TABLE I
IGDP RESULTS OF SEVEN CMOEAS ON LIRCMOP TEST SUITE. "+", "-", OR "≈" INDICATES THAT THE CORRESPONDING ALGORITHM IS SIGNIFICANTLY BETTER THAN, WORSE THAN, OR COMPARABLE TO DPPCMO. THE BEST AVERAGE IGDP VALUE ON EACH TEST PROBLEM IS HIGHLIGHTED IN GRAY.

Problem	dpACS	PPS	CMOES	ToP	BiCo	CCMO	DPPCMO
MW1	1.6700e-3 (5.00e-5) −	2.8122e-2 (6.76e-2) −	1.1806e-3 (2.93e-5) −	1.6885e-1 (0.00e+0) ≈	1.2908e-3 (7.04e-4) −	1.1701e-3 (5.37e-5) −	1.1495e-3 (1.70e-5)
MW2	6.7061e-3 (4.82e-3) +	1.7890e-1 (1.18e-1) −	1.3832e-2 (1.56e-2) +	4.5379e-1 (0.00e+0) ≈	1.3880e-2 (7.25e-3) ≈	1.9716e-2 (8.82e-3) ≈	1.7887e-2 (7.99e-3)
MW3	2.6403e-3 (2.24e-4) +	3.8135e-3 (4.90e-4) −	3.1666e-3 (3.70e-4) −	4.6259e-1 (3.13e-1) −	3.1387e-3 (2.62e-4) −	2.9769e-3 (3.83e-4) ≈	2.9077e-3 (1.92e-4)
MW4	2.9269e-2 (6.09e-5) −	5.8146e-2 (6.31e-3) −	2.9932e-2 (4.49e-4) −	3.5521e-1 (2.30e-2) −	2.9436e-2 (4.17e-4) −	2.9156e-2 (3.68e-4) ≈	2.8966e-2 (3.55e-4)
MW5	5.2194e-3 (1.84e-3) −	1.8643e-1 (1.51e-1) −	5.3130e-4 (2.30e-4) +	4.1626e-1 (4.56e-2) −	4.4153e-3 (1.99e-2) ≈	1.6617e-3 (2.20e-3) ≈	8.2877e-4 (5.82e-4)
MW6	4.6235e-3 (3.83e-3) +	6.6499e-1 (3.20e-1) −	1.3147e-2 (1.03e-2) ≈	7.0203e-1 (2.89e-1) −	7.8316e-3 (5.04e-3) +	2.3085e-2 (1.07e-2) −	1.5035e-2 (8.17e-3)
MW7	2.4155e-3 (1.86e-4) −	2.8627e-3 (2.61e-4) −	1.9984e-3 (2.03e-4) ≈	1.0250e-1 (1.45e-1) −	2.2964e-3 (3.11e-4) −	1.9592e-3 (2.16e-4) ≈	2.0265e-3 (2.23e-4)
MW8	2.1138e-2 (2.35e-3) +	1.8492e-1 (9.10e-2) −	2.5211e-2 (5.14e-3) ≈	4.6573e-1 (2.32e-1) −	2.5545e-2 (7.09e-3) ≈	3.0203e-2 (6.97e-3) −	2.4976e-2 (5.29e-3)
MW9	4.8857e-3 (5.91e-4) −	2.6641e-1 (2.97e-1) −	2.4667e-2 (1.19e-1) −	5.1439e-1 (3.05e-1) −	4.3558e-3 (1.01e-3) −	2.9046e-3 (1.73e-4) ≈	2.8436e-3 (1.64e-4)
MW10	1.5018e-2 (1.95e-2) +	3.1495e-1 (1.64e-1) −	1.9053e-2 (1.23e-2) ≈	NaN (NaN)	3.0138e-2 (2.54e-2) ≈	3.5193e-2 (3.34e-2) ≈	2.3570e-2 (1.80e-2)
