Reaching Pareto Front Shape Invariance with a Continuous Multi-Objective Ant Colony Optimization Algorithm Supplementary Material

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In this document, we present the complete results for the calculation of the hypervolume indicator (HV), the Inverted Generational Distance plus indicator (IGD$^+$), and the Riesz s-energy $E_s = U^{\mathcal{K}^{\text{RSE}}}$ of the Pareto front approximations generated by GI-MOACO$_{\mathbb{R}}$, MOACO$_{\mathbb{R}}$ [4], iMOACO$_{\mathbb{R}}$ [3], AdaW [9], AR-MOEA [11], SPEA2+SDE [7], RVEA-iGNG [10], and Two_Arch2 [15]. For all Multi-Objective Evolutionary Algorithms (MOEAs), we employed the implementations as in the PlatEMO platform [12]. The HV and IGD$^+$ indicator asses convergence towards the Pareto front (PF) [8], while the E_s indicator measures diversity of the PFAs [2]. We adopted the test suites Deb-Thiele-Laumanns-Zitzler (DTLZ) [1], Walking-Fish-Group (WFG) [5], their inverted versions DTLZ^{-1} and WFG^{-1} [6], respectively, for 2, 3, 5, and 7 objectives. Additionally, we employed the Irregular MOPs (IMOP) [13] and the Viennet problems (VIE) [14].

For all Tables SM-1-SM-18, we performed 30 independent executions of each algorithm per test instance. We show the mean and standard deviation (in parentheses). The two best values are shown in grayscale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best-ranked value performs better in a statistically significant way than the rest of the values.

The structure of this supplementary material (SM) is organized as follows. Section I presents the complete HV results. Section II presents the complete IGD$^+$ results. Section III presents the complete E_s results.

I. Hypervolume Results

This section presents the complete HV results. Tables SM-1-SM-6 show a comparison of the HV indicator of the PFAs generated by GI-MOACO$_{\mathbb{R}}$, MOACO$_{\mathbb{R}}$ [4], iMOACO$_{\mathbb{R}}$ [3], AdaW [9], AR-MOEA [11], SPEA2+SDE [7], RVEA-iGNG [10], and Two_Arch2 [15].

TABLE SM-1

Hypervolume results for the compared Multi-objective algorithms on the IMOP problems. We show the mean and standard deviation (in parentheses). The two best values are shown in grayscale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best-ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
IMOP1	2	1.35717e+00 (8#) (2.62664e-02)	1.39991e+00 (7#) (1.30062e-01)	1.42221e+00 (6#) (1.01596e-03)	1.42486e+00 (3) (5.19913e-05)	1.42240e+00 (5) (3.75704e-05)	1.42418e+00 (4#) (3.33953e-04)	1.42520e+00 (1) (6.87527e-06)	1.42505e+00 (2) (1.00720e-04)
IMOP2	2	4.78915e-01 (2#) (4.23873e-03)	4.74410e-01 (4#) (5.14150e-02)	4.78826e-01 (3#) (3.93876e-03)	3.12828e-01 (6) (7.26992e-02)	3.08916e-01 (8) (1.11211e-01)	5.11052e-01 (1) (8.39773e-05)	3.09135e-01 (7) (1.12157e-01)	3.26440e-01 (5) (1.09543e-01)
IMOP3	2	1.12146e+00 (8#) (2.96485e-02)	1.16398e+00 (6#) (1.15561e-01)	1.15699e+00 (7#) (2.28033e-02)	1.41268e+00 (3) (3.53084e-02)	1.38570e+00 (4) (1.23739e-01)	1.42216e+00 (2#) (1.46057e-02)	1.43248e+00 (1) (3.77954e-03)	1.33595e+00 (5) (8.78516e-02)
IMOP4	3	6.43399e-01 (7#) (2.63327e-02)	6.64542e-01 (6#) (1.49214e-02)	6.35531e-01 (8#) (2.46791e-02)	8.70685e-01 (5#) (2.10268e-02)	8.77963e-01 (1) (4.85178e-04)	8.76468e-01 (4#) (6.86043e-04)	8.77294e-01 (2#) (8.91080e-04)	8.76473e-01 (3#) (1.67581e-03)
IMOP5	3	3.03026e+00 (8#) (5.12082e-02)	3.07101e+00 (6#) (7.41988e-02)	3.04708e+00 (7#) (3.98993e-02)	3.58200e+00 (5) (3.00087e-02)	3.62479e+00 (3) (1.10702e-02)	3.60180e+00 (4#) (1.37152e-02)	3.62619e+00 (2#) (1.21001e-02)	3.62659e+00 (1) (7.86222e-03)
IMOP6	3	9.95935e-01 (6#) (9.43962e-03)	9.78609e-01 (8#) (1.03485e-02)	9.84159e-01 (7#) (3.74288e-03)	1.05286e+00 (1) (1.46021e-03)	1.01378e+00 (4) (1.04917e-01)	1.01084e+00 (5#) (1.06654e-01)	1.05050e+00 (2#) (7.69109e-04)	1.02104e+00 (3#) (1.27700e-01)
IMOP7	3	9.66232e-01 (2#) (3.30430e-02)	9.60720e-01 (4#) (9.75255e-02)	9.62250e-01 (3#) (1.88672e-02)	1.01722e+00 (1) (1.45567e-01)	4.01575e-01 (7) (2.76890e-01)	4.81869e-01 (6#) (3.44945e-01)	3.79802e-01 (8#) (2.37019e-01)	8.90710e-01 (5#) (2.05887e-01)
IMOP8	3	3.01100e+00 (6#) (4.32553e-02)	2.88008e+00 (8#) (3.30079e-02)	2.89248e+00 (7#) (2.82621e-02)	3.30958e+00 (3) (1.20037e-02)	3.08445e+00 (5) (4.17833e-01)	3.36508e+00 (1) (5.93579e-03)	3.32385e+00 (2) (9.59902e-03)	3.25324e+00 (4) (3.71695e-01)

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TABLE SM-2

HYPERVOLUME RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE VIE PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAYSCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST-RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
VIE1	3	2.31642e+01 (4#) (1.99467e-02)	2.30578e+01 (5#) (3.04232e-02)	2.25435e+01 (8#) (6.83085e-02)	2.32040e+01 (3) (1.65522e-02)	2.28919e+01 (6) (7.50368e-02)	2.28866e+01 (7#) (1.42499e-01)	2.32275e+01 (1) (1.35475e-02)	2.32211e+01 (2) (1.98918e-02)
VIE2	3	7.84899e+00 (3#) (3.72031e-04)	7.84492e+00 (5#) (1.45742e-03)	7.79217e+00 (8#) (6.75468e-03)	7.85009e+00 (2) (3.71878e-04)	7.83219e+00 (6) (2.62649e-03)	7.82610e+00 (7#) (6.39609e-03)	7.85069e+00 (1) (2.81160e-04)	7.84893e+00 (4) (1.66761e-03)
VIE3	3	3.16070e+01 (1) (1.50917e-03)	3.15150e+01 (7#) (1.80888e-02)	3.14933e+01 (8#) (3.69052e-02)	3.15955e+01 (5) (1.62381e-03)	3.16066e+01 (2) (1.36561e-03)	3.16044e+01 (3) (7.78499e-03)	3.15992e+01 (4) (5.18365e-03)	3.15909e+01 (6) (4.06905e-03)

TABLE SM-3

HYPERVOLUME RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAYSCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST-RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1	2	8.62877e-01 (6#) (8.76993e-03)	0.00000e+00 (7#) (0.00000e+00)	0.00000e+00 (8#) (0.00000e+00)	8.73550e-01 (3) (3.53038e-04)	8.73583e-01 (2) (4.75059e-04)	8.73267e-01 (5#) (5.18496e-04)	8.73406e-01 (4) (9.11682e-04)	8.73596e-01 (1) (2.32784e-04)
	3	9.66338e-01 (6#) (5.76590e-03)	0.00000e+00 (7#) (0.00000e+00)	0.00000e+00 (8#) (0.00000e+00)	9.74234e-01 (2#) (1.54644e-04)	9.74331e-01 (1) (1.25413e-04)	9.69991e-01 (5#) (1.81772e-03)	9.73891e-01 (4#) (2.09781e-04)	9.74134e-01 (3#) (9.34455e-05)
	5	9.94569e-01 (5#) (1.09771e-02)	-	0.00000e+00 (7#) (0.00000e+00)	9.98694e-01 (2#) (7.07203e-05)	9.98724e-01 (1) (1.65711e-05)	9.94102e-01 (6#) (1.83681e-03)	9.98407e-01 (4#) (5.12152e-05)	9.98544e-01 (3#) (8.29073e-05)
	7	9.55795e-01 (6#) (8.00716e-02)	-	0.00000e+00 (7#) (0.00000e+00)	9.99915e-01 (2#) (2.53034e-05)	9.99941e-01 (1) (1.26610e-06)	9.98382e-01 (5#) (5.64178e-04)	9.99864e-01 (4#) (9.26845e-06)	9.99901e-01 (3#) (3.12927e-05)
DTLZ2	2	3.21087e+00 (3#) (1.56917e-04)	3.20935e+00 (8#) (5.59370e-04)	3.21080e+00 (5#) (8.71422e-06)	3.21017e+00 (7) (2.51026e-03)	3.21087e+00 (2) (6.85724e-06)	3.21076e+00 (6#) (1.29774e-04)	3.21151e+00 (1) (2.30502e-05)	3.21086e+00 (4) (8.48921e-04)
	3	7.41829e+00 (5#) (2.91358e-03)	7.39007e+00 (8#) (7.77249e-03)	7.42050e+00 (3#) (2.46759e-04)	7.41405e+00 (7#) (7.73598e-03)	7.42218e+00 (1) (1.05651e-04)	7.42097e+00 (2#) (1.33974e-03)	7.42021e+00 (4#) (9.75258e-04)	7.41762e+00 (6#) (4.43450e-03)
	5	3.16146e+01 (6#) (1.68607e-02)	-	3.16532e+01 (3#) (1.73943e-03)	3.16257e+01 (5#) (2.42569e-02)	3.16694e+01 (1) (2.18632e-04)	3.16693e+01 (2#) (4.45841e-03)	3.15710e+01 (7#) (1.98340e-02)	3.16405e+01 (4#) (1.18754e-02)
	7	1.27629e+02 (6#) (3.11733e-02)	-	1.27791e+02 (4#) (3.41515e-03)	1.27773e+02 (5) (2.48586e-02)	1.27824e+02 (2) (3.74841e-04)	1.27825e+02 (1) (2.66568e-03)	1.27343e+02 (7) (2.11752e-01)	1.27807e+02 (3) (5.22377e-03)
DTLZ3	2	2.41906e+00 (5#) (5.56683e-01)	0.00000e+00 (7#) (0.00000e+00)	0.00000e+00 (8#) (0.00000e+00)	2.92426e+00 (4) (7.33620e-01)	3.18997e+00 (1) (1.42652e-02)	3.12253e+00 (3#) (4.31638e-01)	2.28821e+00 (6) (1.23060e+00)	3.18548e+00 (2) (3.52357e-02)
	3	4.21010e+00 (6#) (2.12266e+00)	0.00000e+00 (7#) (0.00000e+00)	0.00000e+00 (8#) (0.00000e+00)	7.38711e+00 (3) (1.78601e-02)	7.29811e+00 (4) (5.33981e-01)	7.41180e+00 (1) (8.27348e-03)	6.67446e+00 (5) (1.65452e+00)	7.39952e+00 (2) (1.67585e-02)
	5	5.64355e-01 (6) (2.23229e+00)	-	0.00000e+00 (7#) (0.00000e+00)	3.13543e+01 (4) (1.81496e-01)	3.16308e+01 (3) (3.06262e-02)	3.16598e+01 (1) (9.10615e-03)	3.09475e+01 (5) (2.48697e+00)	3.16442e+01 (2) (1.29216e-02)
	7	2.69092e+01 (6#) (1.06816e+02)	-	0.00000e+00 (7#) (0.00000e+00)	1.10242e+02 (5) (3.77704e+01)	1.25715e+02 (3) (1.12456e+01)	1.27821e+02 (1) (5.63246e-03)	1.25600e+02 (4) (9.29818e+00)	1.27785e+02 (2) (1.25611e-02)
DTLZ4	2	3.21067e+00 (2) (2.20144e-04)	3.20735e+00 (4) (4.57324e-03)	3.21079e+00 (1) (2.65268e-05)	3.20916e+00 (3) (4.14332e-03)	2.84758e+00 (7) (5.64358e-01)	3.08967e+00 (5) (3.69433e-01)	2.88843e+00 (6) (5.44903e-01)	2.76709e+00 (8) (5.93643e-01)
	3	7.40760e+00 (2) (2.16532e-03)	7.36968e+00 (5) (1.47089e-02)	7.41999e+00 (1) (3.81345e-04)	7.38240e+00 (3) (1.95316e-01)	6.96045e+00 (8) (9.10448e-01)	7.28776e+00 (7) (3.45680e-01)	7.30693e+00 (6) (6.24580e-01)	7.37509e+00 (4) (1.83925e-01)
	5	3.16293e+01 (4#) (2.24895e-02)	-	3.16385e+01 (3#) (3.93769e-03)	3.16527e+01 (1) (1.19526e-02)	3.16145e+01 (5) (1.66326e-01)	3.15813e+01 (6#) (2.01753e-01)	3.15220e+01 (7#) (6.12266e-02)	3.16461e+01 (2#) (1.14712e-02)
	7	1.27760e+02 (6#) (1.13429e-02)	-	1.27781e+02 (5#) (4.75117e-03)	1.27789e+02 (4#) (1.00649e-02)	1.27825e+02 (1) (4.49585e-04)	1.27825e+02 (2#) (2.99782e-03)	1.26849e+02 (7#) (4.04884e-01)	1.27811e+02 (3#) (5.28436e-03)
DTLZ5	2	3.21087e+00 (3#) (1.56917e-04)	3.20935e+00 (8#) (5.59370e-04)	3.21080e+00 (5#) (8.71422e-06)	3.21017e+00 (7) (2.51026e-03)	3.21087e+00 (2) (6.85724e-06)	3.21076e+00 (6#) (1.29774e-04)	3.21151e+00 (1) (2.30502e-05)	3.21086e+00 (4) (8.48921e-04)
	3	6.10154e+00 (6#) (1.60452e-03)	6.09923e+00 (7#) (3.61560e-03)	6.07974e+00 (8#) (2.70745e-04)	6.10390e+00 (3) (2.68252e-03)	6.10285e+00 (5) (3.10904e-04)	6.10342e+00 (4#) (4.25951e-04)	6.10468e+00 (1) (1.51526e-04)	6.10400e+00 (2) (1.20637e-03)
	5	2.32909e+01 (2) (1.04715e-01)	-	2.15459e+01 (6#) (1.24083e-01)	2.27302e+01 (5) (4.36129e-01)	2.31548e+01 (4) (8.05319e-02)	2.35524e+01 (1) (6.34605e-02)	2.32553e+01 (3) (7.37443e-02)	2.08593e+01 (7) (1.36491e+00)
	7	9.15082e+01 (2#) (4.84151e-01)	-	7.59003e+01 (7#) (1.42097e+00)	8.73472e+01 (5) (4.23741e+00)	9.12262e+01 (4) (3.49095e-01)	9.26921e+01 (1) (3.46215e-01)	9.12907e+01 (3) (3.02594e-01)	8.30475e+01 (6) (5.80674e+00)
DTLZ6	2	3.21122e+00 (3#) (2.89901e-05)	3.08694e+00 (7#) (4.94508e-02)	2.96341e+00 (8#) (1.09428e-01)	3.20948e+00 (6) (2.84302e-03)	3.21088e+00 (4) (5.17226e-07)	3.21086e+00 (5#) (1.41866e-04)	3.21144e+00 (1) (3.23175e-05)	3.21128e+00 (2) (4.51633e-05)
	3	6.10426e+00 (4#) (8.72000e-05)	5.73900e+00 (7#) (1.26926e-01)	5.64867e+00 (8#) (1.99532e-01)	6.10446e+00 (3) (8.49226e-05)	6.10376e+00 (5) (9.33920e-05)	6.10362e+00 (6#) (3.24027e-04)	6.10506e+00 (1) (6.66181e-05)	6.10476e+00 (2) (1.18496e-04)
	5	2.30087e+01 (3) (5.05006e-02)	-	1.20454e+01 (7#) (4.35685e+00)	2.13488e+01 (6) (1.64019e+00)	2.30528e+01 (2) (1.68836e-01)	2.33661e+01 (1) (9.68303e-02)	2.26872e+01 (4) (1.85707e-01)	2.23713e+01 (5) (8.48985e-01)
	7	9.11552e+01 (1) (8.54669e-01)	-	1.06970e+01 (7#) (1.56009e+01)	7.50197e+01 (6) (1.43658e+01)	9.10429e+01 (3) (4.54199e-01)	9.10537e+01 (2) (5.36704e-01)	8.70950e+01 (4) (1.13960e+00)	8.66701e+01 (5) (5.42402e+00)
DTLZ7	2	1.77255e+01 (1) (9.31752e-06)	1.76963e+01 (5#) (7.21152e-02)	1.77196e+01 (2#) (3.99254e-04)	1.77104e+01 (4) (2.98522e-02)	1.76556e+01 (8) (1.41374e-01)	1.77143e+01 (3) (1.47947e-02)	1.76791e+01 (7) (1.20311e-01)	1.76903e+01 (6) (1.06015e-01)
	3	1.63741e+01 (1) (1.76075e-03)	1.62432e+01 (7#) (3.75618e-02)	1.62381e+01 (8#) (7.93862e-03)	1.63711e+01 (2) (1.17880e-02)	1.62920e+01 (6) (1.28177e-01)	1.63133e+01 (5) (7.37983e-02)	1.63279e+01 (4) (1.01996e-01)	1.63613e+01 (3) (5.54594e-02)
	5	1.29014e+01 (3#) (2.08566e-02)	-	1.17706e+01 (7#) (8.98847e-02)	1.29901e+01 (2) (3.20990e-02)	1.27939e+01 (4) (2.55599e-02)	1.27879e+01 (5#) (2.63020e-01)	1.27409e+01 (6#) (9.72431e-02)	1.30487e+01 (1) (3.28037e-02)
	7	9.18034e+00 (2#) (2.97216e-02)	-	7.93495e+00 (7#) (1.53401e-01)	9.05501e+00 (3) (1.92671e-01)	8.84746e+00 (5) (4.01251e-02)	8.94722e+00 (4#) (3.13133e-01)	8.77138e+00 (6#) (4.03197e-01)	9.42346e+00 (1) (7.06743e-02)

