1.15e-08	3.86e-07 -	1.03e-05 -	6.86e-03 -	1.98e-03 -	6.47e-03 -	3.44e-01 -
WCCI20-MaTSO5-T18	8.04e-02	1.38e-01 -	1.59e+00 -	5.60e+00 -	2.84e+01 -	1.49e+01 -	6.72e+01 -
WCCI20-MaTSO5-T19	3.66e+02	3.57e+02 =	2.96e+02 +	2.33e+02 +	2.34e+02 +	3.87e+02 -	4.54e+02 -
WCCI20-MaTSO5-T20	5.22e-09	2.40e-07 -	1.51e-05 -	3.77e-03 -	4.71e-04 -	1.06e-02 -	3.32e-01 -
WCCI20-MaTSO5-T21	1.60e-01	3.04e-01 -	1.61e+00 -	4.96e+00 -	2.88e+01 -	1.56e+01 -	6.78e+01 -
WCCI20-MaTSO5-T22	3.39e+02	3.56e+02 =	2.89e+02 +	2.16e+02 +	2.09e+02 +	3.68e+02 -	4.58e+02 -
WCCI20-MaTSO5-T23	1.09e-08	2.29e-07 -	2.31e-05 -	1.15e-02 -	5.94e-04 -	9.19e-03 -	3.41e-01 -
WCCI20-MaTSO5-T24	1.55e-01	6.29e-02 +	2.86e+00 -	7.21e+00 -	3.13e+01 -	1.70e+01 -	6.71e+01 -
WCCI20-MaTSO5-T25	3.42e+02	3.50e+02 =	3.00e+02 +	2.68e+02 +	2.27e+02 +	3.85e+02 -	4.54e+02 -
WCCI20-MaTSO5-T26	7.01e-09	8.93e-08 -	3.29e-05 -	1.72e-02 -	1.29e-03 -	7.21e-03 -	3.24e-01 -
WCCI20-MaTSO5-T27	9.46e-02	1.90e-01 -	2.71e+00 -	6.63e+00 -	3.32e+01 -	1.75e+01 -	6.73e+01 -
WCCI20-MaTSO5-T28	3.61e+02	3.58e+02 =	2.73e+02 +	2.20e+02 +	2.08e+02 +	3.52e+02 =	4.61e+02 -
WCCI20-MaTSO5-T29	8.29e-09	7.32e-07 -	6.51e-06 -	5.56e-03 -	3.98e-04 -	5.57e-03 -	3.30e-01 -
WCCI20-MaTSO5-T30	2.12e-01	9.10e-02 +	2.17e+00 -	6.66e+00 -	3.27e+01 -	1.67e+01 -	6.68e+01 -
WCCI20-MaTSO5-T31	3.64e+02	3.48e+02 +	1.86e+02 +	2.55e+02 +	2.16e+02 +	3.84e+02 -	4.60e+02 -
WCCI20-MaTSO5-T32	6.24e-09	1.79e-07 -	3.86e-04 -	5.69e-03 -	2.59e-03 -	3.14e-03 -	3.25e-01 -
WCCI20-MaTSO5-T33	6.34e-02	1.32e-01 -	1.53e+00 -	5.01e+00 -	3.05e+01 -	1.61e+01 -	6.68e+01 -
WCCI20-MaTSO5-T34	3.47e+02	3.52e+02 =	2.82e+02 +	2.32e+02 +	2.40e+02 +	3.63e+02 =	4.54e+02 -
WCCI20-MaTSO5-T35	4.89e-09	2.01e-07 -	2.98e-05 -	4.72e-03 -	8.38e-04 -	6.91e-03 -	3.46e-01 -
WCCI20-MaTSO5-T36	1.28e-01	2.13e-01 -	1.29e+00 -	4.48e+00 -	2.93e+01 -	1.37e+01 -	6.74e+01 -
WCCI20-MaTSO5-T37	3.62e+02	3.49e+02 +	2.86e+02 +	2.28e+02 +	2.24e+02 +	3.84e+02 -	4.63e+02 -
WCCI20-MaTSO5-T38	6.48e-09	1.72e-07 -	2.35e-05 -	9.38e-03 -	1.10e-03 -	7.35e-03 -	3.19e-01 -
WCCI20-MaTSO5-T39	5.00e-02	2.26e-01 -	1.94e+00 -	6.84e+00 -	3.43e+01 -	1.76e+01 -	6.75e+01 -
WCCI20-MaTSO5-T40	3.59e+02	3.60e+02 =	2.48e+02 +	2.14e+02 +	2.34e+02 +	3.62e+02 =	4.60e+02 -
WCCI20-MaTSO5-T41	7.03e-09	3.35e-07 -	4.06e-04 -	5.82e-03 -	9.59e-04 -	4.30e-03 -	3.37e-01 -
WCCI20-MaTSO5-T42	7.68e-02	7.37e-02 +	1.36e+00 -	6.20e+00 -	2.61e+01 -	1.47e+01 -	6.70e+01 -
WCCI20-MaTSO5-T43	3.63e+02	3.56e+02 =	2.77e+02 +	2.34e+02 +	2.15e+02 +	3.90e+02 -	4.54e+02 -
WCCI20-MaTSO5-T44	4.79e-09	1.26e-07 -	1.80e-05 -	2.85e-03 -	2.46e-03 -	1.33e-02 -	3.38e-01 -
WCCI20-MaTSO5-T45	2.18e-01	5.27e-02 +	1.57e+00 -	5.35e+00 -	3.06e+01 -	1.53e+01 -	6.71e+01 -
WCCI20-MaTSO5-T46	3.63e+02	3.55e+02 =	2.85e+02 +	2.12e+02 +	2.37e+02 +	3.71e+02 =	4.58e+02 -
WCCI20-MaTSO5-T47	4.54e-09	1.19e-07 -	3.55e-05 -	6.66e-03 -	1.86e-03 -	8.59e-03 -	3.51e-01 -
WCCI20-MaTSO5-T48	9.50e-02	1.20e-01 -	1.59e+00 -	6.30e+00 -	2.84e+01 -	1.51e+01 -	6.72e+01 -
WCCI20-MaTSO5-T49	3.46e+02	3.57e+02 =	2.94e+02 +	2.63e+02 +	2.25e+02 +	3.85e+02 -	4.57e+02 -
WCCI20-MaTSO5-T50	1.03e-08	4.92e-07 -	3.88e-04 -	4.32e-03 -	1.90e-03 -	5.56e-03 -	3.46e-01 -
+/-/=	Base	10/26/14	17/33/0	17/33/0	17/33/0	0/43/7	0/50/0

Table 12: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO6 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO6-T1	7.40e+01	6.90e+01 =	2.04e+02 -	6.14e+02 -	6.42e+02 -	3.86e+02 -	2.27e+03 -
WCCI20-MaTSO6-T2	1.20e-09	2.24e-07 -	8.97e-06 -	2.13e-03 -	8.21e-04 -	7.46e-03 -	3.36e-01 -
WCCI20-MaTSO6-T3	1.43e+04	1.44e+04 =	1.31e+04 +	1.40e+04 =	6.86e+03 +	1.41e+04 =	1.31e+04 +
WCCI20-MaTSO6-T4	4.78e+01	4.78e+01 =	9.27e+01 -	2.08e+02 -	6.70e+02 -	1.74e+02 -	2.60e+03 -
WCCI20-MaTSO6-T5	1.83e-09	2.24e-07 -	1.10e-05 -	3.90e-03 -	1.80e-03 -	4.90e-03 -	3.36e-01 -
WCCI20-MaTSO6-T6	1.46e+04	1.43e+04 +	1.36e+04 +	1.33e+04 +	7.46e+03 +	1.39e+04 +	1.30e+04 +