MW11	3.9129e-3 (3.75e-4) −	3.8164e-3 (2.61e-4) −	2.6818e-3 (1.27e-4) −	4.8037e-1 (1.45e-1) −	2.5947e-3 (1.07e-4) ≈	2.6622e-3 (1.31e-4) −	2.5824e-3 (1.12e-4)
MW12	4.0897e-3 (1.68e-4) −	2.2488e-1 (2.76e-1) −	3.1044e-3 (6.32e-4) −	7.4785e-1 (1.59e-1) −	2.8516e-3 (1.16e-4) ≈	3.0455e-3 (1.55e-4) −	2.8794e-3 (1.45e-4)
MW13	1.6434e-2 (9.48e-3) +	4.3151e-1 (3.57e-1) −	3.0013e-2 (1.89e-2) ≈	8.9589e-1 (4.84e-1) −	1.4183e-2 (1.01e-2) +	4.3700e-2 (4.59e-2) ≈	3.0431e-2 (1.24e-2)
MW14	7.8472e-2 (2.45e-3) −	1.0433e-1 (1.90e-2) −	6.7946e-2 (2.63e-3) −	4.0272e-1 (4.21e-1) −	6.3035e-2 (1.48e-3) ≈	6.5231e-2 (2.85e-3) ≈	6.4512e-2 (2.76e-3)
LIRCMOP1	8.8889e-2 (2.35e-2) −	5.7439e-3 (7.44e-4) +	9.8756e-3 (2.84e-3) −	1.0390e-1 (7.83e-2) −	7.1782e-3 (2.68e-3) ≈	3.7172e-2 (2.93e-2) −	6.9889e-3 (1.25e-3)
LIRCMOP2	4.1376e-2 (2.92e-2) −	5.3556e-3 (3.25e-4) +	1.5341e-2 (6.67e-3) −	5.5408e-2 (5.27e-2) −	6.1540e-3 (1.53e-3) +	5.0794e-2 (2.21e-2) −	7.3503e-3 (1.99e-3)
LIRCMOP3	8.6535e-2 (4.06e-2) −	3.7603e-3 (1.34e-3) +	5.4607e-2 (3.22e-2) −	2.6424e-1 (5.41e-2) −	9.8161e-3 (7.28e-3) ≈	1.1847e-1 (4.82e-2) −	1.8195e-2 (2.14e-2)
LIRCMOP4	6.0992e-2 (3.72e-2) −	3.0118e-3 (2.60e-4) +	3.4359e-2 (1.72e-2) −	1.9875e-1 (3.43e-2) −	8.1028e-3 (5.12e-3) +	7.2823e-2 (2.44e-2) −	1.1547e-2 (9.06e-3)
LIRCMOP5	3.6208e-3 (3.08e-4) +	4.5566e-3 (4.83e-4) ≈	4.8527e-3 (2.21e-4) −	4.9211e-2 (2.06e-1) −	5.0802e-1 (5.38e-1) −	4.5780e-3 (2.11e-4) ≈	4.5112e-3 (1.82e-4)
LIRCMOP6	3.4840e-3 (4.15e-4) +	4.4529e-3 (5.33e-4) ≈	4.5863e-3 (2.07e-4) −	1.5563e-2 (5.49e-2) −	3.8321e-1 (5.92e-1) −	4.4154e-3 (2.10e-4) ≈	4.3465e-3 (2.08e-4)
LIRCMOP7	7.1931e-3 (5.13e-4) −	7.2870e-3 (6.12e-4) −	5.7024e-3 (2.91e-4) ≈	7.2071e-3 (3.85e-4) −	7.8749e-3 (3.13e-3) −	5.7163e-3 (2.53e-4) −	5.5448e-3 (1.78e-4)
LIRCMOP8	7.0343e-3 (5.29e-4) −	7.3290e-3 (7.21e-4) −	5.7071e-3 (2.41e-4) −	7.2309e-3 (4.80e-4) −	6.3856e-3 (2.32e-3) ≈	5.6094e-3 (1.97e-4) ≈	5.5658e-3 (1.95e-4)