TABLE SM-4

HYPERVOLUME RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAYSCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST-RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1^{-1}	2	1.51471e+05 (6#) (1.06155e+02)	1.16502e+05 (7#) (1.32128e+03)	1.16178e+05 (8#) (1.17067e+03)	1.51632e+05 (3) (3.64186e+01)	1.51704e+05 (1) (6.67793e+00)	1.51537e+05 (5#) (1.98448e+01)	1.51634e+05 (2) (1.77501e+00)	1.51622e+05 (4) (1.27443e+01)
	3	2.22226e+07 (6#) (8.33909e+04)	1.37345e+07 (7#) (2.77738e+05)	1.22597e+07 (8#) (3.87860e+05)	2.26735e+07 (1) (4.98924e+04)	2.25367e+07 (3) (8.55255e+04)	2.24762e+07 (4#) (1.18588e+05)	2.26376e+07 (2#) (1.08580e+05)	2.22365e+07 (5#) (8.72823e+04)
	5	1.39484e+08 (7#) (2.25949e+07)	-	1.84625e+10 (6#) (1.91930e+09)	5.12575e+10 (3) (4.54952e+09)	3.24582e+10 (5) (4.62715e+09)	4.83170e+10 (4#) (6.11483e+09)	8.94995e+10 (1) (3.55643e+09)	5.23728e+10 (2) (4.55209e+09)
	7	3.03277e+08 (7#) (4.92671e+06)	-	2.09070e+13 (3#) (2.92767e+12)	9.66144e+12 (5) (5.29985e+12)	2.40738e+12 (6) (2.03997e+12)	9.72559e+12 (4#) (6.07362e+12)	1.09543e+14 (1) (1.02295e+13)	5.76454e+13 (2) (1.25464e+13)
DTLZ2^{-1}	2	1.75808e+01 (3#) (2.10831e-04)	1.75518e+01 (6#) (1.11286e-02)	1.75427e+01 (8#) (2.61043e-02)	1.75789e+01 (4) (4.17506e-04)	1.75685e+01 (5) (5.01343e-05)	1.75497e+01 (7#) (1.25928e-02)	1.75819e+01 (1) (3.80071e-04)	1.75810e+01 (2) (5.55659e-04)
	3	5.92515e+01 (2#) (3.80021e-02)	5.69902e+01 (7#) (2.06950e-01)	5.65770e+01 (8#) (3.54351e-01)	5.93555e+01 (1) (3.49705e-02)	5.85324e+01 (5) (2.65462e-02)	5.76391e+01 (6#) (3.42113e-01)	5.92127e+01 (3#) (8.41168e-02)	5.90321e+01 (4#) (9.38675e-02)
	5	3.61911e+02 (6#) (1.59131e+00)	-	2.58816e+02 (7#) (6.06586e+00)	3.95769e+02 (3) (1.86619e+00)	3.67481e+02 (5) (2.44131e+00)	3.92235e+02 (4#) (4.13548e+00)	4.02214e+02 (1) (2.62544e+00)	3.97222e+02 (2) (1.98444e+00)
	7	1.17406e+03 (6#) (1.39100e+01)	-	1.14151e+03 (7#) (1.96956e+01)	1.73850e+03 (4) (2.19935e+01)	1.43412e+03 (5) (4.25583e+01)	2.03469e+03 (1) (1.99836e+01)	1.89842e+03 (2) (2.64909e+01)	1.84532e+03 (3) (2.38007e+01)
DTLZ3^{-1}	2	3.76638e+06 (6#) (2.50774e+04)	2.36408e+06 (7#) (4.99640e+04)	2.34640e+06 (8#) (5.22593e+04)	3.79900e+06 (3) (3.76275e+03)	3.79702e+06 (5) (1.30343e+02)	3.79775e+06 (4#) (1.63905e+03)	3.80235e+06 (1) (2.19610e+02)	3.80093e+06 (2) (5.12294e+03)
	3	4.93156e+09 (5#) (3.11193e+07)	2.24145e+09 (7#) (4.89204e+07)	2.20129e+09 (8#) (5.76706e+07)	4.97850e+09 (4) (3.32620e+07)	4.86755e+09 (6) (2.49153e+07)	5.01712e+09 (1) (1.82296e+07)	5.01189e+09 (3) (8.91452e+06)	5.01507e+09 (2) (1.15898e+07)
	5	1.77335e+15 (6) (1.08191e+14)	-	6.06158e+14 (7#) (4.95531e+13)	2.69620e+15 (4) (1.06916e+14)	2.07185e+15 (5) (1.72970e+14)	4.01212e+15 (1) (3.85514e+13)	3.25002e+15 (2) (7.96024e+13)	3.16688e+15 (3) (8.90940e+13)
	7	3.57859e+19 (7#) (7.17115e+19)	-	1.53669e+20 (6#) (1.38489e+19)	4.12374e+20 (4) (5.16495e+19)	2.82034e+20 (5) (7.57043e+19)	1.71238e+21 (1) (4.68535e+19)	9.30430e+20 (2) (7.65634e+19)	8.28096e+20 (3) (6.27168e+19)
DTLZ4^{-1}	2	1.74839e+01 (8#) (8.82442e-02)	1.75511e+01 (6#) (1.42250e-02)	1.75404e+01 (7#) (3.38223e-02)	1.75786e+01 (3) (3.77615e-04)	1.75685e+01 (4) (5.66185e-05)	1.75631e+01 (5#) (6.74543e-03)	1.75817e+01 (1) (4.51758e-04)	1.75810e+01 (2) (4.11904e-04)
	3	5.86899e+01 (4#) (1.21402e-01)	5.69734e+01 (7#) (2.70755e-01)	5.66106e+01 (8#) (2.50878e-01)	5.93458e+01 (1) (3.15072e-02)	5.85325e+01 (5) (2.77181e-02)	5.84252e+01 (6#) (1.77504e-01)	5.92161e+01 (2#) (5.94511e-02)	5.91228e+01 (3#) (8.40029e-02)
	5	3.36065e+02 (6#) (5.10670e+00)	-	2.26577e+02 (7#) (2.89864e+01)	3.90827e+02 (4) (1.66082e+00)	3.65906e+02 (5) (2.37251e+00)	4.00954e+02 (2#) (2.25035e+00)	4.02852e+02 (1) (3.35859e+00)	3.92334e+02 (3) (2.36241e+00)
	7	1.04569e+03 (6#) (2.12109e+01)	-	7.44393e+02 (7#) (1.67529e+02)	1.64321e+03 (4) (2.31067e+01)	1.38762e+03 (5) (4.25932e+01)	2.02124e+03 (1) (1.66921e+01)	1.92324e+03 (2) (2.22525e+01)	1.77758e+03 (3) (2.04922e+01)
DTLZ5^{-1}	2	1.75808e+01 (3#) (2.10831e-04)	1.75518e+01 (6#) (1.11286e-02)	1.75427e+01 (8#) (2.61043e-02)	1.75789e+01 (4) (4.17506e-04)	1.75685e+01 (5) (5.01343e-05)	1.75497e+01 (7#) (1.25928e-02)	1.75819e+01 (1) (3.80071e-04)	1.75810e+01 (2) (5.55659e-04)
	3	5.98662e+01 (1) (3.76868e-03)	6.09923e+00 (7#) (3.61560e-03)	6.07974e+00 (8#) (2.70745e-04)	6.10390e+00 (4) (2.68252e-03)	6.10285e+00 (6) (3.10904e-04)	6.10342e+00 (5) (4.25951e-04)	6.10468e+00 (2) (1.51526e-04)	6.10400e+00 (3) (1.20637e-03)
	5	4.03311e+02 (3#) (7.40381e-01)	-	2.92898e+02 (7#) (4.17731e+00)	4.13528e+02 (1) (1.27798e+00)	3.88898e+02 (5) (4.68671e+00)	3.82622e+02 (6#) (5.85974e+00)	4.04035e+02 (2#) (2.20980e+00)	4.02033e+02 (4#) (2.22426e+00)
	7	1.78897e+03 (5#) (6.23842e+00)	-	1.19128e+03 (7#) (2.62558e+01)	2.03143e+03 (1) (1.11288e+01)	1.78394e+03 (6) (2.31520e+01)	1.97899e+03 (3#) (2.77341e+01)	1.97001e+03 (4#) (2.63852e+01)	1.98196e+03 (2#) (1.66319e+01)
DTLZ6^{-1}	2	1.17635e+02 (2#) (2.98964e-03)	1.17377e+02 (8#) (8.47567e-02)	1.17495e+02 (6#) (6.26766e-03)	1.17616e+02 (4) (4.69337e-03)	1.17513e+02 (5) (6.84629e-04)	1.17409e+02 (7#) (7.05661e-02)	1.17647e+02 (1) (4.43171e-03)	1.17634e+02 (3) (4.09334e-03)
	3	9.31760e+02 (4#) (3.82524e-01)	8.88210e+02 (7#) (4.59863e+00)	8.87256e+02 (8#) (2.76663e+00)	9.32536e+02 (2) (6.09173e-01)	9.17140e+02 (6) (5.87387e-01)	9.17861e+02 (5#) (5.60655e+00)	9.33224e+02 (1) (9.89459e-01)	9.32300e+02 (3) (9.16535e-01)
	5	2.18061e+04 (6) (3.05912e+02)	-	1.46686e+04 (7#) (3.34221e+02)	2.62031e+04 (4) (2.55566e+02)	2.45765e+04 (5) (4.00334e+02)	2.98624e+04 (1) (1.64469e+02)	2.85545e+04 (2) (1.99600e+02)	2.81991e+04 (3) (3.00831e+02)
	7	1.58892e+05 (7#) (5.59517e+03)	-	2.91065e+05 (6#) (6.94201e+03)	3.78633e+05 (4) (8.48284e+03)	3.64303e+05 (5) (1.60571e+04)	6.27408e+05 (1) (7.17743e+03)	5.40413e+05 (2) (6.74018e+03)	4.90852e+05 (3) (6.94453e+03)
DTLZ7^{-1}	2	1.28355e+01 (1) (4.69275e-06)	1.27805e+01 (8#) (2.95555e-01)	1.28260e+01 (7#) (1.32735e-03)	1.28354e+01 (4) (1.94228e-04)	1.28353e+01 (5) (1.97177e-05)	1.28349e+01 (6) (5.48016e-04)	1.28355e+01 (3) (1.23812e-05)	1.28355e+01 (2) (1.32646e-05)
	3	2.70065e+01 (1) (7.58168e-04)	2.69551e+01 (5#) (9.74665e-03)	2.67659e+01 (8#) (1.12896e-01)	2.69459e+01 (6) (3.25193e-01)	2.69456e+01 (7) (1.97582e-01)	2.69958e+01 (4) (2.72979e-03)	2.69998e+01 (3) (4.88019e-03)	2.70048e+01 (2) (1.42730e-03)
	5	6.34231e+01 (3) (1.14566e-02)	-	6.12781e+01 (7#) (3.56041e-01)	6.28701e+01 (5) (2.28192e+00)	6.23766e+01 (6) (3.81242e+00)	6.36684e+01 (1) (6.29164e-03)	6.31649e+01 (4) (8.62215e-02)	6.34936e+01 (2) (3.00627e-02)
	7	1.12519e+02 (4#) (1.66529e-01)	-	1.10383e+02 (6#) (4.99097e-01)	1.12259e+02 (5) (1.59667e+00)	1.13411e+02 (3) (3.05504e-02)	1.14290e+02 (1) (1.07007e-02)	1.09924e+02 (7) (3.94649e+00)	1.13624e+02 (2) (2.40569e-01)