WCCI20-MaTSO6-T7	4.79e+01	5.61e+01 -	2.11e+02 -	3.39e+02 -	2.95e+02 -	9.36e+01 -	1.33e+03 -
WCCI20-MaTSO6-T8	1.94e-09	8.48e-08 -	9.99e-06 -	6.09e-03 -	3.30e-03 -	6.59e-03 -	3.35e-01 -
WCCI20-MaTSO6-T9	1.42e+04	1.44e+04 =	1.37e+04 +	1.32e+04 +	7.25e+03 +	1.38e+04 +	1.32e+04 +
WCCI20-MaTSO6-T10	6.63e+01	6.27e+01 =	2.91e+02 -	2.22e+02 -	3.31e+02 -	6.90e+02 -	2.65e+03 -
WCCI20-MaTSO6-T11	1.60e-09	1.51e-07 -	7.62e-06 -	1.32e-02 -	3.62e-03 -	6.90e-03 -	3.37e-01 -
WCCI20-MaTSO6-T12	1.38e+04	1.44e+04 =	1.36e+04 =	1.40e+04 =	7.44e+03 +	1.40e+04 =	1.32e+04 =
WCCI20-MaTSO6-T13	5.34e+01	4.81e+01 =	2.09e+03 -	2.75e+02 -	6.01e+02 -	1.02e+02 =	1.60e+03 -
WCCI20-MaTSO6-T14	2.88e-09	4.94e-07 -	2.08e-05 -	3.80e-03 -	2.03e-03 -	7.01e-03 -	3.41e-01 -
WCCI20-MaTSO6-T15	1.46e+04	1.44e+04 =	1.35e+04 +	1.41e+04 =	7.12e+03 +	1.41e+04 +	1.31e+04 +
WCCI20-MaTSO6-T16	6.67e+01	5.76e+01 =	8.04e+02 -	6.27e+02 -	3.05e+02 -	7.58e+02 -	2.37e+03 -
WCCI20-MaTSO6-T17	1.31e-09	3.36e-08 -	4.37e-06 -	1.42e-02 -	1.87e-03 -	6.60e-03 -	3.39e-01 -
WCCI20-MaTSO6-T18	1.45e+04	1.44e+04 =	1.30e+04 +	1.35e+04 =	7.31e+03 +	1.41e+04 +	1.31e+04 +
WCCI20-MaTSO6-T19	4.75e+01	4.78e+01 =	3.55e+03 -	1.00e+02 =	1.35e+02 -	1.82e+02 -	2.20e+03 -
WCCI20-MaTSO6-T20	1.86e-09	7.82e-08 -	1.45e-05 -	7.96e-03 -	2.82e-03 -	4.85e-03 -	3.49e-01 -
WCCI20-MaTSO6-T21	1.44e+04	1.43e+04 =	1.37e+04 +	1.34e+04 +	7.19e+03 +	1.39e+04 +	1.32e+04 +
WCCI20-MaTSO6-T22	1.78e+02	1.09e+02 =	3.88e+02 =	2.94e+02 =	6.25e+02 =	4.99e+02 -	1.47e+03 -
WCCI20-MaTSO6-T23	2.78e-09	1.55e-07 -	1.07e-05 -	4.20e-03 -	1.61e-03 -	8.37e-03 -	3.36e-01 -
WCCI20-MaTSO6-T24	1.44e+04	1.44e+04 =	1.37e+04 +	1.39e+04 +	7.22e+03 +	1.39e+04 +	1.32e+04 +
WCCI20-MaTSO6-T25	6.64e+01	5.83e+01 =	2.51e+02 -	5.36e+02 -	7.34e+02 -	3.25e+02 -	4.10e+03 -
WCCI20-MaTSO6-T26	1.86e-09	9.49e-08 -	2.56e-05 =	4.00e-03 -	1.68e-03 -	7.71e-03 -	3.42e-01 -
WCCI20-MaTSO6-T27	1.29e+04	1.42e+04 =	1.30e+04 +	1.34e+04 =	6.94e+03 +	1.40e+04 =	1.28e+04 +
WCCI20-MaTSO6-T28	8.37e+01	6.84e+01 =	1.11e+03 -	1.67e+02 -	2.57e+02 -	1.60e+02 -	2.03e+03 -
WCCI20-MaTSO6-T29	1.65e-09	1.47e-07 -	7.62e-06 -	1.22e-02 -	2.24e-03 -	7.63e-03 -	3.31e-01 -
WCCI20-MaTSO6-T30	1.44e+04	1.44e+04 =	1.30e+04 +	1.38e+04 =	7.55e+03 +	1.40e+04 +	1.31e+04 +
WCCI20-MaTSO6-T31	1.06e+02	9.89e+01 =	5.72e+02 =	3.26e+02 -	1.80e+02 =	2.69e+02 -	3.22e+03 -
WCCI20-MaTSO6-T32	1.45e-09	4.49e-08 -	1.35e-05 -	2.74e-02 -	8.52e-04 -	1.43e-02 -	3.31e-01 -
WCCI20-MaTSO6-T33	1.43e+04	1.43e+04 =	1.35e+04 +	1.40e+04 =	7.08e+03 +	1.37e+04 +	1.30e+04 +
WCCI20-MaTSO6-T34	5.08e+01	4.80e+01 +	5.05e+02 -	2.02e+02 -	1.72e+02 -	9.43e+01 -	1.23e+03 -
WCCI20-MaTSO6-T35	2.76e-09	1.80e-07 -	9.96e-06 -	9.24e-03 -	2.09e-03 -	5.17e-03 -	3.26e-01 -
WCCI20-MaTSO6-T36	1.02e+04	1.45e+04 -	1.36e+04 =	1.37e+04 =	6.98e+03 =	1.41e+04 =	1.31e+04 =
WCCI20-MaTSO6-T37	5.82e+01	7.40e+01 -	3.59e+02 -	1.36e+02 -	7.33e+01 -	1.69e+02 -	2.15e+03 -
WCCI20-MaTSO6-T38	1.46e-09	1.35e-07 -	2.16e-05 -	8.37e-03 -	8.88e-04 -	5.34e-03 -	3.43e-01 -
WCCI20-MaTSO6-T39	1.45e+04	1.44e+04 =	1.36e+04 +	1.29e+04 +	7.08e+03 +	1.41e+04 +	1.32e+04 +
WCCI20-MaTSO6-T40	2.11e+02	1.16e+02 =	7.62e+02 -	8.79e+02 -	3.79e+02 =	7.43e+02 -	5.05e+03 -
WCCI20-MaTSO6-T41	1.54e-09	6.32e-08 -	3.16e-06 -	1.69e-03 -	3.88e-03 -	7.44e-03 -	3.24e-01 -
WCCI20-MaTSO6-T42	1.46e+04	1.44e+04 =	1.34e+04 +	1.39e+04 +	7.36e+03 +	1.41e+04 +	1.31e+04 +
WCCI20-MaTSO6-T43	9.53e+01	1.06e+02 =	4.32e+02 -	4.03e+02 -	4.38e+02 =	7.70e+02 -	5.58e+03 -
WCCI20-MaTSO6-T44	1.34e-09	8.84e-08 -	1.44e-05 -	1.46e-02 -	2.27e-03 -	6.52e-03 -	3.43e-01 -
WCCI20-MaTSO6-T45	1.43e+04	1.45e+04 =	1.34e+04 +	1.28e+04 +	7.23e+03 +	1.41e+04 +	1.30e+04 +
WCCI20-MaTSO6-T46	2.89e+02	3.28e+02 =	7.96e+02 =	7.33e+02 -	7.90e+02 =	1.85e+03 -	5.87e+03 -
WCCI20-MaTSO6-T47	2.02e-09	1.30e-07 -	1.43e-05 -	1.11e-02 -	1.52e-03 -	7.39e-03 -	3.34e-01 -
WCCI20-MaTSO6-T48	1.45e+04	1.45e+04 =	1.35e+04 +	1.37e+04 =	7.55e+03 +	1.40e+04 +	1.33e+04 +