LIRCMOP9	3.5119e-3 (1.69e-4) −	1.9866e-3 (7.54e-5) −	2.0871e-3 (9.39e-5) −	1.1964e-1 (9.05e-2) −	5.8984e-2 (3.06e-2) −	2.0556e-3 (7.81e-5) −	1.9265e-3 (9.52e-5)
LIRCMOP10	4.4833e-3 (1.49e-4) −	3.7502e-3 (1.52e-4) +	4.2351e-3 (1.86e-4) −	4.8243e-3 (2.58e-4) −	3.6796e-2 (6.62e-2) −	4.0664e-3 (1.78e-4) −	3.9252e-3 (1.66e-4)
LIRCMOP11	7.0452e-4 (1.04e-4) −	6.5621e-4 (5.26e-5) −	5.9068e-4 (4.62e-5) ≈	1.0258e-1 (4.47e-2) −	2.0970e-3 (5.31e-3) −	5.7920e-4 (4.32e-5) ≈	5.6986e-4 (4.80e-5)
LIRCMOP12	8.1530e-4 (1.73e-4) −	4.8029e-4 (5.43e-5) −	4.0653e-4 (4.40e-5) −	2.4710e-2 (4.11e-2) −	5.3515e-3 (7.45e-3) −	3.6839e-4 (3.25e-5) −	3.3436e-4 (3.57e-5)
LIRCMOP13	4.0697e-2 (3.29e-4) +	6.3963e-2 (2.60e-3) −	6.8892e-2 (2.47e-3) −	7.5913e-2 (2.09e-3) −	4.4969e-2 (1.48e-3) ≈	6.9357e-2 (1.98e-3) −	4.4491e-2 (1.35e-3)
LIRCMOP14	4.3834e-2 (4.77e-4) +	5.7874e-2 (1.99e-3) −	5.4498e-2 (1.51e-3) −	6.4486e-2 (1.97e-3) −	4.6099e-2 (1.61e-3) ≈	5.4041e-2 (1.13e-3) −	4.6078e-2 (1.34e-3)
DASCMOP1	2.9125e-3 (1.24e-4) −	1.5299e-1 (1.62e-1) −	1.8995e-3 (8.09e-5) −	7.4543e-1 (1.21e-1) −	6.9830e-1 (2.99e-2) −	1.8830e-3 (9.19e-5) −	1.7609e-3 (7.56e-5)
DASCMOP2	4.7779e-3 (3.23e-4) −	3.8975e-3 (1.80e-4) −	3.4025e-3 (1.08e-4) −	4.9429e-1 (3.07e-1) −	1.4044e-1 (1.18e-2) −	3.4112e-3 (1.10e-4) −	3.1685e-3 (9.13e-5)
DASCMOP3	5.7252e-3 (2.71e-4) −	1.5174e-1 (7.12e-2) −	5.4653e-3 (1.59e-4) −	6.6478e-1 (1.56e-1) −	1.7810e-1 (1.79e-2) −	5.5640e-3 (3.91e-4) −	5.3318e-3 (6.34e-5)
DASCMOP4	3.1425e-2 (1.53e-1) −	1.6480e-1 (5.57e-2) −	2.2189e-2 (8.10e-2) −	NaN (NaN)	6.5635e-4 (4.68e-5) −	6.7794e-4 (3.14e-4) ≈	6.2522e-4 (1.57e-5)
DASCMOP5	7.5872e-3 (1.81e-3) −	3.0917e-3 (2.07e-4) −	3.2908e-3 (5.92e-4) −	NaN (NaN)	1.7567e-3 (7.54e-5) −	1.6966e-3 (5.29e-5) ≈	1.6970e-3 (4.26e-5)
DASCMOP6	3.4015e-2 (1.23e-1) −	9.6440e-2 (2.06e-1) −	8.2738e-3 (1.25e-2) −	NaN (NaN)	2.2313e-2 (5.38e-2) ≈	6.7892e-3 (4.75e-3) ≈	5.7866e-3 (2.53e-3)