TABLE SM-5

Hypervolume results for the compared Multi-objective algorithms on the WFG problems. We show the mean and standard deviation (in parentheses). The two best values are shown in grayscale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best-ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1	2	5.69520e+00 (8#) (4.02286e-02)	5.79825e+00 (7#) (6.42353e-02)	5.80198e+00 (6#) (4.16510e-02)	1.13557e+01 (5) (1.67893e-01)	1.16501e+01 (2) (2.44168e-01)	1.18767e+01 (1) (1.50166e-01)	1.14192e+01 (4) (3.45778e-01)	1.16446e+01 (3) (2.72965e-01)
	3	4.79055e+01 (6#) (2.10602e-01)	4.44400e+01 (7#) (2.03545e-01)	4.40939e+01 (8#) (4.79463e-01)	9.18905e+01 (3) (1.62424e+00)	9.11888e+01 (4) (2.67161e+00)	9.80519e+01 (1) (1.92943e+00)	9.29023e+01 (2) (2.39289e+00)	8.90838e+01 (5) (2.55715e+00)
	5	4.35779e+03 (6) (2.57952e+01)	-	4.10614e+03 (7#) (8.26536e+01)	9.28046e+03 (2) (2.57757e+02)	8.99912e+03 (3) (2.60952e+02)	9.81315e+03 (1) (2.84710e+02)	8.99103e+03 (4) (3.12521e+02)	8.25334e+03 (5) (3.59725e+02)
	7	7.39810e+05 (7#) (2.95693e+03)	-	7.81499e+05 (6#) (7.16921e+03)	1.55341e+06 (3) (7.13554e+04)	1.46273e+06 (5) (5.67564e+04)	1.86555e+06 (1) (7.27798e+04)	1.58212e+06 (2) (6.26459e+04)	1.46592e+06 (4) (7.89530e+04)
WFG2	2	1.10839e+01 (3) (6.88561e-02)	1.10973e+01 (2) (3.74645e-01)	1.11140e+01 (1) (3.41505e-01)	1.06033e+01 (4) (2.13012e-01)	1.05198e+01 (6) (2.94987e-01)	1.05680e+01 (5) (1.78601e-02)	1.04561e+01 (8) (1.90766e-01)	1.04563e+01 (7) (2.55378e-01)
	3	9.82588e+01 (2) (6.20318e-01)	9.83501e+01 (1) (1.19322e+00)	9.74687e+01 (3) (4.90771e-01)	9.58231e+01 (4) (6.90822e+00)	9.33757e+01 (6) (7.61969e+00)	9.40405e+01 (5) (7.41646e+00)	9.27328e+01 (7) (7.83858e+00)	9.04921e+01 (8) (7.40565e+00)
	5	9.88352e+03 (2) (7.47662e+01)	-	1.02185e+04 (1) (4.44213e+01)	9.59303e+03 (5) (8.74704e+02)	9.56088e+03 (6) (8.68897e+02)	9.64391e+03 (4) (7.91604e+02)	9.66969e+03 (3) (8.43022e+02)	9.35678e+03 (7) (9.00945e+02)
	7	1.85521e+06 (6) (4.10320e+04)	-	1.96386e+06 (1) (9.26653e+03)	1.94063e+06 (3) (1.10313e+05)	1.87856e+06 (5) (1.62775e+05)	1.95189e+06 (2) (1.09206e+05)	1.93888e+06 (4) (1.24543e+05)	1.82999e+06 (7) (1.74431e+05)
WFG3	2	1.06343e+01 (8) (8.25104e-02)	1.08354e+01 (7) (1.11286e-01)	1.09128e+01 (1) (7.20981e-03)	1.08389e+01 (6) (2.99073e-02)	1.08613e+01 (4) (3.96769e-02)	1.08897e+01 (2) (1.50384e-02)	1.08557e+01 (5) (3.27627e-02)	1.08790e+01 (3) (4.68322e-02)
	3	7.01133e+01 (7#) (1.32258e+00)	6.70784e+01 (8#) (6.45319e-01)	7.04338e+01 (6#) (3.52078e-01)	7.38767e+01 (4) (4.26052e-01)	7.31152e+01 (5) (3.57715e-01)	7.46622e+01 (2#) (3.87451e-01)	7.46855e+01 (1) (2.37844e-01)	7.39197e+01 (3) (3.43158e-01)
	5	6.55357e+03 (4#) (2.10755e+02)	-	5.34025e+03 (7#) (1.49424e+02)	6.27427e+03 (5) (1.02039e+02)	6.55466e+03 (3) (9.76663e+01)	6.21971e+03 (6#) (1.94488e+02)	6.87637e+03 (1) (5.95662e+01)	6.76878e+03 (2) (6.22572e+01)
	7	1.23640e+06 (3#) (4.45014e+04)	-	9.82510e+05 (7#) (3.52405e+04)	1.11913e+06 (5) (2.33002e+04)	1.09077e+06 (6) (2.69577e+04)	1.17849e+06 (4#) (5.41660e+04)	1.27912e+06 (1) (2.22415e+04)	1.26725e+06 (2) (1.57596e+04)
WFG4	2	8.52436e+00 (6#) (2.34244e-02)	8.07118e+00 (8#) (6.93525e-02)	8.11435e+00 (7#) (2.32594e-02)	8.57055e+00 (5) (3.19831e-02)	8.58331e+00 (4) (3.40510e-02)	8.63812e+00 (2#) (1.96459e-02)	8.64883e+00 (1) (1.14845e-02)	8.61373e+00 (3) (2.57256e-02)
	3	7.53349e+01 (4#) (2.36824e-01)	6.59471e+01 (8#) (7.65132e-01)	6.94217e+01 (7#) (2.83385e-01)	7.50824e+01 (6) (2.49520e-01)	7.51682e+01 (5) (2.18386e-01)	7.61159e+01 (1) (1.73790e-01)	7.58892e+01 (3) (1.92464e-01)	7.59787e+01 (2) (1.64701e-01)
	5	8.91518e+03 (1) (3.17026e+01)	-	7.82938e+03 (7#) (1.59852e+02)	8.23995e+03 (6) (6.73546e+01)	8.53611e+03 (4) (4.92728e+01)	8.65585e+03 (2#) (5.30255e+01)	8.28800e+03 (5) (5.58358e+01)	8.59329e+03 (3) (3.76319e+01)
	7	1.83877e+06 (1) (9.62757e+03)	-	1.58870e+06 (6#) (2.82283e+04)	1.49693e+06 (7) (3.29156e+04)	1.70411e+06 (4) (1.34763e+04)	1.73922e+06 (2) (1.28771e+04)	1.59213e+06 (5) (1.82259e+04)	1.72605e+06 (3) (1.14951e+04)
WFG5	2	8.10974e+00 (5#) (2.14196e-02)	7.92119e+00 (8#) (3.76381e-01)	8.02260e+00 (7#) (3.31438e-02)	8.09520e+00 (6) (2.76305e-02)	8.12818e+00 (4) (1.66701e-02)	8.14021e+00 (2#) (1.32397e-02)	8.14358e+00 (1) (1.07803e-02)	8.13049e+00 (3) (9.75715e-03)
	3	7.18809e+01 (5#) (2.57393e-01)	6.40856e+01 (8#) (1.02271e+00)	6.82043e+01 (7#) (8.58826e-01)	7.18227e+01 (6) (1.91689e-01)	7.23187e+01 (3) (2.97551e-01)	7.26193e+01 (1) (2.86342e-01)	7.21137e+01 (4) (2.09176e-01)	7.23895e+01 (2) (2.27405e-01)
	5	8.45427e+03 (1) (3.96888e+01)	-	5.43668e+03 (7#) (1.65197e+02)	8.06523e+03 (5) (6.26285e+01)	8.37293e+03 (2) (2.42340e+01)	8.31304e+03 (3#) (3.95038e+01)	7.93941e+03 (6) (5.11020e+01)	8.25734e+03 (4) (3.18546e+01)
	7	1.72635e+06 (1) (9.98366e+03)	-	9.73394e+05 (7#) (4.33238e+04)	1.45505e+06 (6) (2.32548e+04)	1.69239e+06 (2) (1.02674e+04)	1.67986e+06 (3) (8.62541e+03)	1.50869e+06 (5) (1.94823e+04)	1.65064e+06 (4) (9.59443e+03)
WFG6	2	7.93598e+00 (8) (8.56485e-04)	8.44211e+00 (2) (1.39239e-01)	8.55674e+00 (1) (3.06860e-02)	8.11045e+00 (7) (1.48800e-01)	8.28890e+00 (4) (9.44821e-02)	8.31962e+00 (3) (6.08334e-02)	8.26781e+00 (5) (1.13130e-01)	8.26350e+00 (6) (1.57336e-01)
	3	7.09874e+01 (7#) (1.12699e-01)	6.64486e+01 (8#) (1.43837e+00)	7.35179e+01 (4#) (5.68705e-01)	7.29163e+01 (6) (5.83787e-01)	7.31021e+01 (5) (4.86797e-01)	7.38877e+01 (1) (3.54540e-01)	7.35923e+01 (3) (4.61699e-01)	7.36865e+01 (2) (4.13058e-01)
	5	8.34442e+03 (4) (1.26810e+01)	-	8.00707e+03 (7#) (4.62749e+02)	8.14168e+03 (5) (1.14578e+02)	8.51342e+03 (2) (8.70075e+01)	8.52946e+03 (1) (7.06974e+01)	8.03627e+03 (6) (9.46280e+01)	8.39232e+03 (3) (7.00984e+01)
	7	1.74566e+06 (2#) (7.94178e+02)	-	1.37231e+06 (7#) (6.25307e+04)	1.42534e+06 (6#) (4.54871e+04)	1.74755e+06 (1) (1.76842e+04)	1.73203e+06 (3#) (1.48150e+04)	1.51940e+06 (5#) (2.11574e+04)	1.67884e+06 (4#) (2.07011e+04)
WFG7	2	8.53421e+00 (8#) (3.43360e-02)	8.61570e+00 (7#) (1.74090e-01)	8.66943e+00 (4#) (1.80359e-03)	8.62584e+00 (6) (4.59740e-02)	8.64491e+00 (5) (4.97922e-02)	8.67650e+00 (3#) (1.85135e-03)	8.68322e+00 (1) (2.02657e-03)	8.67810e+00 (2) (3.77500e-03)
	3	7.53232e+01 (6#) (3.88998e-01)	6.74466e+01 (8#) (1.07064e+00)	7.46514e+01 (7#) (4.17146e-01)	7.62065e+01 (5) (2.30240e-01)	7.63542e+01 (4) (1.25181e-01)	7.67574e+01 (3#) (8.36858e-02)	7.67908e+01 (2#) (7.10578e-02)	7.68096e+01 (1) (7.83400e-02)
	5	8.89375e+03 (1) (2.85550e+01)	-	7.68907e+03 (7#) (3.47759e+02)	8.47877e+03 (6) (1.26118e+02)	8.81201e+03 (4) (7.03086e+01)	8.87156e+03 (2#) (3.67925e+01)	8.62133e+03 (5) (6.72524e+01)	8.86955e+03 (3) (2.73111e+01)
	7	1.79705e+06 (4#) (2.19921e+04)	-	1.47339e+06 (6#) (3.65855e+04)	1.42706e+06 (7) (5.63302e+04)	1.81332e+06 (2) (1.63940e+04)	1.82562e+06 (1) (6.54323e+03)	1.65817e+06 (5) (1.63699e+04)	1.80239e+06 (3) (9.31716e+03)
WFG8	2	7.48873e+00 (5#) (4.48464e-02)	7.45248e+00 (8#) (1.65012e-01)	7.47968e+00 (7#) (2.39934e-02)	7.65202e+00 (2) (3.48406e-02)	7.53988e+00 (4) (4.55624e-02)	7.62381e+00 (3#) (2.70574e-02)	7.66387e+00 (1) (3.28956e-02)	7.48274e+00 (6) (6.44820e-02)
	3	6.76290e+01 (6#) (6.95059e-01)	5.84795e+01 (8#) (1.09207e+00)	6.47075e+01 (7#) (5.24367e-01)	6.95690e+01 (4) (4.10192e-01)	6.94387e+01 (5) (4.05277e-01)	7.04006e+01 (1) (1.55495e-01)	6.99336e+01 (3) (1.89535e-01)	7.01040e+01 (2) (2.29190e-01)
	5	7.64035e+03 (3#) (1.33060e+02)	-	5.26826e+03 (7#) (3.12390e+02)	7.23931e+03 (5#) (9.26485e+01)	7.82405e+03 (1) (4.56801e+01)	7.76584e+03 (2#) (5.20633e+01)	7.17217e+03 (6#) (5.76395e+01)	7.55804e+03 (4#) (7.76420e+01)
	7	1.53222e+06 (3#) (2.85004e+04)	-	9.38331e+05 (7#) (5.93325e+04)	1.14877e+06 (6#) (4.27951e+04)	1.57751e+06 (1) (1.49125e+04)	1.56061e+06 (2#) (1.15376e+04)	1.23111e+06 (5#) (2.32165e+04)	1.44117e+06 (4#) (1.70167e+04)
WFG9	2	7.69486e+00 (6#) (1.49438e-02)	7.62994e+00 (8#) (7.62965e-02)	7.68155e+00 (7#) (8.15087e-03)	7.98503e+00 (2) (2.42104e-01)	7.98647e+00 (1) (3.05569e-01)	7.82951e+00 (5#) (2.72508e-01)	7.93672e+00 (4) (2.92245e-01)	7.96865e+00 (3) (2.93881e-01)
	3	6.81140e+01 (6#) (1.75968e-01)	6.51618e+01 (8#) (5.85456e-01)	6.61035e+01 (7#) (3.79639e-01)	6.86855e+01 (5) (1.21997e+00)	6.93217e+01 (4) (1.44076e+00)	7.02205e+01 (3#) (2.31585e+00)	7.03844e+01 (2#) (2.06597e+00)	7.12186e+01 (1) (2.10169e+00)
	5	7.70708e+03 (2#) (8.03157e+01)	-	6.24637e+03 (7#) (2.25192e+02)	7.16199e+03 (6) (9.71056e+01)	7.46068e+03 (4) (1.63104e+02)	7.66339e+03 (3#) (2.02657e+02)	7.38517e+03 (5#) (1.80174e+02)	7.91103e+03 (1) (1.65660e+02)
	7	1.57081e+06 (1) (1.28074e+04)	-	1.14192e+06 (7#) (5.10931e+04)	1.27585e+06 (6) (6.19365e+04)	1.47368e+06 (4) (4.61070e+04)	1.54205e+06 (3) (4.71734e+04)	1.38878e+06 (5) (3.40726e+04)	1.56222e+06 (2) (2.15671e+04)