WCCI20-MaTSO6-T49	7.30e+01	7.17e+01 =	1.90e+02 =	7.43e+02 -	1.41e+02 =	1.60e+02 -	1.18e+03 -
WCCI20-MaTSO6-T50	1.60e-09	6.23e-08 -	3.82e-04 -	3.50e-03 -	1.89e-03 -	8.00e-03 -	3.31e-01 -
+/-/=	Base	2/21/27	13/30/7	7/32/11	15/28/7	12/34/4	14/34/2

Table 13: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO7 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO7-T1	1.63e-11	2.99e-05 -	1.35e-04 =	1.63e-01 -	1.51e-01 -	2.43e+00 -	2.12e+01 -
WCCI20-MaTSO7-T2	3.37e+02	3.54e+02 =	1.94e+02 +	2.31e+02 +	2.15e+02 +	3.60e+02 =	4.56e+02 -
WCCI20-MaTSO7-T3	5.73e-02	2.71e-01 -	2.54e+00 -	9.08e+00 -	3.50e+01 -	1.59e+01 -	6.64e+01 -
WCCI20-MaTSO7-T4	5.60e-12	6.60e-06 -	2.28e-04 -	1.89e-01 -	8.76e-02 -	2.32e+00 -	2.11e+01 -
WCCI20-MaTSO7-T5	3.62e+02	3.55e+02 +	2.24e+02 +	2.48e+02 +	2.25e+02 +	3.62e+02 =	4.58e+02 -
WCCI20-MaTSO7-T6	8.44e-02	2.35e-01 -	2.33e+00 -	5.11e+00 -	3.15e+01 -	1.45e+01 -	6.77e+01 -
WCCI20-MaTSO7-T7	9.63e-12	9.46e-06 -	6.66e-04 -	1.76e-01 -	8.12e-02 -	2.53e+00 -	2.12e+01 -
WCCI20-MaTSO7-T8	3.64e+02	3.42e+02 +	2.77e+02 +	2.57e+02 +	2.13e+02 +	3.70e+02 =	4.59e+02 -
WCCI20-MaTSO7-T9	2.62e-01	2.24e-01 +	1.95e+00 -	6.30e+00 -	2.75e+01 -	1.51e+01 -	6.71e+01 -
WCCI20-MaTSO7-T10	5.71e-11	4.27e-06 -	5.04e-04 =	1.56e-01 -	4.45e-01 -	2.64e+00 -	2.11e+01 -
WCCI20-MaTSO7-T11	3.63e+02	3.56e+02 =	1.91e+02 +	2.30e+02 +	2.12e+02 +	3.76e+02 =	4.59e+02 -
WCCI20-MaTSO7-T12	2.97e-02	1.14e-01 -	2.16e+00 -	6.32e+00 -	3.01e+01 -	1.52e+01 -	6.71e+01 -
WCCI20-MaTSO7-T13	7.72e-12	1.45e-05 -	2.28e-04 -	3.01e-01 -	1.26e-01 -	2.65e+00 -	2.11e+01 -
WCCI20-MaTSO7-T14	3.38e+02	3.55e+02 =	2.15e+02 +	2.25e+02 +	2.03e+02 +	3.57e+02 =	4.61e+02 -
WCCI20-MaTSO7-T15	7.57e-02	1.07e-01 -	2.09e+00 -	8.61e+00 -	3.22e+01 -	1.67e+01 -	6.69e+01 -
WCCI20-MaTSO7-T16	4.67e-12	7.14e-06 -	2.43e-05 =	2.37e-01 -	2.68e-01 -	2.52e+00 -	2.11e+01 -
WCCI20-MaTSO7-T17	3.64e+02	3.48e+02 +	2.65e+02 +	2.77e+02 +	1.75e+02 +	3.83e+02 -	4.59e+02 -
WCCI20-MaTSO7-T18	2.31e-01	1.31e-01 +	1.42e+00 -	6.89e+00 -	3.09e+01 -	1.55e+01 -	6.73e+01 -
WCCI20-MaTSO7-T19	1.24e-09	5.51e-06 -	1.38e-05 =	2.69e-01 -	3.16e-01 -	2.55e+00 -	2.12e+01 -
WCCI20-MaTSO7-T20	3.36e+02	3.34e+02 =	2.41e+02 +	2.46e+02 +	1.98e+02 +	3.80e+02 -	4.61e+02 -
WCCI20-MaTSO7-T21	1.05e-01	7.10e-02 +	2.02e+00 -	6.49e+00 -	3.26e+01 -	1.57e+01 -	6.73e+01 -
WCCI20-MaTSO7-T22	2.44e-12	1.67e-05 -	4.10e-05 =	2.10e-01 -	5.34e-01 -	2.56e+00 -	2.11e+01 -
WCCI20-MaTSO7-T23	3.58e+02	3.57e+02 =	2.23e+02 +	2.36e+02 +	1.91e+02 +	3.54e+02 =	4.61e+02 -
WCCI20-MaTSO7-T24	1.23e-01	2.08e-01 -	2.28e+00 -	6.37e+00 -	2.84e+01 -	1.64e+01 -	6.69e+01 -
WCCI20-MaTSO7-T25	7.57e-12	1.51e-06 -	8.94e-05 -	7.14e-02 -	6.69e-01 -	2.42e+00 -	2.11e+01 -
WCCI20-MaTSO7-T26	3.56e+02	3.57e+02 =	2.64e+02 +	2.33e+02 +	2.01e+02 +	3.77e+02 =	4.52e+02 -
WCCI20-MaTSO7-T27	9.70e-02	1.46e-01 -	1.29e+00 -	5.63e+00 -	2.97e+01 -	1.45e+01 -	6.81e+01 -
WCCI20-MaTSO7-T28	4.47e-12	4.42e-05 -	3.63e-07 -	2.79e-01 -	4.77e-01 -	2.47e+00 -	2.11e+01 -
WCCI20-MaTSO7-T29	3.40e+02	3.54e+02 =	2.34e+02 +	2.31e+02 +	2.03e+02 +	3.67e+02 =	4.57e+02 -
WCCI20-MaTSO7-T30	8.92e-02	1.37e-01 -	1.91e+00 -	6.00e+00 -	3.28e+01 -	1.66e+01 -	6.72e+01 -
WCCI20-MaTSO7-T31	3.03e-12	3.59e-05 -	1.33e-04 -	1.88e-01 -	1.68e-01 -	2.62e+00 -	2.11e+01 -
WCCI20-MaTSO7-T32	3.46e+02	3.50e+02 =	2.09e+02 +	2.45e+02 +	2.29e+02 +	3.55e+02 =	4.57e+02 -
WCCI20-MaTSO7-T33	1.04e-01	7.66e-02 +	2.05e+00 -	5.06e+00 -	3.11e+01 -	1.58e+01 -	6.70e+01 -
WCCI20-MaTSO7-T34	3.63e-12	2.70e-05 -	2.31e-04 -	1.95e-02 -	3.04e-01 -	2.38e+00 -	2.12e+01 -
WCCI20-MaTSO7-T35	3.44e+02	3.40e+02 +	2.54e+02 +	2.38e+02 +	2.03e+02 +	3.70e+02 =	4.60e+02 -
WCCI20-MaTSO7-T36	2.91e-01	4.05e-01 -	2.12e+00 -	5.74e+00 -	3.22e+01 -	1.61e+01 -	6.74e+01 -
WCCI20-MaTSO7-T37	1.52e-11	5.46e-05 -	3.40e-04 =	1.67e-01 -	1.08e-01 -	2.53e+00 -	2.12e+01 -
WCCI20-MaTSO7-T38	3.39e+02	3.55e+02 =	2.22e+02 +	2.34e+02 +	2.13e+02 +	3.76e+02 -	4.57e+02 -