DASCMOP7	7.2226e-2 (8.56e-2) −	4.7093e-2 (7.49e-3) −	1.1939e-1 (2.93e-1) −	NaN (NaN)	2.4573e-2 (1.05e-3) −	2.3177e-2 (8.97e-4) ≈	2.2893e-2 (5.97e-4)
DASCMOP8	4.0251e-2 (7.92e-3) −	2.9630e-2 (1.69e-3) −	7.4321e-2 (1.81e-1) −	NaN (NaN)	1.8891e-2 (9.62e-4) ≈	1.8714e-2 (7.75e-4) ≈	1.8958e-2 (6.85e-4)
DASCMOP9	2.4693e-2 (1.16e-3) −	5.6297e-2 (5.14e-2) −	2.1475e-2 (6.31e-4) −	3.9263e-1 (1.58e-1) −	2.2031e-1 (3.37e-2) −	2.1313e-2 (1.05e-3) −	2.0743e-2 (9.61e-4)
DOC1	5.6608e-3 (8.96e-4) −	6.7381e-2 (5.85e-2) −	3.7415e-2 (4.72e-2) −	3.3236e-3 (1.50e-4) −	5.5763e-3 (9.52e-3) −	3.0900e-3 (2.50e-4) −	2.9093e-3 (2.11e-4)
DOC2	2.2900e-1 (9.69e-2) −	3.7635e-1 (1.20e-1) −	NaN (NaN)	3.0430e-1 (7.10e-2) −	NaN (NaN)	1.5957e-2 (4.84e-2) −	3.9834e-3 (1.10e-3)
DOC3	6.4892e+2 (5.87e+2) ≈	2.2767e+2 (1.66e+2) +	6.4561e+2 (4.87e+2) ≈	9.3275e+1 (1.22e+2) +	4.6522e+2 (1.53e+2) ≈	5.5944e+2 (4.80e+2) ≈	6.2566e+2 (4.19e+2)
DOC4	6.2126e-2 (1.11e-2) −	2.7291e-1 (5.55e-2) −	3.0721e-2 (7.70e-3) −	3.6552e-2 (4.09e-2) −	2.3735e-1 (1.57e-1) −	2.3110e-2 (3.88e-3) −	1.8920e-2 (2.79e-3)
DOC5	5.7896e+0 (1.44e+1) +	5.4299e+1 (1.18e+2) −	1.8717e+1 (4.69e+1) ≈	3.5048e+1 (5.40e+1) −	NaN (NaN)	6.5679e+0 (2.92e+1) ≈	6.6044e+0 (2.92e+1)
DOC6	1.4786e+0 (5.65e-1) −	5.3075e-1 (4.69e-2) −	1.7969e-1 (2.71e-1) −	1.9528e+0 (8.70e-1) −	1.0129e+0 (8.39e-1) −	4.4358e-2 (8.78e-2) −	2.4693e-3 (1.96e-4)
DOC7	2.4599e-1 (1.22e-1) −	4.7354e-1 (1.85e-1) −	5.7076e-2 (2.04e-1) −	3.6327e-1 (3.29e-1) −	5.0347e+0 (1.73e+0) −	2.1019e-2 (1.02e-1) ≈	2.1563e-3 (9.98e-5)
DOC8	1.8537e+0 (6.72e-1) −	1.0602e+2 (4.10e+1) −	1.3130e-1 (3.34e-2) −	1.6493e+1 (1.09e+1) −	6.2242e+1 (6.19e+1) −	1.4824e-1 (4.08e-2) −	6.7670e-2 (4.52e-3)
DOC9	7.1403e-2 (1.34e-2) −	2.6022e-1 (2.21e-2) −	8.3003e-2 (1.44e-2) −	1.7255e-1 (3.95e-2) −	9.7825e-2 (9.79e-2) ≈	6.9892e-2 (7.97e-3) −	5.9246e-2 (6.37e-3)
+/ − / ≈	11/34/1	6/38/2	2/34/9	1/37/2	4/24/16	0/25/21	