TABLE SM-6

HYPERVOLUME RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE WFG^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAYSCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST-RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_\mathbb{R}$	MOACO$_\mathbb{R}$	iMOACO$_\mathbb{R}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1^{-1}	2	1.88472e+01 (4#) (3.95446e-03)	1.85459e+01 (8#) (4.33517e-01)	1.88224e+01 (5#) (5.80509e-03)	1.87593e+01 (6) (1.10013e-01)	1.88552e+01 (3) (6.91242e-03)	1.88604e+01 (2#) (2.09510e-03)	1.88668e+01 (1) (4.95077e-04)	1.87549e+01 (7) (3.45190e-01)
	3	8.15447e+01 (6#) (4.52736e-01)	7.77976e+01 (8#) (7.58855e-01)	8.00534e+01 (7#) (4.29232e-01)	8.30169e+01 (5) (2.34595e+00)	8.49060e+01 (2) (8.10556e-02)	8.51919e+01 (1) (8.07330e-02)	8.38581e+01 (4) (1.87520e-01)	8.42695e+01 (3) (3.66113e+00)
	5	1.18549e+03 (4#) (2.54742e+01)	-	9.20689e+02 (6#) (4.26212e+00)	1.27248e+03 (1) (2.18639e+01)	1.25132e+03 (3) (4.27730e+01)	1.26765e+03 (2#) (9.51521e+01)	9.76045e+02 (5#) (2.31182e+01)	9.08640e+02 (7#) (1.16690e+02)
	7	1.39766e+04 (4#) (4.35770e+02)	-	4.56349e+03 (7#) (1.32200e+02)	1.51590e+04 (2) (1.65073e+02)	1.39825e+04 (3) (3.10842e+02)	1.57677e+04 (1) (4.94159e+02)	8.38324e+03 (5) (2.72085e+02)	6.93429e+03 (6) (1.62193e+03)
WFG2^{-1}	2	2.33383e+01 (6#) (2.00492e-02)	2.33322e+01 (7#) (3.04501e-02)	2.33240e+01 (8#) (1.86105e-01)	2.33716e+01 (4) (6.64228e-03)	2.33700e+01 (5) (8.39449e-03)	2.33738e+01 (3#) (4.45951e-03)	2.33838e+01 (2) (7.26636e-04)	2.33840e+01 (1) (7.92952e-04)
	3	1.31125e+02 (5#) (3.16991e-01)	1.26219e+02 (8#) (1.16594e+00)	1.26970e+02 (7#) (3.39969e+00)	1.31732e+02 (3) (3.92036e-01)	1.31988e+02 (2) (1.03802e-01)	1.31634e+02 (4#) (2.60791e-01)	1.30855e+02 (6#) (5.91056e-01)	1.32098e+02 (1) (1.71809e-01)
	5	2.71376e+03 (3) (1.30845e+01)	-	1.73052e+03 (7#) (4.82221e+01)	2.75602e+03 (2) (2.92849e+01)	2.63394e+03 (4) (8.65417e+01)	2.80356e+03 (1) (5.97047e+01)	1.83554e+03 (6) (1.04180e+02)	2.35132e+03 (5) (7.44434e+01)
	7	3.59063e+04 (3#) (5.60843e+02)	-	1.54632e+04 (6#) (1.90160e+03)	3.92431e+04 (2) (3.93702e+02)	3.35023e+04 (4) (1.37936e+03)	3.99648e+04 (1) (2.95639e+03)	1.20527e+04 (7) (8.74408e+02)	2.02775e+04 (5) (2.69499e+03)
WFG3^{-1}	2	1.98574e+01 (5#) (2.35779e-02)	1.97252e+01 (7#) (2.25155e-01)	1.94583e+01 (8#) (3.86988e-01)	1.98567e+01 (6) (7.46755e-02)	1.99505e+01 (3) (5.92551e-03)	1.99111e+01 (4#) (2.73642e-02)	1.99579e+01 (1) (7.91000e-03)	1.99554e+01 (2) (1.53096e-02)
	3	1.01950e+02 (3#) (5.34766e-01)	8.69560e+01 (8#) (1.51767e+00)	9.04679e+01 (7#) (2.20408e+00)	1.01031e+02 (5) (5.89313e-01)	1.01965e+02 (2) (1.24735e-01)	1.00512e+02 (6#) (4.99140e-01)	1.01803e+02 (4#) (1.66811e-01)	1.02692e+02 (1) (1.21749e-01)
	5	2.16107e+03 (1) (1.67058e+01)	-	1.20789e+03 (7#) (1.98758e+01)	2.04451e+03 (3) (2.84957e+01)	2.04352e+03 (4) (5.40358e+01)	1.89856e+03 (6#) (3.89109e+01)	1.92451e+03 (5) (2.65688e+01)	2.07402e+03 (2) (2.38820e+01)
	7	3.30242e+04 (2#) (2.83623e+02)	-	1.43742e+04 (7#) (5.89120e+02)	3.32754e+04 (1) (6.18829e+02)	3.23532e+04 (3) (1.55195e+03)	3.09681e+04 (4#) (2.91171e+03)	2.77142e+04 (6#) (6.88127e+02)	2.93508e+04 (5#) (1.84807e+03)
WFG4^{-1}	2	2.22544e+01 (1) (3.46641e-03)	2.21785e+01 (7#) (6.59119e-02)	2.21614e+01 (8#) (1.73264e-01)	2.22489e+01 (2) (6.11321e-03)	2.22441e+01 (5) (4.11959e-03)	2.21852e+01 (6) (2.26699e-02)	2.22460e+01 (4) (9.35402e-03)	2.22472e+01 (3) (5.71496e-03)
	3	1.44245e+02 (3#) (2.67645e-01)	1.31482e+02 (8#) (1.24983e+00)	1.35674e+02 (7#) (1.31067e+00)	1.44598e+02 (1) (1.75318e-01)	1.43612e+02 (5) (2.27501e-01)	1.40874e+02 (6#) (6.58525e-01)	1.44543e+02 (2#) (2.07468e-01)	1.43915e+02 (4#) (2.45172e-01)
	5	5.95781e+03 (5#) (4.43415e+01)	-	3.50081e+03 (7#) (9.06657e+01)	6.00754e+03 (4) (7.28534e+01)	5.91548e+03 (6) (7.21966e+01)	6.12237e+03 (3#) (1.26955e+02)	6.35279e+03 (1) (5.56668e+01)	6.33908e+03 (2) (4.56644e+01)
	7	1.94534e+05 (6#) (2.76166e+03)	-	1.33107e+05 (7#) (4.96355e+03)	2.03529e+05 (5) (4.77355e+03)	2.35469e+05 (4) (7.43920e+03)	2.83478e+05 (2#) (4.38251e+03)	2.78005e+05 (3#) (4.17721e+03)	2.93426e+05 (1) (4.03100e+03)
WFG5^{-1}	2	2.21074e+01 (7#) (2.23079e-02)	2.20965e+01 (8#) (2.87382e-02)	2.21495e+01 (5#) (7.78510e-03)	2.21925e+01 (4) (6.42343e-03)	2.21976e+01 (3) (5.34019e-03)	2.21463e+01 (6#) (3.19564e-02)	2.22194e+01 (1) (6.26074e-03)	2.22146e+01 (2) (4.73949e-03)
	3	1.42325e+02 (5#) (5.92772e-01)	1.29537e+02 (8#) (1.07419e+00)	1.38443e+02 (7#) (5.56455e-01)	1.43925e+02 (2) (1.12694e-01)	1.43018e+02 (4) (9.92235e-02)	1.39740e+02 (6#) (6.86337e-01)	1.44002e+02 (1) (1.93512e-01)	1.43334e+02 (3) (2.35178e-01)
	5	5.85330e+03 (6#) (6.39515e+01)	-	4.09103e+03 (7#) (6.69049e+01)	6.32628e+03 (2) (3.05654e+01)	6.14643e+03 (4) (4.23729e+01)	6.01144e+03 (5#) (1.31452e+02)	6.39091e+03 (1) (2.71838e+01)	6.28759e+03 (3) (4.10987e+01)
	7	1.82266e+05 (6#) (7.46540e+03)	-	1.66647e+05 (7#) (3.52006e+03)	2.57636e+05 (5) (4.81972e+03)	2.60701e+05 (4) (4.79153e+03)	2.75621e+05 (3#) (5.01816e+03)	2.95404e+05 (2#) (2.61129e+03)	2.96552e+05 (1) (3.68902e+03)
WFG6^{-1}	2	2.22161e+01 (3#) (1.69994e-02)	2.20319e+01 (7#) (1.59195e-01)	2.17694e+01 (8#) (1.82943e-01)	2.21635e+01 (5) (7.61789e-02)	2.22265e+01 (2) (3.77775e-02)	2.21632e+01 (6#) (4.96982e-02)	2.22330e+01 (1) (4.95463e-02)	2.22104e+01 (4) (7.16790e-02)
	3	1.44382e+02 (2#) (2.96180e-01)	1.31497e+02 (8#) (1.08746e+00)	1.33367e+02 (7#) (5.15935e-01)	1.44473e+02 (1) (1.57280e-01)	1.43503e+02 (5) (1.64678e-01)	1.40841e+02 (6#) (1.06446e+00)	1.44357e+02 (3#) (2.48874e-01)	1.43871e+02 (4#) (2.43030e-01)
	5	5.98881e+03 (6#) (5.67606e+01)	-	3.95597e+03 (7#) (4.61888e+01)	6.36718e+03 (1) (2.18808e+01)	6.21839e+03 (4) (5.05661e+01)	6.18060e+03 (5#) (1.04748e+02)	6.35338e+03 (2#) (4.46180e+01)	6.34655e+03 (3#) (3.89550e+01)
	7	1.85074e+05 (6#) (2.95969e+03)	-	1.70587e+05 (7#) (1.89381e+03)	2.62834e+05 (4) (3.77750e+03)	2.58942e+05 (5) (7.05552e+03)	2.82852e+05 (3#) (5.47437e+03)	2.92025e+05 (2#) (3.16899e+03)	2.94373e+05 (1) (3.85907e+03)
WFG7^{-1}	2	2.22557e+01 (1) (7.49315e-04)	2.21789e+01 (8#) (1.16310e-01)	2.22258e+01 (6#) (2.27703e-02)	2.22471e+01 (3) (5.14662e-03)	2.22444e+01 (4) (1.97930e-03)	2.21950e+01 (7) (1.87681e-02)	2.22500e+01 (2) (7.34263e-03)	2.22421e+01 (5) (1.32523e-02)
	3	1.44136e+02 (2#) (3.06644e-01)	1.36386e+02 (8#) (1.17046e+00)	1.38430e+02 (7#) (1.20385e+00)	1.44102e+02 (3) (2.36065e-01)	1.42998e+02 (5) (2.32508e-01)	1.40857e+02 (6#) (9.85715e-01)	1.44421e+02 (1) (1.13498e-01)	1.43973e+02 (4) (2.33104e-01)
	5	5.91665e+03 (6#) (4.95948e+01)	-	3.74835e+03 (7#) (6.12247e+01)	6.00479e+03 (5) (7.13972e+01)	6.05526e+03 (3) (5.85880e+01)	6.03920e+03 (4#) (2.12203e+02)	6.35701e+03 (2#) (3.20938e+01)	6.35942e+03 (1) (5.07440e+01)
	7	1.94601e+05 (6#) (2.88137e+03)	-	1.51276e+05 (7#) (3.54761e+03)	2.19646e+05 (5) (5.65113e+03)	2.48845e+05 (4) (7.36373e+03)	2.84768e+05 (3#) (5.07945e+03)	2.88844e+05 (2#) (3.44520e+03)	2.95891e+05 (1) (4.00136e+03)
WFG8^{-1}	2	2.22564e+01 (1) (2.50141e-04)	2.20429e+01 (8#) (8.18404e-01)	2.21928e+01 (5#) (2.69818e-02)	2.22487e+01 (2) (7.94287e-03)	2.22138e+01 (4) (3.42184e-02)	2.21578e+01 (7) (4.13194e-02)	2.22275e+01 (3) (3.58453e-02)	2.21841e+01 (6) (1.03343e-01)
	3	1.44334e+02 (3#) (1.73458e-01)	1.37878e+02 (8#) (6.89565e-01)	1.40080e+02 (7#) (3.25203e-01)	1.45035e+02 (1) (9.66996e-02)	1.43951e+02 (5) (1.20827e-01)	1.40520e+02 (6#) (8.21523e-01)	1.44557e+02 (2#) (1.87287e-01)	1.43988e+02 (4#) (2.65476e-01)
	5	6.03530e+03 (6#) (2.83284e+01)	-	4.27009e+03 (7#) (3.88930e+01)	6.46016e+03 (1) (3.80144e+01)	6.20627e+03 (4) (5.70574e+01)	6.10078e+03 (5#) (2.06269e+02)	6.45376e+03 (2#) (4.15194e+01)	6.42356e+03 (3#) (5.43773e+01)
	7	1.98255e+05 (7#) (2.75124e+03)	-	2.04932e+05 (6#) (2.04104e+03)	2.79403e+05 (5) (5.46635e+03)	2.82189e+05 (4) (4.95372e+03)	2.94167e+05 (3#) (7.00988e+03)	3.08764e+05 (2#) (2.89489e+03)	3.09786e+05 (1) (3.35660e+03)
WFG9^{-1}	2	2.22055e+01 (2#) (1.81397e-02)	2.21417e+01 (8#) (5.93815e-02)	2.21779e+01 (6#) (5.99518e-03)	2.21845e+01 (5) (1.93794e-02)	2.21869e+01 (4) (2.83854e-02)	2.21448e+01 (7#) (3.93081e-02)	2.22103e+01 (1) (1.45718e-02)	2.21970e+01 (3) (2.30713e-02)
	3	1.42737e+02 (3#) (5.34174e-01)	1.38149e+02 (8#) (4.87721e-01)	1.40281e+02 (6#) (3.96248e-01)	1.42493e+02 (4) (5.66204e-01)	1.41566e+02 (5) (6.26307e-01)	1.40245e+02 (7#) (8.78605e-01)	1.43718e+02 (1) (2.92787e-01)	1.43474e+02 (2) (2.41444e-01)
	5	6.00010e+03 (4#) (3.90848e+01)	-	4.66672e+03 (7#) (5.67399e+01)	5.96943e+03 (5) (9.30132e+01)	5.90135e+03 (6) (1.24962e+02)	6.28690e+03 (3#) (9.43200e+01)	6.43169e+03 (2#) (4.42666e+01)	6.45669e+03 (1) (3.44716e+01)
	7	2.05683e+05 (7#) (2.72381e+03)	-	2.09632e+05 (6#) (2.84762e+03)	2.51782e+05 (5) (5.70383e+03)	2.62284e+05 (4) (1.01916e+04)	2.81713e+05 (3#) (9.64378e+03)	2.98041e+05 (2#) (7.24326e+03)	3.14614e+05 (1) (3.50033e+03)

II. IGD$^+$ Results

This section presents the complete IGD$^+$ results. Tables SM-7-SM-12 show a comparison of the IGD$^+$ indicator of the PFAs generated by GI-MOACO$_{\mathbb{R}}$, MOACO$_{\mathbb{R}}$ [4], iMOACO$_{\mathbb{R}}$ [3], AdaW [9], AR-MOEA [11], SPEA2+SDE [7], RVEA-iGNG [10], and Two_Arch2 [15].

TABLE SM-7

IGD$^+$ results for the compared Multi-objective algorithms on the IMOP problems. We show the mean and standard deviation (in parentheses). The two best values are shown in gray scale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
IMOP1	2	3.34242e-02 (8#) (1.29359e-02)	1.28641e-02 (7#) (6.54356e-02)	1.72483e-03 (5#) (4.91101e-04)	3.48390e-04 (3) (2.43440e-05)	1.73905e-03 (6) (2.32560e-05)	6.55343e-04 (4) (1.34185e-04)	2.10597e-04 (1) (1.58001e-05)	3.02900e-04 (2) (4.48587e-05)
IMOP2	2	1.58345e-02 (2#) (1.74001e-03)	2.03716e-02 (4#) (3.58738e-02)	1.59063e-02 (3#) (1.62166e-03)	1.29244e-01 (5) (6.14272e-02)	1.45799e-01 (8) (8.05789e-02)	1.03085e-03 (1) (5.69453e-05)	1.45316e-01 (7#) (8.15424e-02)	1.30934e-01 (6) (7.84025e-02)
IMOP3	2	1.48570e-01 (8#) (1.31587e-02)	1.34223e-01 (7#) (6.05013e-02)	1.33825e-01 (6#) (9.20922e-03)	1.15584e-02 (3) (1.41359e-02)	2.76055e-02 (4) (6.13634e-02)	8.55331e-03 (2) (8.45377e-03)	2.90400e-03 (1) (2.22991e-03)	5.42836e-02 (5) (4.06452e-02)
IMOP4	3	8.85199e-02 (7#) (9.98499e-03)	8.12784e-02 (6#) (4.65941e-03)	9.44146e-02 (8#) (8.80002e-03)	5.21442e-03 (5) (4.14760e-03)	3.77498e-03 (2) (1.87650e-04)	4.35547e-03 (4) (4.11530e-04)	3.62754e-03 (1) (2.57512e-04)	3.92781e-03 (3) (5.38618e-04)
IMOP5	3	1.40045e-01 (7#) (7.99206e-03)	1.25955e-01 (6#) (1.46284e-02)	1.43150e-01 (8#) (6.57888e-03)	2.44610e-02 (5) (5.01695e-03)	2.07504e-02 (4) (5.05938e-04)	2.02103e-02 (2#) (5.10247e-04)	2.03526e-02 (3#) (2.02798e-03)	1.98406e-02 (1) (6.27433e-04)
IMOP6	3	5.09832e-02 (6#) (3.72526e-03)	5.67646e-02 (7#) (4.67666e-03)	5.73911e-02 (8#) (1.60579e-03)	2.39762e-02 (1) (8.52272e-04)	4.53842e-02 (4) (6.04963e-02)	4.57280e-02 (5#) (6.20095e-02)	2.52983e-02 (2#) (4.56273e-04)	3.94550e-02 (3#) (6.31778e-02)
IMOP7	3	8.17324e-02 (3#) (1.94031e-02)	7.68033e-02 (2#) (4.81385e-02)	8.24103e-02 (4#) (1.17755e-02)	4.36056e-02 (1) (8.29626e-02)	4.14149e-01 (7) (1.58500e-01)	3.68094e-01 (6#) (1.97649e-01)	4.25140e-01 (8#) (1.36979e-01)	1.06062e-01 (5#) (1.19599e-01)
IMOP8	3	7.34560e-02 (5#) (8.53856e-03)	9.86815e-02 (8#) (6.69676e-03)	9.52966e-02 (7#) (5.57159e-03)	2.23385e-02 (3) (2.30480e-03)	8.39559e-02 (6) (1.37839e-01)	8.68964e-03 (1) (7.91535e-04)	2.14185e-02 (2) (1.77739e-03)	4.57592e-02 (4) (1.17079e-01)

TABLE SM-8

IGD$^+$ results for the compared Multi-objective algorithms on the VIE problems. We show the mean and standard deviation (in parentheses). The two best values are shown in gray scale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
VIE1	3	4.36508e-02 (4#) (1.49345e-03)	4.85059e-02 (6#) (2.36057e-03)	8.33559e-02 (8#) (4.26006e-03)	3.91482e-02 (2) (8.31923e-04)	5.89671e-02 (7) (5.23390e-03)	4.45366e-02 (5#) (2.71719e-03)	4.07451e-02 (3#) (1.20391e-03)	3.79650e-02 (1) (9.45535e-04)
VIE2	3	2.59767e-03 (3#) (8.87961e-05)	3.23773e-03 (6#) (2.46340e-04)	1.45971e-02 (8#) (1.15531e-03)	2.68883e-03 (4) (1.04591e-04)	4.89724e-03 (7) (3.39961e-04)	3.17994e-03 (5#) (2.28176e-04)	2.35077e-03 (2#) (9.03911e-05)	2.30978e-03 (1) (7.68198e-05)
VIE3	3	3.43042e-03 (1) (1.76067e-04)	8.12115e-03 (7#) (9.65425e-04)	2.21775e-02 (8#) (7.45557e-03)	3.53386e-03 (2) (1.34181e-04)	6.24136e-03 (6) (3.40266e-04)	4.60810e-03 (5) (4.70790e-04)	3.81641e-03 (3) (2.68057e-04)	3.86337e-03 (4) (2.25673e-04)