WCCI20-MaTSO7-T39	4.31e-02	2.28e-01 -	1.60e+00 -	5.23e+00 -	3.25e+01 -	1.48e+01 -	6.70e+01 -
WCCI20-MaTSO7-T40	3.38e-12	3.14e-06 -	3.71e-05 =	2.50e-01 -	3.91e-01 -	2.51e+00 -	2.12e+01 -
WCCI20-MaTSO7-T41	3.46e+02	3.48e+02 -	2.02e+02 +	2.37e+02 +	1.92e+02 +	3.87e+02 -	4.61e+02 -
WCCI20-MaTSO7-T42	2.89e-01	2.45e-01 +	2.33e+00 -	6.43e+00 -	2.99e+01 -	1.67e+01 -	6.72e+01 -
WCCI20-MaTSO7-T43	2.78e-12	2.45e-05 -	1.96e-12 +	9.79e-02 -	1.12e-01 -	2.57e+00 -	2.11e+01 -
WCCI20-MaTSO7-T44	3.23e+02	3.56e+02 =	2.19e+02 +	2.31e+02 +	1.96e+02 +	3.67e+02 =	4.55e+02 -
WCCI20-MaTSO7-T45	1.73e-02	3.15e-01 -	1.99e+00 -	6.04e+00 -	3.27e+01 -	1.51e+01 -	6.71e+01 -
WCCI20-MaTSO7-T46	6.06e-12	9.59e-06 -	1.38e-07 =	1.96e-01 -	3.34e-01 -	2.59e+00 -	2.11e+01 -
WCCI20-MaTSO7-T47	3.47e+02	3.57e+02 =	2.26e+02 +	2.38e+02 +	2.05e+02 +	3.71e+02 =	4.62e+02 -
WCCI20-MaTSO7-T48	7.02e-02	7.72e-02 -	1.54e+00 -	5.84e+00 -	3.40e+01 -	1.54e+01 -	6.67e+01 -
WCCI20-MaTSO7-T49	3.09e-12	3.62e-05 -	8.05e-08 =	9.95e-02 -	1.69e-01 -	2.69e+00 -	2.11e+01 -
WCCI20-MaTSO7-T50	3.56e+02	3.58e+02 =	2.61e+02 +	1.89e+02 +	2.20e+02 +	3.62e+02 =	4.58e+02 -
+/-/=	Base	9/29/12	18/23/9	17/33/0	17/33/0	0/37/13	0/50/0

Table 14: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO8 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO8-T1	5.34e+01	5.31e+01 =	3.66e+02 -	1.64e+02 -	2.03e+02 -	3.33e+02 -	2.08e+03 -
WCCI20-MaTSO8-T2	3.62e-10	1.82e-05 -	2.37e-02 -	2.28e-01 -	2.89e-01 -	2.54e+00 -	2.12e+01 -
WCCI20-MaTSO8-T3	3.69e+02	3.61e+02 =	1.85e+02 +	2.36e+02 +	2.09e+02 +	4.15e+02 -	4.60e+02 -
WCCI20-MaTSO8-T4	8.41e-09	5.53e-07 -	7.96e-04 -	4.85e-03 -	2.74e-03 -	9.76e-03 -	3.23e-01 -
WCCI20-MaTSO8-T5	1.10e+00	1.61e+00 =	2.70e+00 -	1.58e+01 -	3.13e+01 -	2.25e+01 -	6.73e+01 -
WCCI20-MaTSO8-T6	6.51e+01	5.71e+01 +	3.33e+03 -	2.92e+02 -	2.15e+02 -	2.63e+02 -	2.01e+03 -
WCCI20-MaTSO8-T7	1.14e-11	2.80e-05 -	1.25e-10 =	8.36e-01 -	2.42e-02 -	2.38e+00 -	2.12e+01 -
WCCI20-MaTSO8-T8	3.38e+02	3.46e+02 =	2.52e+02 +	2.48e+02 +	1.91e+02 +	4.18e+02 -	4.61e+02 -
WCCI20-MaTSO8-T9	8.52e-09	1.11e-06 -	7.10e-04 -	1.34e-02 -	1.26e-03 -	7.87e-03 -	3.12e-01 -
WCCI20-MaTSO8-T10	1.57e+00	1.71e+00 =	3.34e+00 -	1.57e+01 -	3.10e+01 -	2.47e+01 -	6.72e+01 -
WCCI20-MaTSO8-T11	4.75e+01	4.80e+01 -	2.74e+03 -	1.84e+02 -	2.35e+02 -	7.90e+01 -	7.38e+02 -
WCCI20-MaTSO8-T12	1.52e-11	1.39e-05 -	6.53e-05 =	3.37e-01 -	4.67e-02 -	2.68e+00 -	2.12e+01 -
WCCI20-MaTSO8-T13	3.61e+02	3.60e+02 =	2.21e+02 +	2.49e+02 +	1.66e+02 +	3.88e+02 -	4.62e+02 -
WCCI20-MaTSO8-T14	2.00e-08	7.63e-07 -	3.77e-04 -	1.38e-02 -	1.86e-03 -	6.20e-03 -	3.23e-01 -
WCCI20-MaTSO8-T15	7.16e-01	1.17e+00 -	3.35e+00 -	1.74e+01 -	3.49e+01 -	2.47e+01 -	6.80e+01 -
WCCI20-MaTSO8-T16	1.21e+02	1.15e+02 =	3.93e+02 -	4.72e+02 =	5.95e+02 -	3.19e+02 -	1.94e+03 -
WCCI20-MaTSO8-T17	8.75e-12	2.23e-05 -	1.05e-06 =	7.52e-01 -	4.25e-02 -	2.75e+00 -	2.12e+01 -
WCCI20-MaTSO8-T18	3.61e+02	3.53e+02 =	2.01e+02 +	2.31e+02 +	1.83e+02 +	4.20e+02 -	4.60e+02 -
WCCI20-MaTSO8-T19	7.89e-09	1.72e-07 -	1.00e-03 -	1.07e-02 -	1.18e-03 -	1.65e-02 -	3.13e-01 -
WCCI20-MaTSO8-T20	1.52e+00	1.76e+00 =	3.06e+00 -	1.61e+01 -	3.11e+01 -	2.51e+01 -	6.67e+01 -
WCCI20-MaTSO8-T21	4.80e+01	4.81e+01 =	2.76e+04 -	1.14e+03 -	1.05e+02 -	5.50e+03 -	9.27e+02 -
WCCI20-MaTSO8-T22	9.51e-12	2.66e-05 -	1.23e-01 -	2.67e+00 -	2.25e-01 -	2.72e+00 -	2.12e+01 -
WCCI20-MaTSO8-T23	3.66e+02	3.56e+02 =	2.69e+02 +	2.43e+02 +	2.16e+02 +	4.02e+02 -	4.61e+02 -
WCCI20-MaTSO8-T24	1.21e-08	1.22e-06 -	4.36e-04 -	1.05e-02 -	1.04e-03 -	9.48e-03 -	3.25e-01 -
WCCI20-MaTSO8-T25	6.84e-01	9.71e-01 -	2.11e+00 -	1.31e+01 -	3.04e+01 -	2.58e+01 -	6.78e+01 -
WCCI20-MaTSO8-T26	6.28e+01	1.21e+02 =	5.90e+02 -	5.33e+02 -	5.93e+02 -	8.41e+02 -	3.02e+03 -
WCCI20-MaTSO8-T27	6.86e-12	2.53e-05 -	1.07e-10 -	1.40e+00 -	9.46e-02 -	2.97e+00 -	2.12e+01 -
WCCI20-MaTSO8-T28	3.42e+02	3.54e+02 =	2.44e+02 +	2.53e+02 +	2.01e+02 +	3.86e+02 -	4.53e+02 -
WCCI20-MaTSO8-T29	1.16e-08	4.47e-07 -	7.29e-04 -	2.88e-03 -	5.84e-04 -	8.16e-03 -	3.21e-01 -
WCCI20-MaTSO8-T30	2.97e-01	6.23e-01 -	2.71e+00 -	1.36e+01 -	3.18e+01 -	2.49e+01 -	6.72e+01 -
WCCI20-MaTSO8-T31	1.82e+02	1.77e+02 =	5.41e+02 -	7.63e+02 -	3.70e+02 =	1.36e+03 -	2.62e+03 -
WCCI20-MaTSO8-T32	1.05e-11	6.73e-06 -	1.12e-02 =	2.34e+00 -	1.32e-01 -	2.73e+00 -	2.12e+01 -
WCCI20-MaTSO8-T33	3.60e+02	3.53e+02 =	1.93e+02 +	2.35e+02 +	1.96e+02 +	3.96e+02 -	4.56e+02 -
WCCI20-MaTSO8-T34	6.76e-09	7.61e-07 -	7.00e-04 -	4.83e-03 -	1.20e-03 -	8.12e-03 -	3.14e-01 -
WCCI20-MaTSO8-T35	2.55e-01	4.74e-01 -	2.30e+00 -	1.26e+01 -	3.46e+01 -	2.42e+01 -	6.72e+01 -
WCCI20-MaTSO8-T36	1.75e+02	2.32e+02 =	6.93e+02 =	3.59e+02 =	7.88e+02 =	8.42e+02 =	3.75e+03 -
WCCI20-MaTSO8-T37	1.01e-11	3.02e-05 -	7.83e-02 =	8.60e-01 -	1.27e-01 -	2.73e+00 -	2.12e+01 -
WCCI20-MaTSO8-T38	3.46e+02	3.55e+02 =	1.87e+02 +	2.26e+02 +	2.14e+02 +	4.22e+02 -	4.55e+02 -
WCCI20-MaTSO8-T39	1.34e-08	8.90e-07 -	3.59e-04 -	9.76e-03 -	1.40e-03 -	1.18e-02 -	3.13e-01 -
WCCI20-MaTSO8-T40	6.64e-01	5.54e-01 =	2.54e+00 -	1.18e+01 -	3.14e+01 -	2.24e+01 -	6.76e+01 -
WCCI20-MaTSO8-T41	1.56e+02	4.26e+02 =	7.97e+02 =	5.04e+02 =	6.64e+02 =	1.03e+03 -	2.04e+03 -
WCCI20-MaTSO8-T42	9.30e-12	4.04e-05 -	3.17e-01 =	2.01e+00 -	6.13e-02 -	2.50e+00 -	2.12e+01 -
WCCI20-MaTSO8-T43	3.27e+02	3.50e+02 =	2.15e+02 +	2.85e+02 +	1.98e+02 +	4.13e+02 -	4.52e+02 -
WCCI20-MaTSO8-T44	8.17e-09	6.07e-07 -	7.14e-04 -	2.24e-02 -	7.95e-04 -	1.01e-02 -	3.04e-01 -
WCCI20-MaTSO8-T45	5.49e-01	8.10e-01 -	2.58e+00 -	1.30e+01 -	3.02e+01 -	2.27e+01 -	6.79e+01 -
WCCI20-MaTSO8-T46	5.18e+01	4.77e+01 =	2.13e+02 -	1.45e+02 -	1.61e+02 -	2.10e+02 -	1.72e+03 -
WCCI20-MaTSO8-T47	7.38e-12	1.02e-05 -	1.87e-03 -	1.06e+00 -	4.65e-02 -	2.62e+00 -	2.11e+01 -
WCCI20-MaTSO8-T48	3.50e+02	3.54e+02 =	1.94e+02 +	2.40e+02 +	1.94e+02 +	3.96e+02 -	4.61e+02 -
WCCI20-MaTSO8-T49	8.78e-09	5.78e-07 -	8.14e-04 -	1.29e-02 -	1.28e-03 -	8.47e-03 -	3.29e-01 -
WCCI20-MaTSO8-T50	4.18e-01	3.30e-01 +	2.45e+00 -	1.54e+01 -	3.24e+01 -	2.35e+01 -	6.70e+01 -
+/-/=	Base	2/26/22	10/32/8	10/37/3	10/37/3	0/50/0	0/50/0

Table 15: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO9 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO9-T1	1.49e+02	2.84e+02 =	2.19e+02 -	9.19e+02 -	1.06e+03 -	3.30e+02 -	3.57e+03 -
WCCI20-MaTSO9-T2	2.99e-12	5.16e-05 -	6.31e-03 -	1.15e+00 -	2.10e-01 -	2.71e+00 -	2.12e+01 -
WCCI20-MaTSO9-T3	3.63e+02	3.54e+02 +	1.86e+02 +	2.75e+02 +	1.89e+02 +	4.32e+02 -	4.58e+02 -
WCCI20-MaTSO9-T4	3.34e-09	3.91e-07 -	1.75e-04 -	4.84e-03 -	1.25e-03 -	8.82e-03 -	3.31e-01 -
WCCI20-MaTSO9-T5	1.65e+00	3.00e+00 -	2.55e+00 -	1.72e+01 -	3.19e+01 -	2.45e+01 -	6.83e+01 -
WCCI20-MaTSO9-T6	1.33e+04	1.31e+04 +	1.21e+04 +	1.30e+04 =	5.87e+03 +	1.30e+04 +	1.23e+04 +
WCCI20-MaTSO9-T7	4.78e+01	4.84e+01 -	5.55e+03 -	9.00e+01 -	1.66e+02 -	3.67e+02 -	8.66e+02 -
WCCI20-MaTSO9-T8	4.77e-12	1.10e-05 -	1.11e-11 =	2.46e-01 -	7.96e-02 -	2.47e+00 -	2.12e+01 -
WCCI20-MaTSO9-T9	3.41e+02	3.57e+02 =	1.63e+02 +	2.14e+02 +	2.03e+02 +	3.96e+02 -	4.57e+02 -
WCCI20-MaTSO9-T10	3.59e-09	6.27e-08 -	2.32e-04 -	1.16e-02 -	7.65e-04 -	4.70e-03 -	3.24e-01 -
WCCI20-MaTSO9-T11	5.86e-01	1.05e+00 -	3.75e+00 -	1.59e+01 -	3.50e+01 -	2.47e+01 -	6.76e+01 -
WCCI20-MaTSO9-T12	1.32e+04	1.32e+04 =	1.22e+04 +	1.22e+04 +	5.74e+03 +	1.26e+04 +	1.20e+04 +
WCCI20-MaTSO9-T13	4.77e+01	5.10e+01 =	3.61e+03 -	2.38e+02 -	4.18e+02 -	3.27e+02 -	1.34e+03 -
WCCI20-MaTSO9-T14	4.18e-12	5.51e-05 -	8.70e-06 =	2.90e-01 -	4.31e-02 -	2.74e+00 -	2.12e+01 -
WCCI20-MaTSO9-T15	3.40e+02	3.57e+02 =	1.99e+02 +	2.61e+02 +	2.02e+02 +	4.18e+02 -	4.53e+02 -
WCCI20-MaTSO9-T16	5.70e-09	3.54e-07 -	9.01e-04 -	6.83e-03 -	5.22e-04 -	9.08e-03 -	3.21e-01 -
WCCI20-MaTSO9-T17	2.92e-01	4.26e-01 -	2.17e+00 -	1.06e+01 -	3.30e+01 -	2.38e+01 -	6.68e+01 -
WCCI20-MaTSO9-T18	1.33e+04	1.33e+04 =	1.25e+04 +	1.19e+04 +	6.04e+03 +	1.29e+04 +	1.22e+04 +