TABLE SM-9
IGD$^+$ RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1	2	1.50621e-02 (6#) (1.13833e-02)	1.71916e+01 (7#) (2.52501e+00)	1.85811e+01 (8#) (2.49458e+00)	1.25605e-03 (2) (1.92962e-04)	1.39246e-03 (4) (5.30146e-04)	1.25041e-03 (1) (1.50959e-04)	1.57201e-03 (5#) (1.11145e-03)	1.30541e-03 (3) (1.94213e-04)
	3	3.45133e-02 (6#) (1.55748e-02)	1.48541e+01 (8#) (2.00957e+00)	1.41421e+01 (7#) (3.12538e+00)	1.20052e-02 (2) (2.09937e-04)	1.19312e-02 (1) (3.42924e-04)	1.27722e-02 (4#) (3.23622e-04)	1.29264e-02 (5#) (5.15038e-04)	1.21752e-02 (3#) (1.66590e-04)
	5	8.26990e-02 (6#) (5.75393e-02)	-	1.32581e+01 (7#) (2.34192e+00)	3.50155e-02 (3#) (6.62430e-04)	3.30203e-02 (1) (2.80979e-04)	3.65069e-02 (4#) (5.44587e-04)	3.71640e-02 (5#) (9.19071e-04)	3.47226e-02 (2#) (7.58561e-04)
	7	2.71334e-01 (6#) (1.69994e-01)	-	1.43182e+01 (7#) (2.36372e+00)	4.95366e-02 (5#) (3.74753e-03)	3.76315e-02 (1) (6.51624e-04)	4.42204e-02 (3#) (5.77788e-04)	4.66920e-02 (4#) (9.18363e-04)	4.00155e-02 (2#) (5.53635e-04)
DTLZ2	2	1.71875e-03 (6#) (7.52819e-05)	2.42664e-03 (8#) (3.04889e-04)	1.71662e-03 (5#) (4.60996e-06)	1.56397e-03 (2) (3.30409e-05)	1.68478e-03 (4) (4.20113e-06)	1.86810e-03 (7) (8.41659e-05)	1.46072e-03 (1) (1.45071e-05)	1.58046e-03 (3) (3.35111e-05)
	3	2.08809e-02 (4#) (1.18089e-03)	3.30389e-02 (8#) (1.75888e-03)	2.04468e-02 (2#) (1.34118e-04)	2.06772e-02 (3) (6.38391e-04)	1.98888e-02 (1) (6.63623e-05)	2.15461e-02 (6#) (5.77256e-04)	2.20229e-02 (7#) (5.53870e-04)	2.10304e-02 (5#) (6.16555e-04)
	5	8.85010e-02 (6#) (5.93873e-03)	-	7.44150e-02 (3#) (8.52269e-04)	7.88457e-02 (5#) (3.26074e-03)	6.84817e-02 (1) (1.49718e-04)	6.96433e-02 (2#) (1.97599e-03)	1.06854e-01 (7#) (2.82821e-03)	7.64964e-02 (4#) (1.74748e-03)
	7	1.53993e-01 (6#) (9.30571e-03)	-	1.01397e-01 (4#) (1.56363e-03)	1.13845e-01 (5#) (4.30832e-03)	8.52092e-02 (1) (3.25669e-04)	8.67673e-02 (2#) (2.01756e-03)	1.79851e-01 (7#) (1.14939e-02)	9.69662e-02 (3#) (1.88707e-03)
DTLZ3	2	3.97973e-01 (5#) (2.34950e-01)	1.78731e+02 (8#) (1.32905e+01)	1.76925e+02 (7#) (1.59146e+01)	1.18894e-01 (4) (3.04630e-01)	1.19047e-02 (1) (7.44178e-03)	3.89241e-02 (3) (1.81692e-01)	4.12661e-01 (6) (5.96704e-01)	1.31925e-02 (2) (1.54456e-02)
	3	8.56331e-01 (6#) (4.79224e-01)	1.76897e+02 (8#) (1.58298e+01)	1.69395e+02 (7#) (1.90621e+01)	2.77947e-02 (3) (5.23495e-03)	4.34189e-02 (4) (8.35083e-02)	2.15969e-02 (1) (3.57790e-03)	1.85903e-01 (5) (3.37078e-01)	2.49038e-02 (2) (6.75673e-03)
	5	5.00633e+00 (6#) (2.15358e+00)	-	1.59504e+02 (7#) (1.33588e+01)	1.44272e-01 (4) (2.22268e-02)	8.49743e-02 (3) (1.32806e-02)	7.16503e-02 (1) (4.10032e-03)	1.55377e-01 (5#) (1.71779e-01)	7.76098e-02 (2) (4.13030e-03)
	7	1.30904e+01 (6#) (6.80069e+00)	-	1.70147e+02 (7#) (1.26977e+01)	5.79509e-01 (5#) (1.11794e+00)	1.50778e-01 (3) (1.88119e-01)	9.05370e-02 (1) (3.94610e-03)	2.04338e-01 (4#) (1.70178e-01)	1.07465e-01 (2) (5.86580e-03)
DTLZ4	2	1.82290e-03 (3#) (1.16207e-04)	2.52099e-03 (4#) (4.33947e-04)	1.73559e-03 (2#) (8.50789e-06)	1.55380e-03 (1) (6.09662e-05)	1.08497e-01 (7) (1.65882e-01)	3.74658e-02 (5) (1.08545e-01)	9.63915e-02 (6#) (1.60225e-01)	1.32128e-01 (8) (1.74513e-01)
	3	2.54037e-02 (2) (1.03623e-03)	3.81822e-02 (6) (2.29110e-03)	1.99944e-02 (1) (3.15899e-04)	2.73232e-02 (3) (3.83137e-02)	9.96909e-02 (8) (1.41611e-01)	4.77549e-02 (7) (6.92309e-02)	3.79686e-02 (5) (9.02396e-02)	3.02064e-02 (4) (3.86630e-02)
	5	7.90584e-02 (6#) (6.98353e-03)	-	6.92987e-02 (2#) (1.24934e-03)	6.91347e-02 (1) (2.02054e-03)	6.95182e-02 (3) (2.48406e-02)	7.74541e-02 (5#) (2.89218e-02)	1.12994e-01 (7#) (7.33780e-03)	7.08563e-02 (4) (2.15565e-03)
	7	1.13536e-01 (6#) (4.54415e-03)	-	9.87688e-02 (4#) (1.90186e-03)	1.06288e-01 (5#) (3.83608e-03)	8.18342e-02 (1) (3.19414e-04)	8.86244e-02 (2#) (2.27954e-03)	2.04140e-01 (7#) (7.17319e-03)	9.51841e-02 (3#) (2.20353e-03)
DTLZ5	2	1.71875e-03 (6#) (7.52819e-05)	2.42664e-03 (8#) (3.04889e-04)	1.71662e-03 (5#) (4.60996e-06)	1.56397e-03 (2) (3.30409e-05)	1.68478e-03 (4) (4.20113e-06)	1.86810e-03 (7) (8.41659e-05)	1.46072e-03 (1) (1.45071e-05)	1.58046e-03 (3) (3.35111e-05)
	3	2.49751e-03 (6#) (4.87650e-04)	2.76908e-03 (7#) (1.03361e-04)	7.31520e-03 (8#) (6.33735e-05)	1.69322e-03 (3) (4.33083e-05)	2.05229e-03 (5) (7.86450e-05)	1.92159e-03 (4) (9.92515e-05)	1.62569e-03 (1) (4.54464e-05)	1.68227e-03 (2) (5.15053e-05)
	5	4.40239e-02 (3#) (1.90326e-03)	-	1.29202e-01 (7#) (6.39605e-03)	4.25842e-02 (2) (2.52608e-03)	5.12808e-02 (6) (2.24834e-03)	4.95133e-02 (5#) (3.24291e-03)	4.56862e-02 (4#) (2.37274e-03)	4.23489e-02 (1) (2.41067e-03)
	7	6.62179e-02 (3#) (2.78076e-03)	-	2.49356e-01 (7#) (1.45972e-02)	7.05039e-02 (4#) (3.89035e-03)	7.23480e-02 (5) (2.46278e-03)	6.32734e-02 (2#) (2.38089e-03)	7.70861e-02 (6#) (2.41773e-03)	6.11063e-02 (1) (1.81541e-03)
DTLZ6	2	1.51580e-03 (2#) (5.58651e-05)	6.22235e-02 (7#) (2.51623e-02)	1.15476e-01 (8#) (5.31082e-02)	1.56940e-03 (4) (6.06355e-05)	1.66915e-03 (5) (1.81917e-06)	1.82237e-03 (6) (9.26682e-05)	1.50719e-03 (1) (2.12018e-05)	1.51870e-03 (3) (4.90536e-05)
	3	1.73458e-03 (4#) (2.37716e-05)	8.85403e-02 (7#) (3.48786e-02)	1.14488e-01 (8#) (5.73799e-02)	1.66578e-03 (3) (3.24344e-05)	1.84416e-03 (5) (2.87740e-05)	1.86824e-03 (6) (8.22479e-05)	1.53764e-03 (1) (2.01689e-05)	1.60641e-03 (2) (2.94581e-05)
	5	4.95490e-02 (2#) (4.62584e-03)	-	2.84010e-01 (7#) (8.52519e-02)	4.99023e-02 (3) (4.88696e-03)	5.90098e-02 (6) (3.97844e-03)	4.86663e-02 (1) (2.72330e-03)	5.80387e-02 (5#) (3.60304e-03)	5.73529e-02 (4) (5.87406e-03)
	7	9.54318e-02 (4#) (1.41329e-02)	-	6.03178e-01 (7#) (1.58865e-01)	9.41034e-02 (2#) (1.16730e-02)	9.46340e-02 (3) (4.94319e-03)	7.67410e-02 (1) (2.46122e-03)	1.05980e-01 (6#) (5.39758e-03)	9.78250e-02 (5) (9.66827e-03)
DTLZ7	2	1.52788e-03 (2#) (2.37943e-05)	1.79433e-02 (5#) (8.10333e-02)	4.02167e-03 (4#) (1.68734e-04)	1.51004e-03 (1) (3.63078e-05)	9.02020e-02 (8) (1.79994e-01)	1.71381e-03 (3) (8.75897e-05)	6.05212e-02 (7#) (1.53054e-01)	4.58632e-02 (6) (1.35032e-01)
	3	2.18718e-02 (2#) (4.99417e-04)	4.79599e-02 (5#) (3.39682e-03)	5.57169e-02 (7#) (1.77334e-03)	2.03867e-02 (1) (4.38543e-04)	7.10822e-02 (8) (8.49045e-02)	2.73888e-02 (3#) (3.75544e-02)	4.89392e-02 (6#) (6.84088e-02)	2.89040e-02 (4#) (3.67679e-02)
	5	1.19658e-01 (4#) (3.04200e-03)	-	3.31783e-01 (7#) (2.42297e-02)	1.06450e-01 (2) (3.37828e-03)	1.44992e-01 (5) (5.48959e-03)	1.00619e-01 (1) (4.37676e-02)	1.53164e-01 (6#) (1.42689e-02)	1.07609e-01 (3) (1.24769e-02)
	7	2.13589e-01 (3#) (5.66937e-03)	-	6.69752e-01 (7#) (1.07872e-01)	2.28128e-01 (5#) (8.33996e-03)	2.42048e-01 (6) (5.84530e-03)	1.47834e-01 (1) (7.14353e-03)	2.16482e-01 (4#) (2.95571e-02)	1.62626e-01 (2) (1.90246e-02)

TABLE SM-10

IGD$^+$ RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1^{-1}	2	1.38420e+00 (6#) (1.00005e-01)	4.27760e+01 (8#) (2.27200e+00)	4.27740e+01 (7#) (1.81099e+00)	1.22556e+00 (3) (4.49757e-02)	1.16567e+00 (1) (7.32643e-03)	1.30066e+00 (5) (3.04775e-02)	1.22386e+00 (2) (1.14808e-02)	1.23658e+00 (4) (1.91443e-02)
	3	1.35946e+01 (1) (1.89664e-01)	5.22629e+01 (8#) (1.59466e+00)	5.20951e+01 (7#) (1.24346e+00)	1.37405e+01 (2) (1.85838e-01)	1.45469e+01 (6) (2.79567e-01)	1.44179e+01 (4) (2.53361e-01)	1.44777e+01 (5) (3.37122e-01)	1.44121e+01 (3) (2.32445e-01)
	5	4.67904e+01 (3#) (3.57286e-01)	-	9.06870e+01 (7#) (1.37369e+00)	4.36774e+01 (1) (5.25556e-01)	4.93141e+01 (5) (1.52187e+00)	4.43047e+01 (2#) (4.28175e-01)	5.00073e+01 (6#) (8.14587e-01)	4.68991e+01 (4) (6.88663e-01)
	7	6.29766e+01 (3#) (2.70053e-01)	-	1.39862e+02 (7#) (2.85289e+00)	5.91800e+01 (2#) (1.11197e+00)	6.54033e+01 (4) (1.28263e+00)	5.86984e+01 (1) (8.26769e-01)	8.31243e+01 (6#) (2.47934e+00)	7.75636e+01 (5) (5.89023e+00)
DTLZ2^{-1}	2	5.53258e-03 (2#) (8.50084e-05)	9.35288e-03 (7#) (1.63628e-03)	1.17703e-02 (8#) (3.62489e-03)	5.59733e-03 (3) (1.88217e-04)	8.55992e-03 (6) (1.93156e-05)	7.57018e-03 (5) (5.73975e-04)	5.37908e-03 (1) (7.40947e-05)	5.59795e-03 (4) (1.73764e-04)
	3	8.20627e-02 (3#) (1.40995e-03)	1.33627e-01 (7#) (4.88781e-03)	1.42400e-01 (8#) (7.84022e-03)	7.90361e-02 (1) (1.51867e-03)	1.01319e-01 (6) (9.60456e-04)	9.99335e-02 (5#) (5.92521e-03)	8.19648e-02 (2#) (2.10421e-03)	8.21298e-02 (4#) (1.92617e-03)
	5	3.84753e-01 (6#) (4.70910e-03)	-	6.65294e-01 (7#) (1.56012e-02)	3.46046e-01 (3) (3.32942e-03)	3.73447e-01 (5) (5.02162e-03)	3.57212e-01 (4) (9.32438e-03)	3.40772e-01 (1) (6.82005e-03)	3.41503e-01 (2) (4.07636e-03)
	7	6.20399e-01 (6#) (6.61037e-03)	-	8.17328e-01 (7#) (9.44474e-03)	5.22519e-01 (2#) (4.73842e-03)	6.09891e-01 (5) (1.56257e-02)	5.16458e-01 (1) (7.07788e-03)	5.29195e-01 (4#) (8.07586e-03)	5.23265e-01 (3) (6.86746e-03)
DTLZ3^{-1}	2	1.26073e+01 (6#) (6.75830e+00)	4.28638e+02 (7#) (2.01881e+01)	4.36603e+02 (8#) (2.15658e+01)	4.18788e+00 (3) (9.51285e-01)	5.46257e+00 (5) (4.80521e-02)	4.82818e+00 (4) (4.80367e-01)	3.39835e+00 (1) (5.84788e-02)	3.73865e+00 (2) (1.28170e+00)
	3	5.63084e+01 (4#) (3.36152e+00)	4.96149e+02 (7#) (1.18622e+01)	5.02833e+02 (8#) (1.44557e+01)	5.24575e+01 (3) (3.82210e+00)	6.69147e+01 (6) (2.59998e+00)	6.21003e+01 (5) (3.71159e+00)	5.02427e+01 (1) (1.44270e+00)	5.11068e+01 (2) (1.00787e+00)
	5	2.44642e+02 (5#) (4.48535e+00)	-	6.72502e+02 (7#) (1.29960e+01)	2.32311e+02 (4) (9.30816e+00)	2.48239e+02 (6) (5.52285e+00)	2.24989e+02 (2) (7.12593e+00)	2.17036e+02 (1) (4.92163e+00)	2.27473e+02 (3) (7.81500e+00)
	7	3.95393e+02 (5#) (9.00977e+00)	-	7.86654e+02 (7#) (9.81447e+00)	3.68178e+02 (4#) (1.02886e+01)	4.22449e+02 (6) (1.46294e+01)	3.17642e+02 (1) (5.64738e+00)	3.52526e+02 (3#) (1.35879e+01)	3.40520e+02 (2) (9.68711e+00)
DTLZ4^{-1}	2	1.81605e-02 (8#) (1.14944e-02)	9.34667e-03 (6#) (2.41431e-03)	1.16512e-02 (7#) (4.32678e-03)	5.52129e-03 (3) (1.83287e-04)	8.37235e-03 (5) (2.04786e-05)	7.08976e-03 (4) (4.09574e-04)	5.41468e-03 (2) (8.40635e-05)	5.33553e-03 (1) (1.47830e-04)
	3	9.86046e-02 (5#) (3.67171e-03)	1.32329e-01 (7#) (6.62472e-03)	1.43966e-01 (8#) (5.66690e-03)	7.94714e-02 (1) (1.17649e-03)	1.03894e-01 (6) (8.83206e-04)	9.07378e-02 (4#) (3.04120e-03)	8.27019e-02 (3#) (1.69716e-03)	8.24132e-02 (2#) (1.88374e-03)
	5	4.40286e-01 (6#) (1.03197e-02)	-	7.46430e-01 (7#) (8.49941e-02)	3.51485e-01 (4) (4.82660e-03)	3.77050e-01 (5) (4.92864e-03)	3.39562e-01 (2) (5.05769e-03)	3.38025e-01 (1) (6.46744e-03)	3.46648e-01 (3) (4.88620e-03)
	7	6.87485e-01 (6#) (9.80765e-03)	-	1.01912e+00 (7#) (1.04739e-01)	5.30579e-01 (4#) (6.98018e-03)	6.17014e-01 (5) (1.60559e-02)	4.99096e-01 (1) (5.15079e-03)	5.19930e-01 (2#) (7.32989e-03)	5.21863e-01 (3) (6.54000e-03)
DTLZ5^{-1}	2	5.53258e-03 (2#) (8.50084e-05)	9.35288e-03 (7#) (1.63628e-03)	1.17703e-02 (8#) (3.62489e-03)	5.59733e-03 (3) (1.88217e-04)	8.55992e-03 (6) (1.93156e-05)	7.57018e-03 (5) (5.73975e-04)	5.37908e-03 (1) (7.40947e-05)	5.59795e-03 (4) (1.73764e-04)
	3	7.58443e-02 (2#) (1.41548e-03)	1.31850e-01 (7#) (9.58245e-03)	1.33854e-01 (8#) (8.81769e-03)	7.46915e-02 (1) (1.33008e-03)	9.06031e-02 (6) (8.85756e-04)	9.02581e-02 (5#) (5.20724e-03)	7.78054e-02 (3#) (1.93253e-03)	7.79416e-02 (4#) (1.49632e-03)
	5	3.41235e-01 (6#) (3.42758e-03)	-	5.65289e-01 (7#) (1.01480e-02)	3.00341e-01 (1) (3.43879e-03)	3.29238e-01 (5) (7.77114e-03)	3.25199e-01 (4#) (1.12543e-02)	3.07553e-01 (3#) (5.28693e-03)	3.06207e-01 (2) (4.65877e-03)
	7	5.45499e-01 (6#) (3.93453e-03)	-	6.99002e-01 (7#) (1.13834e-02)	4.30567e-01 (1) (5.21492e-03)	5.01817e-01 (5) (9.10831e-03)	4.49818e-01 (3) (7.86492e-03)	4.50512e-01 (4) (7.83592e-03)	4.42686e-01 (2) (6.59426e-03)
DTLZ6^{-1}	2	1.73780e-02 (2#) (4.88813e-04)	2.83634e-02 (8#) (3.96676e-03)	2.68797e-02 (7#) (3.02248e-04)	1.76510e-02 (4) (5.57650e-04)	2.62929e-02 (6) (7.89984e-05)	2.56794e-02 (5) (2.51362e-03)	1.66818e-02 (1) (2.54259e-04)	1.74340e-02 (3) (6.59449e-04)
	3	2.50955e-01 (4#) (3.68343e-03)	3.99663e-01 (7#) (1.62216e-02)	4.09816e-01 (8#) (1.04167e-02)	2.46797e-01 (1) (3.23669e-03)	3.06405e-01 (5) (2.15955e-03)	3.07162e-01 (6#) (2.28893e-02)	2.48695e-01 (2#) (5.32588e-03)	2.49797e-01 (3#) (4.01647e-03)
	5	1.19873e+00 (6#) (1.44498e-02)	-	2.15936e+00 (7#) (2.36180e-02)	1.07279e+00 (3) (1.21439e-02)	1.14137e+00 (5) (1.69736e-02)	1.10808e+00 (4) (2.38461e-02)	1.03701e+00 (1) (1.45619e-02)	1.04766e+00 (2) (1.62626e-02)
	7	1.93742e+00 (6#) (1.40319e-02)	-	2.43349e+00 (7#) (2.15904e-02)	1.56816e+00 (3#) (1.61747e-02)	1.71281e+00 (5) (3.62558e-02)	1.60184e+00 (4) (2.66336e-02)	1.55633e+00 (1) (1.74972e-02)	1.56143e+00 (2) (2.53112e-02)
DTLZ7^{-1}	2	7.56659e-04 (1) (1.58679e-05)	1.26830e-03 (7#) (5.08398e-04)	7.05783e-03 (8#) (1.04201e-03)	7.88961e-04 (3) (2.22106e-05)	9.93344e-04 (6) (3.29692e-05)	8.30770e-04 (5) (3.13106e-05)	7.88736e-04 (2) (1.91499e-05)	7.98148e-04 (4) (1.81632e-05)
	3	1.01957e-02 (4#) (3.12299e-04)	1.69639e-02 (6#) (1.25595e-03)	9.93873e-02 (8#) (4.65054e-02)	9.01522e-03 (1) (3.75161e-04)	3.25910e-02 (7) (8.01372e-02)	9.58843e-03 (3#) (3.30260e-04)	1.04747e-02 (5#) (4.58093e-04)	9.13562e-03 (2#) (2.99016e-04)
	5	6.75424e-02 (4#) (1.82147e-03)	-	4.66735e-01 (7#) (6.60083e-02)	6.25845e-02 (3) (4.95470e-03)	7.01842e-02 (5) (5.89764e-03)	3.73203e-02 (1) (8.52880e-04)	9.92130e-02 (6#) (1.21456e-02)	6.18707e-02 (2) (4.64184e-03)
	7	3.10503e-01 (6#) (3.47203e-02)	-	9.00525e-01 (7#) (1.40005e-01)	2.01181e-01 (3#) (3.54974e-02)	1.80276e-01 (2) (6.51794e-03)	3.91289e-02 (1) (6.84691e-04)	3.00591e-01 (5#) (9.59026e-03)	2.30284e-01 (4) (3.63383e-02)