WCCI20-MaTSO9-T19	5.75e+01	5.47e+01 =	1.32e+03 -	3.03e+02 -	3.70e+02 -	2.38e+02 -	1.95e+03 -
WCCI20-MaTSO9-T20	3.92e-12	4.55e-05 -	1.77e-01 -	2.13e+00 -	1.02e-01 -	2.71e+00 -	2.12e+01 -
WCCI20-MaTSO9-T21	3.60e+02	3.45e+02 =	1.83e+02 +	2.53e+02 +	2.04e+02 +	3.89e+02 -	4.59e+02 -
WCCI20-MaTSO9-T22	5.61e-09	3.14e-07 -	1.47e-04 -	7.33e-03 -	2.07e-03 -	5.40e-03 -	3.40e-01 -
WCCI20-MaTSO9-T23	2.17e+00	2.69e+00 =	3.30e+00 =	1.48e+01 -	3.46e+01 -	2.52e+01 -	6.73e+01 -
WCCI20-MaTSO9-T24	1.33e+04	1.33e+04 =	1.20e+04 +	1.27e+04 =	5.46e+03 +	1.28e+04 +	1.20e+04 +
WCCI20-MaTSO9-T25	1.46e+02	5.06e+02 =	8.91e+02 -	7.76e+02 -	7.61e+02 -	1.15e+03 -	3.43e+03 -
WCCI20-MaTSO9-T26	7.17e-12	2.37e-05 -	3.29e-01 =	9.82e-01 -	2.53e-01 -	2.56e+00 -	2.12e+01 -
WCCI20-MaTSO9-T27	3.59e+02	3.57e+02 =	1.73e+02 +	2.54e+02 +	1.96e+02 +	3.77e+02 -	4.56e+02 -
WCCI20-MaTSO9-T28	6.22e-09	2.98e-07 -	7.35e-04 -	4.62e-03 -	1.46e-03 -	8.58e-03 -	3.26e-01 -
WCCI20-MaTSO9-T29	1.52e+00	2.11e+00 =	2.69e+00 =	1.53e+01 -	3.32e+01 -	2.57e+01 -	6.74e+01 -
WCCI20-MaTSO9-T30	1.37e+04	1.38e+04 =	1.30e+04 +	1.24e+04 +	6.23e+03 +	1.30e+04 +	1.22e+04 +
WCCI20-MaTSO9-T31	2.69e+02	2.46e+02 =	6.98e+02 -	4.58e+02 =	8.72e+02 =	1.01e+03 -	2.02e+03 -
WCCI20-MaTSO9-T32	4.68e-12	1.52e-05 -	9.91e-02 =	1.72e+00 -	1.11e-01 -	2.64e+00 -	2.12e+01 -
WCCI20-MaTSO9-T33	3.65e+02	3.56e+02 =	1.71e+02 +	2.78e+02 +	2.11e+02 +	4.12e+02 -	4.53e+02 -
WCCI20-MaTSO9-T34	3.24e-09	3.87e-07 -	1.29e-03 -	8.95e-03 -	1.89e-03 -	1.13e-02 -	3.52e-01 -
WCCI20-MaTSO9-T35	1.13e+00	1.42e+00 =	4.18e+00 -	1.65e+01 -	3.25e+01 -	2.49e+01 -	6.78e+01 -
WCCI20-MaTSO9-T36	1.35e+04	1.32e+04 =	1.24e+04 +	1.22e+04 +	6.17e+03 +	1.30e+04 +	1.25e+04 +
WCCI20-MaTSO9-T37	6.65e+01	7.07e+01 =	1.34e+03 -	1.79e+02 =	2.50e+02 -	2.98e+02 -	8.35e+02 -
WCCI20-MaTSO9-T38	3.82e-12	4.66e-05 -	1.25e-01 =	1.24e+00 -	1.34e-01 -	2.66e+00 -	2.11e+01 -
WCCI20-MaTSO9-T39	3.54e+02	3.49e+02 =	1.83e+02 +	2.37e+02 +	1.79e+02 +	3.87e+02 -	4.60e+02 -
WCCI20-MaTSO9-T40	4.95e-09	1.24e-07 -	1.12e-03 -	1.13e-02 -	1.00e-03 -	6.45e-03 -	3.05e-01 -
WCCI20-MaTSO9-T41	6.04e-01	9.91e-01 -	2.99e+00 -	1.48e+01 -	3.27e+01 -	2.34e+01 -	6.76e+01 -
WCCI20-MaTSO9-T42	1.31e+04	1.30e+04 =	1.15e+04 +	1.16e+04 +	5.37e+03 +	1.25e+04 +	1.18e+04 +
WCCI20-MaTSO9-T43	7.28e+01	6.70e+01 =	1.15e+03 -	4.31e+02 =	1.63e+02 =	3.02e+02 =	2.26e+03 -
WCCI20-MaTSO9-T44	4.53e-12	1.08e-05 -	4.61e-01 =	2.11e+00 -	4.72e-01 -	2.57e+00 -	2.12e+01 -
WCCI20-MaTSO9-T45	3.48e+02	3.53e+02 =	2.03e+02 +	2.54e+02 +	1.99e+02 +	4.09e+02 -	4.65e+02 -
WCCI20-MaTSO9-T46	6.73e-09	5.07e-07 -	1.04e-03 -	1.84e-02 -	6.33e-04 -	1.31e-02 -	3.26e-01 -
WCCI20-MaTSO9-T47	9.21e-01	9.82e-01 =	2.35e+00 -	1.27e+01 -	3.56e+01 -	2.32e+01 -	6.74e+01 -
WCCI20-MaTSO9-T48	1.33e+04	1.35e+04 =	1.17e+04 +	1.17e+04 +	5.81e+03 +	1.28e+04 +	1.23e+04 +
WCCI20-MaTSO9-T49	4.76e+01	4.79e+01 =	1.94e+03 -	1.38e+02 -	2.71e+02 -	2.84e+02 -	1.93e+03 -
WCCI20-MaTSO9-T50	1.14e-10	1.84e-05 -	5.72e-12 =	2.26e+00 -	2.26e-01 -	2.59e+00 -	2.11e+01 -
+/-/=	Base	2/22/26	16/25/9	14/31/5	16/32/2	8/42/0	8/42/0

Table 16: The comparison results of MTEA-HKTS with other six algorithms on WCCI20-MaTSO10 problem

	MTEA-HKTS	KR-MTEA	BoKTDE	AEMTO	MTEA-SaO	MaTDE	DE
WCCI20-MaTSO10-T1	8.88e-09	5.25e-05 -	1.11e-04 -	1.18e+00 -	4.91e-02 -	2.80e+00 -	2.12e+01 -
WCCI20-MaTSO10-T2	3.56e+02	3.60e+02 -	2.96e+02 +	2.69e+02 +	2.29e+02 +	3.81e+02 =	4.49e+02 -
WCCI20-MaTSO10-T3	4.12e-09	2.39e-07 -	4.39e-04 -	7.09e-03 -	1.65e-03 -	7.70e-03 -	3.25e-01 -
WCCI20-MaTSO10-T4	6.89e-01	1.16e+00 -	3.08e+00 -	1.53e+01 -	3.32e+01 -	2.59e+01 -	6.75e+01 -
WCCI20-MaTSO10-T5	1.36e+04	1.35e+04 =	1.20e+04 +	1.24e+04 +	5.33e+03 +	1.29e+04 +	1.24e+04 +
WCCI20-MaTSO10-T6	3.77e-12	1.89e-05 -	6.91e-04 -	1.17e+00 -	5.77e-02 -	2.52e+00 -	2.12e+01 -
WCCI20-MaTSO10-T7	3.44e+02	3.61e+02 =	2.61e+02 +	2.34e+02 +	2.04e+02 +	3.90e+02 -	4.56e+02 -
WCCI20-MaTSO10-T8	3.44e-09	1.92e-07 -	5.48e-04 -	1.64e-02 -	1.49e-03 -	1.09e-02 -	3.26e-01 -
WCCI20-MaTSO10-T9	1.11e+00	1.37e+00 =	2.19e+00 -	1.15e+01 -	3.55e+01 -	2.30e+01 -	6.74e+01 -
WCCI20-MaTSO10-T10	1.37e+04	1.37e+04 =	1.32e+04 +	1.23e+04 +	6.11e+03 +	1.34e+04 +	1.23e+04 +
WCCI20-MaTSO10-T11	4.57e-12	8.42e-06 -	5.48e-04 -	6.99e-01 -	4.11e-01 -	2.74e+00 -	2.12e+01 -
WCCI20-MaTSO10-T12	3.25e+02	3.43e+02 =	2.47e+02 +	2.43e+02 +	2.08e+02 +	3.85e+02 -	4.48e+02 -
WCCI20-MaTSO10-T13	5.95e-09	2.72e-07 -	1.13e-04 -	1.77e-02 -	1.62e-03 -	1.56e-02 -	3.26e-01 -
WCCI20-MaTSO10-T14	1.69e+00	2.05e+00 =	3.20e+00 -	1.76e+01 -	3.30e+01 -	2.56e+01 -	6.80e+01 -
WCCI20-MaTSO10-T15	1.34e+04	1.33e+04 =	1.25e+04 +	1.18e+04 +	5.54e+03 +	1.29e+04 +	1.22e+04 +
WCCI20-MaTSO10-T16	2.38e-12	2.40e-05 -	2.79e-01 -	3.44e+00 -	8.06e-01 -	2.77e+00 -	2.12e+01 -
WCCI20-MaTSO10-T17	3.39e+02	3.63e+02 =	2.44e+02 +	2.29e+02 +	2.08e+02 +	4.02e+02 -	4.54e+02 -
WCCI20-MaTSO10-T18	5.60e-09	2.65e-07 -	5.84e-04 -	1.63e-02 -	1.06e-03 -	8.66e-03 -	3.13e-01 -
WCCI20-MaTSO10-T19	2.72e-01	2.86e-01 -	2.43e+00 -	1.25e+01 -	3.41e+01 -	2.33e+01 -	6.75e+01 -
WCCI20-MaTSO10-T20	1.35e+04	1.32e+04 =	1.26e+04 +	1.25e+04 =	5.36e+03 +	1.32e+04 =	1.23e+04 +
WCCI20-MaTSO10-T21	3.22e-12	3.94e-05 -	1.44e-01 -	4.58e-01 -	3.31e-02 -	2.59e+00 -	2.12e+01 -
WCCI20-MaTSO10-T22	3.63e+02	3.63e+02 =	1.89e+02 +	2.27e+02 +	2.28e+02 +	4.16e+02 -	4.58e+02 -
WCCI20-MaTSO10-T23	5.00e-09	1.94e-07 -	5.82e-04 -	2.91e-02 -	1.06e-03 -	3.70e-03 -	3.13e-01 -
WCCI20-MaTSO10-T24	1.07e+00	1.16e+00 =	2.53e+00 -	1.54e+01 -	3.42e+01 -	2.37e+01 -	6.76e+01 -
WCCI20-MaTSO10-T25	1.06e+04	1.32e+04 =	1.21e+04 =	1.20e+04 =	5.00e+03 +	1.25e+04 =	1.21e+04 -
WCCI20-MaTSO10-T26	4.93e-12	2.25e-05 -	1.31e-01 -	1.01e+00 -	1.51e+00 -	2.69e+00 -	2.12e+01 -
WCCI20-MaTSO10-T27	3.69e+02	3.56e+02 +	2.79e+02 +	2.63e+02 +	2.18e+02 +	3.96e+02 -	4.63e+02 -
WCCI20-MaTSO10-T28	8.67e-09	5.11e-07 -	1.09e-03 -	5.18e-03 -	1.46e-03 -	1.06e-02 -	3.49e-01 -
WCCI20-MaTSO10-T29	9.03e-01	1.37e+00 -	2.10e+00 -	1.60e+01 -	2.82e+01 -	2.50e+01 -	6.77e+01 -
WCCI20-MaTSO10-T30	9.56e+03	1.32e+04 =	1.18e+04 =	1.21e+04 =	5.43e+03 =	1.30e+04 =	1.22e+04 =
WCCI20-MaTSO10-T31	4.43e-12	4.12e-05 -	6.87e-02 -	1.64e-01 -	7.26e-02 -	2.49e+00 -	2.12e+01 -
WCCI20-MaTSO10-T32	3.61e+02	3.56e+02 =	2.01e+02 +	2.64e+02 +	2.11e+02 +	4.07e+02 -	4.58e+02 -
WCCI20-MaTSO10-T33	2.25e-09	1.40e-07 -	6.85e-04 -	4.13e-03 -	1.51e-03 -	5.35e-03 -	3.34e-01 -
WCCI20-MaTSO10-T34	1.33e+00	2.18e+00 -	2.47e+00 -	1.70e+01 -	3.15e+01 -	2.53e+01 -	6.75e+01 -
WCCI20-MaTSO10-T35	1.35e+04	1.35e+04 =	1.19e+04 +	1.20e+04 +	5.51e+03 +	1.29e+04 +	1.21e+04 +
WCCI20-MaTSO10-T36	2.93e-12	1.15e-05 -	1.02e-03 -	1.87e-01 -	1.20e-01 -	2.71e+00 -	2.11e+01 -
WCCI20-MaTSO10-T37	3.71e+02	3.62e+02 =	2.39e+02 +	1.97e+02 +	1.85e+02 +	3.77e+02 =	4.54e+02 -
WCCI20-MaTSO10-T38	2.54e-09	6.92e-08 -	2.34e-04 -	1.07e-02 -	7.02e-04 -	8.30e-03 -	3.31e-01 -
WCCI20-MaTSO10-T39	1.11e+00	1.36e+00 =	1.91e+00 =	1.46e+01 -	3.10e+01 -	2.25e+01 -	6.75e+01 -
WCCI20-MaTSO10-T40	1.35e+04	1.33e+04 =	1.26e+04 +	1.15e+04 +	5.70e+03 +	1.30e+04 +	1.24e+04 +
WCCI20-MaTSO10-T41	4.31e-12	1.36e-05 -	5.82e-02 -	3.88e+00 -	1.46e-01 -	2.65e+00 -	2.12e+01 -
WCCI20-MaTSO10-T42	3.60e+02	3.36e+02 =	2.57e+02 +	2.49e+02 +	2.16e+02 +	4.07e+02 -	4.62e+02 -
WCCI20-MaTSO10-T43	2.26e-09	2.68e-07 -	5.88e-04 -	1.63e-02 -	3.13e-03 -	7.91e-03 -	3.33e-01 -
WCCI20-MaTSO10-T44	8.53e-01	1.28e+00 -	3.50e+00 -	1.44e+01 -	3.96e+01 -	2.52e+01 -	6.72e+01 -
WCCI20-MaTSO10-T45	1.32e+04	1.35e+04 =	1.28e+04 =	1.16e+04 +	6.10e+03 +	1.31e+04 =	1.24e+04 +
WCCI20-MaTSO10-T46	5.47e-12	1.00e-05 -	3.17e-01 -	1.21e+00 -	8.72e-01 -	2.63e+00 -	2.12e+01 -
WCCI20-MaTSO10-T47	3.25e+02	3.56e+02 =	2.86e+02 +	2.54e+02 +	2.11e+02 +	4.04e+02 -	4.53e+02 -
WCCI20-MaTSO10-T48	4.55e-09	3.46e-07 -	1.45e-04 -	7.04e-03 -	6.30e-04 -	5.42e-03 -	3.35e-01 -
WCCI20-MaTSO10-T49	2.19e+00	2.61e+00 =	3.22e+00 -	2.02e+01 -	3.15e+01 -	2.64e+01 -	6.73e+01 -