TABLE SM-11

IGD$^+$ RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE WFG PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_\mathbb{R}$	MOACO$_\mathbb{R}$	iMOACO$_\mathbb{R}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1	2	1.17279e+00 (8#) (9.00476e-03)	1.14593e+00 (7#) (1.51154e-02)	1.14439e+00 (6#) (8.90660e-03)	1.01724e-01 (5) (2.50947e-02)	6.24646e-02 (3) (3.76679e-02)	2.89597e-02 (1) (2.24993e-02)	1.00354e-01 (4#) (5.56572e-02)	5.78604e-02 (2) (3.72189e-02)
	3	1.39937e+00 (6#) (6.94568e-03)	1.51135e+00 (8#) (9.20273e-03)	1.48136e+00 (7#) (5.12687e-03)	2.19495e-01 (3) (3.74984e-02)	2.45277e-01 (4) (5.34578e-02)	7.81138e-02 (1) (3.54999e-02)	1.94196e-01 (2) (4.86643e-02)	2.71414e-01 (5) (5.43032e-02)
	5	1.85410e+00 (6#) (1.32292e-02)	-	1.95079e+00 (7#) (2.74713e-02)	3.16977e-01 (2) (5.44186e-02)	4.13388e-01 (4) (5.21148e-02)	1.22338e-01 (1) (4.63414e-02)	3.60096e-01 (3#) (6.64737e-02)	5.04147e-01 (5) (8.47603e-02)
	7	2.26067e+00 (6#) (2.56398e-02)	-	2.29946e+00 (7#) (3.52359e-02)	6.80531e-01 (3#) (9.31389e-02)	8.06418e-01 (5) (8.54802e-02)	1.72791e-01 (1) (6.28567e-02)	6.22690e-01 (2#) (7.97029e-02)	7.47900e-01 (4) (1.05034e-01)
WFG2	2	4.94776e-02 (3) (9.75911e-03)	3.43146e-02 (1) (3.22746e-02)	3.59659e-02 (2#) (2.91976e-02)	7.42862e-02 (4) (1.87453e-02)	8.73074e-02 (6) (4.35519e-02)	7.73912e-02 (5) (2.60654e-03)	9.65011e-02 (8) (2.21659e-02)	9.39746e-02 (7) (4.17917e-02)
	3	6.99709e-02 (1) (1.06366e-02)	8.94203e-02 (2#) (2.62128e-02)	9.10728e-02 (3#) (6.20894e-03)	1.17219e-01 (4) (1.24320e-01)	1.69213e-01 (6) (1.32763e-01)	1.32905e-01 (5) (1.36553e-01)	1.75028e-01 (7) (1.40692e-01)	2.08683e-01 (8) (1.33895e-01)
	5	2.10915e-01 (1) (2.19138e-02)	-	2.81883e-01 (2#) (3.00634e-02)	3.57789e-01 (5) (3.10618e-01)	3.81804e-01 (6) (3.01214e-01)	2.83615e-01 (3) (3.02213e-01)	3.52078e-01 (4) (2.99785e-01)	4.12895e-01 (7) (3.34801e-01)
	7	4.13727e-01 (4#) (6.23243e-02)	-	4.77487e-01 (5#) (7.23927e-02)	3.05153e-01 (2#) (3.39418e-01)	4.79132e-01 (6) (4.98897e-01)	2.24623e-01 (1) (3.53675e-01)	3.65992e-01 (3#) (3.77699e-01)	6.12616e-01 (7) (5.63798e-01)
WFG3	2	5.13717e-02 (8) (1.36414e-02)	1.72062e-02 (7) (8.01717e-03)	8.65157e-03 (1) (9.62310e-04)	1.28650e-02 (4) (2.50032e-03)	1.50131e-02 (5) (5.91783e-03)	9.04240e-03 (2) (1.72184e-03)	1.59710e-02 (6) (4.78614e-03)	1.14095e-02 (3) (6.42530e-03)
	3	1.11567e-01 (7#) (2.08474e-02)	1.56915e-01 (8#) (1.01369e-02)	1.01487e-01 (6#) (4.55275e-03)	5.17286e-02 (3) (5.32697e-03)	6.23408e-02 (5) (4.28927e-03)	6.06588e-02 (4) (8.04667e-03)	4.17150e-02 (1) (2.77839e-03)	4.96769e-02 (2) (4.35873e-03)
	5	2.99764e-01 (4#) (9.57135e-03)	-	6.28217e-01 (7#) (1.77900e-02)	3.14748e-01 (6) (1.61728e-02)	3.12732e-01 (5) (8.52475e-03)	2.92743e-01 (3#) (1.26492e-02)	2.70510e-01 (2#) (6.48900e-03)	2.47873e-01 (1) (5.38222e-03)
	7	5.08632e-01 (3#) (6.21654e-03)	-	8.95747e-01 (7#) (4.10406e-02)	6.48757e-01 (6#) (3.70082e-02)	5.60623e-01 (4) (1.62943e-02)	4.50953e-01 (1) (1.36010e-02)	5.61233e-01 (5#) (2.05687e-02)	4.78599e-01 (2) (1.33736e-02)
WFG4	2	2.12276e-02 (6#) (3.11236e-03)	7.85211e-02 (8#) (3.09984e-03)	7.40996e-02 (7#) (1.96494e-03)	1.01845e-02 (5) (1.70255e-03)	9.00266e-03 (4) (1.34930e-03)	5.83473e-03 (2) (5.74521e-04)	5.08638e-03 (1) (5.93990e-04)	6.95181e-03 (3) (9.98497e-04)
	3	8.13162e-02 (4#) (3.80929e-03)	2.51510e-01 (8#) (1.07925e-02)	1.92669e-01 (7#) (4.40555e-03)	8.34652e-02 (5) (4.08065e-03)	8.58732e-02 (6) (4.12433e-03)	6.99692e-02 (1) (3.49627e-03)	7.75302e-02 (3) (3.88242e-03)	7.21138e-02 (2) (3.11763e-03)
	5	2.99387e-01 (1) (9.59994e-03)	-	5.28764e-01 (7#) (3.18018e-02)	4.50514e-01 (5) (1.85604e-02)	3.50570e-01 (2) (7.80996e-03)	3.82381e-01 (3) (1.58769e-02)	4.99746e-01 (6) (1.17992e-02)	3.85124e-01 (4) (9.00346e-03)
	7	4.83666e-01 (1) (1.19394e-02)	-	8.50509e-01 (5#) (8.95432e-02)	1.02213e+00 (7) (7.25317e-02)	5.81761e-01 (2) (1.18018e-02)	7.05589e-01 (4) (2.00063e-02)	9.70876e-01 (6) (5.36250e-02)	6.74219e-01 (3) (1.82849e-02)
WFG5	2	5.06800e-03 (3#) (5.72334e-04)	2.34574e-02 (8#) (6.08127e-02)	9.33503e-03 (7#) (1.45647e-03)	5.62878e-03 (6) (6.77162e-04)	5.34223e-03 (4) (2.22379e-04)	5.34539e-03 (5) (2.51996e-04)	4.48140e-03 (1) (1.24393e-04)	4.97334e-03 (2) (1.46816e-04)
	3	7.95044e-02 (4#) (5.39914e-03)	2.13406e-01 (8#) (1.60508e-02)	1.53236e-01 (7#) (1.41147e-02)	7.96521e-02 (5) (2.42407e-03)	7.67224e-02 (2) (2.00484e-03)	7.41128e-02 (1) (2.62344e-03)	8.26041e-02 (6) (2.41057e-03)	7.83337e-02 (3) (2.38455e-03)
	5	3.28881e-01 (1) (9.01239e-03)	-	1.07067e+00 (7#) (3.25817e-02)	4.16633e-01 (5) (1.59234e-02)	3.33104e-01 (2) (3.59020e-03)	3.80621e-01 (3) (1.42545e-02)	4.85671e-01 (6) (9.22930e-03)	3.89803e-01 (4) (6.03639e-03)
	7	5.69280e-01 (2#) (1.82570e-02)	-	1.81193e+00 (7#) (7.94585e-02)	9.28115e-01 (5#) (4.38299e-02)	5.30313e-01 (1) (7.55006e-03)	7.12998e-01 (4#) (1.93343e-02)	9.52658e-01 (6#) (3.20769e-02)	6.92548e-01 (3#) (1.58868e-02)
WFG6	2	1.05135e-01 (8) (1.42995e-04)	2.04348e-02 (2) (8.65316e-03)	9.95026e-03 (1) (4.34829e-03)	5.34515e-02 (7) (1.19617e-02)	4.36493e-02 (5) (8.88791e-03)	4.27535e-02 (3) (7.80473e-03)	4.30051e-02 (4) (9.11008e-03)	4.44829e-02 (6) (1.33585e-02)
	3	1.29589e-01 (7#) (3.25655e-03)	2.24624e-01 (8#) (2.65513e-02)	1.03272e-01 (6#) (8.71957e-03)	9.54511e-02 (5) (1.07583e-02)	9.34645e-02 (4) (8.60352e-03)	8.01006e-02 (1) (6.25424e-03)	9.08465e-02 (3) (8.65033e-03)	8.59964e-02 (2) (7.51932e-03)
	5	3.53402e-01 (2#) (6.22308e-03)	-	5.49853e-01 (7#) (8.51568e-02)	4.25760e-01 (5#) (2.58697e-02)	3.36711e-01 (1) (1.31985e-02)	3.70013e-01 (3#) (1.75039e-02)	5.03837e-01 (6#) (1.76839e-02)	3.88070e-01 (4#) (1.42432e-02)
	7	4.89486e-01 (1) (5.74553e-03)	-	1.11829e+00 (7#) (8.53895e-02)	9.91586e-01 (6) (6.92151e-02)	5.12726e-01 (2) (1.33762e-02)	6.79307e-01 (4) (2.44392e-02)	9.56181e-01 (5) (3.51908e-02)	6.69280e-01 (3) (2.48326e-02)
WFG7	2	2.54028e-02 (8#) (5.12441e-03)	1.14017e-02 (7#) (1.16666e-02)	6.39083e-03 (4#) (2.65856e-04)	6.76207e-03 (5) (1.42238e-03)	7.07112e-03 (6) (1.37301e-03)	5.40761e-03 (3) (2.93021e-04)	4.71355e-03 (1) (2.67287e-04)	4.74364e-03 (2) (2.75509e-04)
	3	9.44091e-02 (6#) (7.95000e-03)	2.55383e-01 (8#) (2.00356e-02)	1.19151e-01 (7#) (6.28196e-03)	7.79232e-02 (5) (3.38753e-03)	7.63305e-02 (4) (2.24538e-03)	7.06722e-02 (1) (2.60391e-03)	7.37289e-02 (3) (2.34030e-03)	7.11051e-02 (2) (2.31324e-03)
	5	3.50619e-01 (2#) (9.15504e-03)	-	6.67418e-01 (7#) (6.66426e-02)	4.39298e-01 (5#) (3.07715e-02)	3.38066e-01 (1) (1.22723e-02)	3.75673e-01 (4#) (1.56469e-02)	4.67248e-01 (6#) (1.59232e-02)	3.71491e-01 (3#) (8.71249e-03)
	7	5.90602e-01 (2#) (3.42161e-02)	-	1.07700e+00 (6#) (3.81879e-02)	1.11035e+00 (7#) (9.05248e-02)	5.21465e-01 (1) (1.12538e-02)	6.44397e-01 (4#) (1.37428e-02)	8.92192e-01 (5#) (3.60231e-02)	6.19745e-01 (3#) (1.40201e-02)
WFG8	2	5.35561e-02 (7#) (7.44950e-03)	5.65702e-02 (8#) (1.82343e-02)	5.23227e-02 (6#) (3.78355e-03)	1.48206e-02 (1) (2.51365e-03)	3.33310e-02 (5) (3.97900e-03)	2.28155e-02 (3) (3.38434e-03)	2.04503e-02 (2#) (4.22820e-03)	3.24452e-02 (4) (3.59709e-03)
	3	1.40378e-01 (6#) (1.52570e-02)	3.09845e-01 (8#) (1.82432e-02)	1.88386e-01 (7#) (9.96675e-03)	8.44870e-02 (2) (4.80519e-03)	9.67130e-02 (5) (5.14555e-03)	8.43320e-02 (1) (2.86215e-03)	9.56028e-02 (4) (3.97276e-03)	8.83244e-02 (3) (4.11321e-03)
	5	4.13877e-01 (4#) (3.92343e-02)	-	1.00104e+00 (7#) (6.25426e-02)	4.54023e-01 (5#) (2.56759e-02)	3.36953e-01 (1) (9.45307e-03)	3.95262e-01 (2#) (1.59093e-02)	5.22123e-01 (6#) (1.51474e-02)	3.98121e-01 (3#) (1.16984e-02)
	7	6.91511e-01 (2#) (3.27897e-02)	-	1.52690e+00 (7#) (3.64749e-02)	1.23075e+00 (6#) (8.39735e-02)	5.62238e-01 (1) (2.29150e-02)	7.39419e-01 (3#) (2.38599e-02)	1.11108e+00 (5#) (4.11973e-02)	7.50631e-01 (4#) (2.33754e-02)
WFG9	2	1.13067e-01 (6#) (1.84442e-04)	1.15991e-01 (8#) (4.35462e-03)	1.13620e-01 (7#) (2.53597e-04)	5.83693e-02 (1) (4.33368e-02)	6.25668e-02 (2) (5.15794e-02)	9.21063e-02 (5) (4.38689e-02)	7.30816e-02 (4#) (4.97865e-02)	6.59623e-02 (3) (5.12071e-02)
	3	1.57509e-01 (6#) (4.37601e-03)	2.06198e-01 (8#) (9.83752e-03)	1.98543e-01 (7#) (4.27423e-03)	1.41019e-01 (5) (2.43949e-02)	1.29942e-01 (4) (2.69300e-02)	1.16982e-01 (3#) (4.05882e-02)	1.16220e-01 (2#) (3.73303e-02)	1.00326e-01 (1) (3.78000e-02)
	5	3.69282e-01 (2#) (2.36482e-02)	-	8.32927e-01 (7#) (7.36333e-02)	5.17417e-01 (6) (2.93630e-02)	3.94600e-01 (3) (3.46772e-02)	3.95105e-01 (4#) (3.70609e-02)	4.84497e-01 (5#) (3.56905e-02)	3.57825e-01 (1) (2.79455e-02)
	7	6.12790e-01 (1) (4.62513e-02)	-	1.67908e+00 (7#) (1.40718e-01)	1.27222e+00 (6) (1.45708e-01)	6.45448e-01 (2) (5.11604e-02)	7.35062e-01 (4) (5.64037e-02)	9.89394e-01 (5) (5.95135e-02)	6.92868e-01 (3) (3.06725e-02)