WCCI20-MaTSO10-T50	1.27e+04	1.33e+04 =	1.26e+04 =	1.25e+04 =	5.25e+03 +	1.27e+04 =	1.21e+04 +
+/-/=	Base	1/26/23	16/29/5	16/30/4	19/30/1	5/38/7	8/41/1

Table 17: The experimental results of MTEA-HKTS, KR-MTEA, and three variants

	MTEA-HKTS	MTEA-HKTS1	MTEA-HKTS2	MTEA-HKTS3	KR-MTEA
WCCI20-MaTSO9-T1	1.72E+02	2.45e+02 =	1.75e+02 =	2.57e+02 -	2.99e+02 =
WCCI20-MaTSO9-T2	3.81E-12	2.38e-05 -	5.70e-12 =	2.03e-08 -	2.71e-05 -
WCCI20-MaTSO9-T3	3.61E+02	3.63e+02 =	3.78e+02 -	2.98e+02 +	3.54e+02 =
WCCI20-MaTSO9-T4	3.88E-09	1.30e-07 -	2.38e-09 =	8.45e-08 -	4.48e-07 -
WCCI20-MaTSO9-T5	1.82E+00	2.72e+00 -	8.54e-01 +	1.21e+01 -	2.15e+00 =
WCCI20-MaTSO9-T6	1.32E+04	1.32e+04 =	1.33e+04 =	1.13e+04 +	1.34e+04 =
WCCI20-MaTSO9-T7	4.79E+01	4.82e+01 =	4.79e+01 =	5.07e+01 -	4.83e+01 =
WCCI20-MaTSO9-T8	3.87E-12	2.36e-05 -	5.94e-12 -	4.14e-08 -	2.72e-05 -
WCCI20-MaTSO9-T9	3.53E+02	3.41e+02 =	3.71e+02 =	2.67e+02 +	3.61e+02 =
WCCI20-MaTSO9-T10	3.58E-09	5.38e-08 -	5.17e-09 =	3.70e-04 -	6.48e-08 -
WCCI20-MaTSO9-T11	3.71E-01	8.32e-01 -	6.60e-03 +	1.38e+01 -	6.75e-01 -
WCCI20-MaTSO9-T12	1.34E+04	1.32e+04 =	1.33e+04 =	1.30e+04 =	1.33e+04 =
WCCI20-MaTSO9-T13	5.10E+01	5.10e+01 =	4.78e+01 =	6.09e+01 =	4.79e+01 =
WCCI20-MaTSO9-T14	3.13E-12	1.71e-05 -	7.04e-12 -	1.41e-05 -	2.85e-05 -
WCCI20-MaTSO9-T15	3.63E+02	3.53e+02 =	3.78e+02 -	3.22e+02 =	3.58e+02 =
WCCI20-MaTSO9-T16	4.41E-09	4.02e-07 -	4.70e-09 =	9.20e-08 -	2.67e-07 -
WCCI20-MaTSO9-T17	8.87E-01	1.21e+00 =	1.72e-01 +	8.51e+00 -	1.57e+00 =
WCCI20-MaTSO9-T18	1.36E+04	1.34e+04 =	1.35e+04 =	1.26e+04 +	1.34e+04 =
WCCI20-MaTSO9-T19	5.18E+01	5.40e+01 =	7.33e+01 =	6.58e+01 =	8.02e+01 =
WCCI20-MaTSO9-T20	6.71E-12	2.14e-05 -	1.17e-11 -	1.18e-05 -	2.19e-05 -
WCCI20-MaTSO9-T21	3.61E+02	3.62e+02 =	3.78e+02 -	3.04e+02 =	3.54e+02 =
WCCI20-MaTSO9-T22	3.64E-09	1.76e-07 -	5.28e-09 =	1.07e-07 -	2.84e-07 -
WCCI20-MaTSO9-T23	2.10E+00	3.24e+00 -	1.30e+00 =	1.49e+01 -	2.50e+00 =
WCCI20-MaTSO9-T24	1.33E+04	1.34e+04 =	1.33e+04 =	1.30e+04 =	1.32e+04 =
WCCI20-MaTSO9-T25	3.82E+02	4.36e+02 =	1.76e+02 =	4.12e+02 =	4.74e+02 =
WCCI20-MaTSO9-T26	3.66E-12	1.63e-05 -	6.95e-12 -	1.34e-06 -	1.81e-05 -
WCCI20-MaTSO9-T27	3.45E+02	3.58e+02 =	3.74e+02 -	3.48e+02 =	3.53e+02 =
WCCI20-MaTSO9-T28	6.45E-09	3.16e-07 -	5.80e-09 =	7.93e-08 -	4.56e-07 -
WCCI20-MaTSO9-T29	1.67E+00	2.22e+00 =	6.16e-01 +	1.20e+01 -	1.43e+00 =
WCCI20-MaTSO9-T30	1.34E+04	1.36e+04 =	1.37e+04 =	1.28e+04 =	1.34e+04 =
WCCI20-MaTSO9-T31	2.19E+02	4.20e+02 =	2.89e+02 =	5.05e+02 =	3.55e+02 =
WCCI20-MaTSO9-T32	5.00E-12	9.58e-06 -	9.62e-12 -	2.92e-05 -	7.38e-05 -
WCCI20-MaTSO9-T33	3.46E+02	3.61e+02 =	3.67e+02 =	3.36e+02 =	3.55e+02 =
WCCI20-MaTSO9-T34	4.42E-09	3.65e-07 -	3.30e-09 =	3.70e-04 -	5.11e-07 -
WCCI20-MaTSO9-T35	1.08E+00	1.67e+00 =	4.66e-01 +	8.80e+00 -	6.69e-01 =
WCCI20-MaTSO9-T36	1.35E+04	1.36e+04 =	1.36e+04 =	1.25e+04 +	1.34e+04 =
WCCI20-MaTSO9-T37	5.86E+01	5.65e+01 =	6.12e+01 =	7.29e+01 =	6.97e+01 =
WCCI20-MaTSO9-T38	5.41E-12	1.23e-05 -	1.12e-11 -	1.27e-07 -	3.01e-05 -
WCCI20-MaTSO9-T39	3.54E+02	3.56e+02 =	3.76e+02 -	2.68e+02 +	3.62e+02 =
WCCI20-MaTSO9-T40	6.36E-09	1.50e-07 -	4.58e-09 =	4.19e-08 -	1.76e-07 -
WCCI20-MaTSO9-T41	7.97E-01	1.18e+00 -	8.27e-02 +	1.24e+01 -	9.31e-01 =
WCCI20-MaTSO9-T42	1.31E+04	1.32e+04 =	1.33e+04 =	1.29e+04 =	1.30e+04 =
WCCI20-MaTSO9-T43	9.96E+01	4.80e+01 =	7.89e+01 +	6.42e+01 =	1.44e+02 =
WCCI20-MaTSO9-T44	4.64E-12	2.01e-05 -	6.28e-12 =	2.04e-06 -	3.45e-05 -
WCCI20-MaTSO9-T45	3.65E+02	3.64e+02 =	3.72e+02 =	3.35e+02 +	3.62e+02 =
WCCI20-MaTSO9-T46	7.07E-09	4.26e-07 -	3.74e-09 +	1.07e-07 -	4.65e-07 -
WCCI20-MaTSO9-T47	9.48E-01	2.30e+00 -	4.36e-01 +	1.17e+01 -	1.56e+00 =
WCCI20-MaTSO9-T48	1.34E+04	1.33e+04 =	1.33e+04 =	1.16e+04 +	1.35e+04 =
WCCI20-MaTSO9-T49	5.08E+01	8.64e+01 -	4.75e+01 =	5.50e+01 -	5.10e+01 =
WCCI20-MaTSO9-T50	3.81E-12	1.43e-05 -	7.69e-12 -	7.83e-06 -	3.46e-05 -
+/-/=	Base	0/23/27	12/29/09	8/28/14	0/18/32
MSS	-1.76E-01	8.48e-02 -	-1.39e-01 =	7.33e-02 -	1.58e-01 -