TABLE SM-12

IGD$^+$ RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE WFG^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_\mathbb{R}$	MOACO$_\mathbb{R}$	iMOACO$_\mathbb{R}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1^{-1}	2	7.27297e-03 (5#) (6.21795e-04)	1.69760e-02 (8#) (2.66704e-02)	9.85096e-03 (7#) (6.42630e-04)	5.09105e-03 (3) (7.44020e-04)	4.60219e-03 (2) (9.63606e-05)	5.28346e-03 (4) (2.67132e-04)	4.56459e-03 (1) (1.38328e-04)	7.69000e-03 (6) (1.20153e-02)
	3	9.72023e-02 (6#) (6.29754e-03)	1.27575e-01 (7#) (5.49114e-03)	1.31343e-01 (8#) (5.23670e-03)	5.10945e-02 (3) (5.62447e-03)	5.03974e-02 (2) (9.73031e-04)	4.50444e-02 (1) (7.83365e-04)	5.32949e-02 (4) (1.87916e-03)	5.67683e-02 (5) (5.40837e-02)
	5	2.44127e-01 (4#) (1.79370e-02)	-	4.04816e-01 (6#) (3.34839e-03)	1.78643e-01 (1) (5.21514e-03)	2.18192e-01 (2) (5.74895e-02)	2.26468e-01 (3#) (1.14827e-01)	3.56979e-01 (5#) (1.54200e-02)	4.62000e-01 (7) (1.23898e-01)
	7	3.61000e-01 (3#) (2.11847e-02)	-	1.35457e+00 (7#) (3.74757e-02)	2.96142e-01 (1) (5.92697e-03)	3.84102e-01 (4) (3.04288e-02)	3.14546e-01 (2) (4.54448e-02)	6.98315e-01 (5) (2.26959e-02)	9.79659e-01 (6) (1.82786e-01)
WFG2^{-1}	2	6.54106e-03 (7#) (2.28226e-03)	3.40994e-03 (6#) (4.20104e-04)	8.17001e-03 (8#) (1.85120e-02)	1.76206e-03 (4) (1.97768e-04)	1.92689e-03 (5) (1.83418e-04)	1.53438e-03 (1) (8.32951e-05)	1.59184e-03 (2#) (8.42342e-05)	1.60708e-03 (3) (7.34263e-05)
	3	4.98270e-02 (6#) (4.84760e-03)	9.68994e-02 (8#) (1.15802e-02)	9.16995e-02 (7#) (4.11680e-02)	3.45155e-02 (3) (2.33248e-03)	3.43296e-02 (2) (1.04217e-03)	3.09401e-02 (1) (8.32166e-04)	3.99300e-02 (5) (3.97981e-03)	3.63694e-02 (4) (1.79107e-03)
	5	1.89542e-01 (3#) (5.05716e-03)	-	5.74645e-01 (7#) (2.64758e-02)	1.67502e-01 (2) (9.79544e-03)	2.26887e-01 (4) (5.06367e-02)	1.50995e-01 (1) (3.23883e-02)	5.34533e-01 (6#) (5.82250e-02)	3.77224e-01 (5) (1.98222e-02)
	7	3.50844e-01 (2#) (1.09036e-02)	-	1.11104e+00 (6#) (1.78684e-01)	2.95499e-01 (1) (8.71110e-03)	4.94894e-01 (4) (8.92513e-02)	3.78279e-01 (3) (1.32171e-01)	1.21565e+00 (7) (6.23615e-02)	8.74914e-01 (5) (9.47981e-02)
WFG3^{-1}	2	1.83607e-02 (6#) (3.26951e-03)	2.80943e-02 (7#) (2.21423e-02)	6.02249e-02 (8#) (4.22792e-02)	8.16876e-03 (5) (1.07708e-03)	6.68382e-03 (3) (3.19987e-04)	7.03950e-03 (4) (3.79607e-04)	6.01684e-03 (2) (1.73180e-04)	5.99932e-03 (1) (2.12716e-04)
	3	9.83678e-02 (6#) (1.01701e-02)	2.69516e-01 (8#) (1.78086e-02)	2.58098e-01 (7#) (2.77325e-02)	8.67989e-02 (3) (2.55890e-03)	9.08871e-02 (5) (2.00941e-03)	8.86569e-02 (4#) (2.17052e-03)	8.42146e-02 (2#) (1.87743e-03)	8.19101e-02 (1) (1.45370e-03)
	5	3.91589e-01 (3#) (7.25966e-03)	-	8.35862e-01 (7#) (1.26253e-02)	3.87170e-01 (2) (1.07981e-02)	4.20321e-01 (4) (2.94825e-02)	5.04984e-01 (6#) (2.23223e-02)	4.35304e-01 (5#) (1.09315e-02)	3.81291e-01 (1) (7.40547e-03)
	7	6.46402e-01 (1) (7.69627e-03)	-	1.54741e+00 (7#) (4.93684e-02)	6.78247e-01 (2) (1.36040e-02)	7.86938e-01 (3) (7.67672e-02)	9.57171e-01 (6) (1.30050e-01)	8.94117e-01 (5) (1.87977e-02)	8.63451e-01 (4) (7.37984e-02)
WFG4^{-1}	2	4.28443e-03 (1) (1.29510e-04)	1.14106e-02 (7#) (3.99885e-03)	1.31911e-02 (8#) (1.69131e-02)	4.52833e-03 (4) (2.41272e-04)	6.37836e-03 (6) (3.04917e-04)	6.27224e-03 (5) (6.69671e-04)	4.37213e-03 (2) (2.31780e-04)	4.45565e-03 (3) (1.74289e-04)
	3	8.60459e-02 (4#) (3.11191e-03)	2.47887e-01 (8#) (1.70954e-02)	1.89832e-01 (7#) (1.70662e-02)	8.08388e-02 (2) (2.43305e-03)	9.71000e-02 (6) (2.72887e-03)	9.41348e-02 (5) (4.36454e-03)	7.92491e-02 (1) (2.39907e-03)	8.17375e-02 (3) (2.30442e-03)
	5	5.17829e-01 (4#) (1.12073e-02)	-	1.21013e+00 (7#) (2.66129e-02)	5.35304e-01 (6) (1.48346e-02)	5.27350e-01 (5) (1.68316e-02)	4.84809e-01 (3#) (2.16443e-02)	4.69745e-01 (2#) (1.12437e-02)	4.63062e-01 (1) (1.10111e-02)
	7	1.00498e+00 (5#) (1.11640e-02)	-	1.83447e+00 (7#) (4.20926e-02)	1.14251e+00 (6#) (2.48996e-02)	9.92015e-01 (4) (2.38365e-02)	8.72742e-01 (1) (1.49309e-02)	9.30191e-01 (3#) (1.65694e-02)	8.85247e-01 (2) (2.13276e-02)
WFG5^{-1}	2	1.69489e-02 (7#) (2.51640e-03)	1.75026e-02 (8#) (2.44797e-03)	1.18660e-02 (6#) (5.59413e-04)	6.84931e-03 (4) (4.12666e-04)	8.08325e-03 (5) (4.61234e-04)	6.75513e-03 (3) (7.54696e-04)	4.43710e-03 (1) (2.12776e-04)	4.77261e-03 (2) (1.89849e-04)
	3	1.01687e-01 (6#) (7.78048e-03)	2.73409e-01 (8#) (1.40727e-02)	1.48059e-01 (7#) (5.69448e-03)	7.91980e-02 (2) (2.06036e-03)	9.50225e-02 (4) (1.48573e-03)	9.73226e-02 (5) (4.56858e-03)	7.82819e-02 (1) (2.37808e-03)	8.01843e-02 (3) (2.03733e-03)
	5	5.24799e-01 (6#) (1.49725e-02)	-	1.01773e+00 (7#) (1.86722e-02)	4.54402e-01 (3) (7.68853e-03)	4.55757e-01 (4) (9.26911e-03)	4.81526e-01 (5) (2.31037e-02)	4.36083e-01 (1) (7.33598e-03)	4.49979e-01 (2) (9.12930e-03)
	7	1.13774e+00 (6#) (3.80338e-02)	-	1.62068e+00 (7#) (2.87042e-02)	9.11393e-01 (5#) (1.52538e-02)	8.60011e-01 (4) (1.44736e-02)	8.53560e-01 (3#) (1.46694e-02)	8.43167e-01 (2#) (1.21076e-02)	8.40382e-01 (1) (1.79637e-02)
WFG6^{-1}	2	8.71776e-03 (6#) (2.10006e-03)	2.97698e-02 (7#) (1.79582e-02)	5.73200e-02 (8#) (2.03063e-02)	7.99382e-03 (5) (3.86709e-03)	7.12615e-03 (3) (1.12402e-03)	7.52714e-03 (4) (1.96140e-03)	4.91735e-03 (1) (2.28642e-03)	5.84111e-03 (2) (3.45338e-03)
	3	8.20304e-02 (4#) (4.11845e-03)	2.54636e-01 (8#) (1.53948e-02)	2.26635e-01 (7#) (7.64555e-03)	7.85195e-02 (1) (1.79137e-03)	9.84583e-02 (6) (2.11731e-03)	9.38976e-02 (5#) (5.70311e-03)	8.02451e-02 (3#) (3.26287e-03)	7.96662e-02 (2#) (2.24438e-03)
	5	5.14087e-01 (6#) (1.31948e-02)	-	1.08342e+00 (7#) (1.41654e-02)	4.70380e-01 (2) (7.55509e-03)	4.80618e-01 (4) (9.61345e-03)	4.82050e-01 (5#) (1.53884e-02)	4.72651e-01 (3#) (1.04681e-02)	4.69878e-01 (1) (7.92077e-03)
	7	1.06953e+00 (6#) (1.46038e-02)	-	1.63688e+00 (7#) (2.09789e-02)	9.29980e-01 (5#) (1.35017e-02)	9.18515e-01 (4) (1.86761e-02)	9.05242e-01 (2#) (1.56829e-02)	9.12927e-01 (3#) (1.47204e-02)	9.00446e-01 (1) (2.01674e-02)
WFG7^{-1}	2	4.47351e-03 (2#) (1.68597e-04)	1.21267e-02 (8#) (7.68513e-03)	8.83197e-03 (7#) (2.15291e-03)	4.82452e-03 (4) (1.64032e-04)	7.14537e-03 (6) (2.91587e-04)	6.32648e-03 (5) (5.83078e-04)	4.40758e-03 (1) (1.66469e-04)	4.70343e-03 (3) (3.92470e-04)
	3	8.72974e-02 (4#) (4.37887e-03)	1.84197e-01 (8#) (1.73431e-02)	1.59847e-01 (7#) (1.45667e-02)	8.63247e-02 (3) (3.65868e-03)	1.04873e-01 (6) (3.02701e-03)	9.52815e-02 (5) (6.09143e-03)	8.08427e-02 (1) (2.47442e-03)	8.15083e-02 (2) (2.63627e-03)
	5	5.24929e-01 (5#) (1.21810e-02)	-	1.14152e+00 (7#) (2.09818e-02)	5.41811e-01 (6) (1.47258e-02)	5.03112e-01 (4) (1.18509e-02)	4.94290e-01 (3#) (3.52857e-02)	4.69129e-01 (2#) (8.62751e-03)	4.65795e-01 (1) (1.05265e-02)
	7	1.02748e+00 (5#) (1.03076e-02)	-	1.74222e+00 (7#) (2.69975e-02)	1.10332e+00 (6#) (2.71669e-02)	9.48258e-01 (4) (2.62230e-02)	8.95609e-01 (1) (1.83496e-02)	9.18033e-01 (3#) (1.12880e-02)	8.96820e-01 (2) (1.74817e-02)
WFG8^{-1}	2	4.38800e-03 (1) (9.96867e-05)	2.88872e-02 (8#) (9.98725e-02)	1.02971e-02 (7#) (1.17926e-03)	4.47744e-03 (2) (2.57603e-04)	7.66467e-03 (5) (1.34382e-03)	7.55467e-03 (4) (1.71539e-03)	5.15349e-03 (3) (1.46569e-03)	7.72128e-03 (6) (6.38834e-03)
	3	8.69538e-02 (4#) (2.49518e-03)	1.70769e-01 (8#) (7.80888e-03)	1.41270e-01 (7#) (4.06551e-03)	7.58755e-02 (1) (1.44512e-03)	9.60262e-02 (6) (1.31735e-03)	9.48946e-02 (5#) (4.96184e-03)	7.93001e-02 (2#) (2.03306e-03)	8.07936e-02 (3#) (2.18293e-03)
	5	5.21327e-01 (6#) (8.86517e-03)	-	1.01214e+00 (7#) (1.06418e-02)	4.67034e-01 (1) (8.30310e-03)	4.87523e-01 (4) (1.25279e-02)	4.97338e-01 (5#) (3.53171e-02)	4.69184e-01 (3#) (1.10237e-02)	4.68407e-01 (2) (1.33810e-02)
	7	1.03661e+00 (6#) (1.37261e-02)	-	1.53415e+00 (7#) (1.93759e-02)	9.19605e-01 (4#) (1.43972e-02)	9.10396e-01 (3) (1.42857e-02)	9.24470e-01 (5) (2.07715e-02)	9.02270e-01 (1) (1.28335e-02)	9.05823e-01 (2) (1.66686e-02)
WFG9^{-1}	2	8.10933e-03 (3#) (2.11264e-03)	1.41594e-02 (8#) (2.67428e-03)	1.16364e-02 (7#) (6.01687e-04)	8.98225e-03 (5) (1.70385e-03)	1.00394e-02 (6) (2.26073e-03)	8.22459e-03 (4) (2.04995e-03)	6.19408e-03 (1) (1.18715e-03)	6.99500e-03 (2) (1.51496e-03)
	3	9.80068e-02 (5#) (6.43279e-03)	1.52754e-01 (8#) (6.84361e-03)	1.29595e-01 (7#) (5.35943e-03)	9.77263e-02 (4) (7.47804e-03)	1.15636e-01 (6) (8.93729e-03)	9.05823e-02 (3#) (4.03782e-03)	8.10735e-02 (2) (3.75894e-03)	7.93126e-02 (1) (2.88182e-03)
	5	5.20397e-01 (4#) (1.04247e-02)	-	8.89945e-01 (7#) (1.62623e-02)	5.41728e-01 (6) (1.95700e-02)	5.34719e-01 (5) (2.58205e-02)	4.42093e-01 (2#) (1.45092e-02)	4.44385e-01 (3#) (9.18090e-03)	4.32043e-01 (1) (7.79390e-03)
	7	1.06475e+00 (6#) (1.48484e-02)	-	1.43914e+00 (7#) (2.39696e-02)	1.02081e+00 (5#) (2.32884e-02)	9.43596e-01 (4) (3.48020e-02)	8.72889e-01 (2#) (1.98547e-02)	8.97311e-01 (3#) (2.32455e-02)	8.46531e-01 (1) (1.57428e-02)

III. Riesz s-energy Results

This section presents the complete E_s results. Tables SM-13-SM-18 show a comparison of the E_s indicator of the PFAs generated by GI-MOACO$_{\mathbb{R}}$, MOACO$_{\mathbb{R}}$ [4], iMOACO$_{\mathbb{R}}$ [3], AdaW [9], AR-MOEA [11], SPEA2+SDE [7], RVEA-iGNG [10], and Two_Arch2 [15].

TABLE SM-13

Riesz s-energy results for the compared Multi-objective algorithms on the IMOP problems. We show the mean and standard deviation (in parentheses). The two best values are shown in gray scale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
IMOP1	2	3.91363e+09 (3) (1.88087e+09)	6.45669e+12 (6) (3.53327e+13)	3.90008e+15 (7) (2.12143e+16)	4.55891e+22 (8#) (1.79412e+23)	4.57286e+10 (5) (5.38975e+10)	4.55682e+10 (4#) (7.02081e+09)	3.01541e+08 (1) (7.76497e+07)	2.87465e+09 (2) (3.29710e+08)
IMOP2	2	1.24550e+09 (1) (1.27602e+08)	1.80632e+15 (5) (9.89278e+15)	2.23152e+24 (8) (7.91822e+24)	9.44539e+15 (6#) (4.56027e+16)	1.05378e+20 (7) (4.16038e+20)	3.14585e+09 (2#) (3.62712e+08)	3.61488e+11 (4#) (5.27401e+11)	1.98536e+10 (3#) (4.09193e+10)
IMOP3	2	1.89789e+10 (4) (1.07694e+10)	2.30419e+12 (5) (1.23756e+13)	4.79505e+19 (8) (1.71251e+20)	1.01148e+17 (7#) (3.79096e+17)	1.84715e+14 (6) (9.77046e+14)	8.35097e+09 (2#) (2.98742e+09)	1.44578e+09 (1) (2.88173e+08)	9.54863e+09 (3) (1.54386e+10)
IMOP4	3	8.61273e+10 (2) (1.41713e+10)	3.39719e+13 (4) (9.78585e+13)	5.88234e+30 (8) (2.88884e+31)	1.40413e+16 (6) (6.63777e+16)	7.25887e+18 (7) (3.97578e+19)	1.16682e+10 (1) (2.00568e+09)	8.95246e+13 (5) (4.82473e+14)	3.75174e+11 (3) (2.04000e+12)
IMOP5	3	3.37975e+08 (4) (4.60278e+07)	1.74857e+09 (5) (5.23284e+08)	4.27390e+17 (6) (1.62209e+18)	3.95967e+18 (7) (1.49970e+19)	2.13471e+23 (8) (6.51017e+23)	5.88032e+07 (3#) (6.20274e+06)	3.88630e+07 (2#) (3.37669e+06)	3.70815e+07 (1) (2.19832e+06)
IMOP6	3	6.59648e+07 (2) (9.96961e+06)	2.09737e+08 (4) (9.32598e+07)	7.19363e+21 (7) (3.33320e+22)	5.20183e+09 (5) (2.82627e+10)	1.00000e+99 (8) (1.00000e+99)	2.03863e+10 (6) (6.21613e+10)	5.11682e+07 (1) (8.52932e+06)	1.38078e+08 (3) (5.91674e+08)
IMOP7	3	9.75968e+08 (1) (2.93551e+08)	2.00942e+09 (2) (1.36129e+09)	8.57121e+31 (5) (4.19484e+32)	1.22613e+68 (6#) (6.71581e+68)	2.01070e+160 (8) (1.00000e+99)	9.74255e+15 (4#) (1.41593e+16)	4.02145e+138 (7#) (2.20264e+139)	3.68321e+10 (3#) (1.36135e+11)
IMOP8	3	2.64331e+07 (1) (7.68642e+06)	1.68161e+08 (4) (9.35711e+07)	3.74611e+19 (6) (1.48060e+20)	8.45520e+129 (8#) (4.63110e+130)	6.48796e+97 (7) (3.55360e+98)	4.61890e+07 (3#) (1.55982e+07)	4.49805e+07 (2#) (1.81704e+08)	1.25032e+11 (5#) (4.52190e+11)

TABLE SM-14

Riesz s-energy results for the compared Multi-objective algorithms on the VIE problems. We show the mean and standard deviation (in parentheses). The two best values are shown in gray scale, where the darker tone corresponds to the best one. The rank for each value is shown in parentheses between the mean and the standard deviation. The symbol # is placed where the best ranked value performs better in a statistically significant way than the rest of the values.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
VIE1	3	2.55441e+07 (1) (2.22746e+06)	6.24890e+07 (3) (9.59962e+06)	7.71404e+13 (7) (4.02147e+14)	1.90289e+09 (5#) (4.35038e+09)	3.14378e+16 (8) (1.19714e+17)	2.98665e+08 (4#) (3.62862e+07)	1.14562e+11 (6#) (5.92101e+11)	5.83841e+07 (2#) (1.00973e+08)
VIE2	3	2.78852e+09 (1) (1.91230e+08)	4.27984e+09 (3) (1.66428e+09)	7.51282e+14 (7) (2.89561e+15)	1.42638e+13 (6#) (7.76482e+13)	1.16306e+16 (8) (3.46011e+16)	7.24826e+10 (5#) (1.17661e+10)	1.19294e+10 (4#) (5.21648e+10)	3.57060e+09 (2#) (5.50923e+08)
VIE3	3	5.29317e+09 (2) (1.76968e+09)	1.94138e+10 (4) (3.89887e+09)	4.52383e+17 (7) (1.11305e+18)	5.14406e+16 (6) (2.81633e+17)	5.19956e+20 (8) (2.81541e+21)	1.27920e+11 (5) (2.28127e+10)	2.96582e+09 (1) (4.62531e+08)	1.62904e+10 (3) (4.78198e+09)

TABLE SM-15

RIESZ S-ENERGY RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1	2	7.33047e+15 (4#) (5.93935e+14)	7.64451e+10 (1) (1.35241e+11)	6.81165e+14 (2#) (3.11046e+15)	8.67910e+15 (7#) (3.53980e+14)	6.87368e+15 (3#) (1.15236e+14)	1.23854e+16 (8#) (7.57170e+14)	8.39109e+15 (5#) (9.88488e+14)	8.48007e+15 (6#) (2.20747e+14)
	3	6.65664e+17 (4#) (1.42704e+17)	1.36606e+13 (1) (4.99465e+13)	3.04898e+17 (2#) (1.08724e+18)	9.01836e+17 (5#) (3.15265e+16)	6.62507e+17 (3#) (3.69411e+15)	1.57594e+18 (7#) (1.42736e+17)	1.56535e+18 (6#) (2.00466e+17)	3.23787e+20 (8#) (1.21506e+21)
	5	1.78117e+23 (2#) (1.00783e+23)	-	8.08886e+21 (1) (4.35975e+22)	2.18187e+31 (7#) (1.18172e+32)	1.96779e+23 (3#) (1.64193e+22)	1.54218e+24 (4#) (1.72913e+23)	2.68245e+24 (5#) (5.80020e+23)	2.08478e+25 (6#) (1.06649e+26)
	7	1.10841e+29 (1) (1.84796e+29)	-	1.49321e+45 (6) (8.17865e+45)	2.52994e+56 (7#) (1.38569e+57)	1.01408e+42 (5#) (5.55435e+42)	1.23895e+31 (2#) (1.75275e+30)	6.36568e+31 (3#) (1.87866e+31)	6.71707e+41 (4#) (3.67909e+42)
DTLZ2	2	1.42141e+08 (1) (1.09466e+06)	8.12712e+09 (8) (3.99488e+10)	1.66889e+08 (4) (2.50938e+06)	1.52138e+08 (2#) (3.55760e+06)	1.71360e+08 (5) (7.40194e+06)	6.71233e+08 (7#) (7.04020e+07)	1.82895e+08 (6#) (1.76233e+06)	1.54951e+08 (3#) (3.87784e+06)
	3	4.51388e+06 (2) (1.56289e+05)	1.54857e+07 (4) (2.92895e+06)	5.07419e+07 (7) (1.74206e+08)	4.29042e+06 (1) (9.76957e+04)	4.84593e+06 (3) (1.18085e+05)	2.02870e+07 (6#) (1.96413e+06)	1.73752e+70 (8#) (9.51679e+70)	1.56671e+07 (5#) (3.04212e+07)
	5	5.55996e+06 (2) (7.06875e+05)	-	1.27897e+17 (6) (6.65062e+17)	3.89896e+06 (1) (1.98562e+05)	6.27231e+06 (3) (1.88243e+05)	2.65805e+07 (4) (7.32664e+06)	2.33200e+24 (7) (9.62123e+24)	2.05173e+12 (5) (1.12378e+13)
	7	5.63112e+10 (3) (7.85708e+10)	-	7.69373e+42 (7) (4.21398e+43)	9.78331e+33 (6#) (5.35854e+34)	7.76011e+09 (1) (4.21284e+08)	4.10787e+10 (2#) (1.81600e+10)	5.57039e+27 (5#) (2.98498e+28)	7.01583e+22 (4#) (3.23745e+23)
DTLZ3	2	2.10133e+16 (3#) (8.39373e+15)	4.77976e+11 (1) (1.49737e+12)	9.45997e+15 (2#) (4.60531e+16)	1.15421e+71 (8#) (5.17068e+71)	4.79148e+22 (7#) (2.55105e+23)	9.62169e+21 (6#) (5.26988e+22)	8.98166e+20 (5#) (4.68747e+21)	2.99323e+17 (4#) (6.26171e+17)
	3	1.94687e+17 (1) (1.89963e+17)	8.53275e+17 (2) (3.47134e+18)	1.31311e+19 (4) (5.98578e+19)	1.60610e+38 (8#) (8.79697e+38)	6.04128e+24 (6) (3.30825e+25)	5.74105e+18 (3#) (6.78874e+17)	5.83272e+26 (7#) (1.94403e+27)	2.00658e+20 (5#) (8.74841e+20)
	5	4.99422e+27 (4#) (2.59963e+28)	-	3.22205e+23 (1) (1.73765e+24)	8.92814e+141 (7#) (4.61136e+142)	5.41326e+23 (2#) (6.48378e+23)	2.35590e+24 (3#) (1.50164e+24)	1.27330e+39 (6#) (6.97400e+39)	2.45427e+30 (5#) (1.31511e+31)
	7	6.29774e+33 (3) (3.44892e+34)	-	1.54610e+32 (2) (6.37542e+32)	6.29509e+288 (7#) (1.00000e+99)	5.78340e+282 (6) (1.00000e+99)	4.04047e+31 (1) (1.65190e+31)	1.62870e+157 (5#) (1.00000e+99)	7.36960e+42 (4) (4.03649e+43)
DTLZ4	2	1.45310e+08 (3) (1.46575e+06)	2.65602e+09 (5) (1.02738e+10)	4.36459e+08 (4) (1.08160e+09)	1.30929e+46 (6#) (7.17127e+46)	1.00000e+99 (7#) (1.00000e+99)	1.00000e+99 (8#) (1.00000e+99)	1.34263e+08 (2) (8.23695e+07)	9.97869e+07 (1) (7.73430e+07)
	3	1.52329e+07 (1) (1.74161e+06)	3.91366e+10 (2) (1.78957e+11)	2.17579e+14 (5) (1.19170e+15)	1.00000e+99 (7#) (1.00000e+99)	1.00000e+99 (8) (1.00000e+99)	5.11743e+10 (3#) (1.33863e+11)	2.20510e+65 (6#) (8.35234e+65)	1.44343e+14 (4#) (7.53254e+14)
	5	1.19187e+07 (3) (9.45182e+06)	-	1.84806e+28 (6) (7.94992e+28)	2.20563e+06 (1) (1.19470e+05)	4.53916e+06 (2) (5.65019e+06)	5.05142e+07 (4) (7.85115e+07)	1.00000e+100 (7) (1.00000e+100)	1.19352e+14 (5) (6.41595e+14)
	7	4.97493e+11 (3) (9.24661e+11)	-	1.23201e+53 (6) (6.74789e+53)	1.05726e+130 (7#) (5.79087e+130)	2.25945e+09 (1) (3.26859e+07)	1.39718e+10 (2#) (4.78467e+09)	3.38033e+25 (5#) (1.24587e+26)	7.22742e+24 (4#) (3.95862e+25)
DTLZ5	2	1.42141e+08 (1) (1.09466e+06)	8.12712e+09 (8) (3.99488e+10)	1.66889e+08 (4) (2.50938e+06)	1.52138e+08 (2#) (3.55760e+06)	1.71360e+08 (5) (7.40194e+06)	6.71233e+08 (7#) (7.04020e+07)	1.82895e+08 (6#) (1.76233e+06)	1.54951e+08 (3#) (3.87784e+06)
	3	5.50299e+09 (1) (2.09561e+08)	3.18239e+11 (4) (1.01410e+12)	3.00456e+31 (8) (1.61811e+32)	2.46926e+10 (2#) (3.49384e+10)	4.28498e+21 (7) (2.33551e+22)	5.27915e+10 (3#) (7.44821e+09)	9.24580e+12 (5#) (1.34783e+13)	1.70042e+18 (6#) (9.30036e+18)
	5	1.09181e+11 (2) (1.37349e+11)	-	1.07101e+36 (6) (5.85155e+36)	2.75653e+29 (5) (1.50981e+30)	1.05255e+128 (7) (5.76381e+128)	2.00610e+11 (3#) (1.24788e+11)	2.63140e+18 (4#) (8.88468e+18)	1.97293e+09 (1) (4.70636e+09)
	7	5.99925e+13 (2) (1.01730e+14)	-	2.08109e+50 (5) (1.13986e+51)	3.88289e+31 (4#) (2.12663e+32)	1.63271e+170 (7) (1.00000e+99)	6.13043e+13 (3#) (2.29880e+13)	6.36950e+142 (6#) (3.48872e+143)	2.25623e+11 (1) (2.51234e+11)
DTLZ6	2	1.35684e+09 (1) (6.87202e+06)	2.38742e+12 (7) (9.93791e+12)	2.80106e+13 (8) (7.59485e+13)	1.47545e+09 (2#) (3.85203e+07)	1.58203e+09 (4) (5.05091e+06)	6.48650e+09 (6#) (6.53065e+08)	1.70530e+09 (5#) (2.72895e+07)	1.48647e+09 (3#) (3.88537e+07)
	3	6.51971e+11 (2) (1.49979e+10)	4.61167e+17 (8) (2.52312e+18)	3.09164e+17 (7) (1.43541e+18)	7.36974e+11 (4) (3.55801e+11)	6.11647e+14 (6) (3.12721e+15)	5.10393e+12 (5#) (8.41879e+11)	6.92757e+11 (3#) (1.02964e+10)	5.17626e+11 (1) (4.82153e+10)
	5	2.28969e+16 (3) (3.21563e+16)	-	8.80748e+40 (6) (4.82405e+41)	3.81554e+114 (7) (2.08986e+115)	1.26722e+35 (5) (6.46104e+35)	4.63314e+13 (2#) (2.92863e+13)	1.39678e+22 (4#) (4.66938e+22)	2.68852e+13 (1) (1.46496e+14)
	7	3.61668e+18 (3) (1.02546e+19)	-	7.15889e+41 (5) (2.84285e+42)	6.00566e+139 (7#) (2.56003e+140)	8.67133e+59 (6) (4.74948e+60)	4.11162e+16 (2#) (1.69878e+16)	1.31896e+29 (4#) (7.09963e+29)	7.55810e+13 (1) (4.07681e+13)
DTLZ7	2	5.04017e+08 (1) (8.59814e+06)	1.30966e+11 (7) (7.10000e+11)	1.86716e+17 (8) (1.02249e+18)	6.60307e+08 (2#) (7.36252e+08)	6.05557e+09 (6) (1.36812e+10)	1.55321e+09 (3#) (1.66896e+08)	1.74799e+09 (5#) (3.55153e+09)	1.56018e+09 (4#) (3.54029e+09)
	3	2.08226e+07 (1) (1.16896e+06)	7.69966e+07 (3) (1.61812e+07)	1.60024e+18 (8) (6.34866e+18)	1.86814e+10 (5#) (9.40561e+10)	1.51508e+18 (7) (2.51718e+18)	1.31673e+08 (4#) (9.21300e+07)	6.23848e+07 (2#) (7.49247e+07)	9.75500e+10 (6#) (2.90632e+11)
	5	1.24165e+06 (1) (1.17058e+05)	-	5.79568e+30 (7) (3.16683e+31)	2.34621e+23 (5#) (1.28506e+24)	3.44039e+28 (6) (1.03806e+29)	6.41706e+07 (3#) (8.37932e+07)	1.21738e+07 (2#) (1.44645e+07)	1.01305e+12 (4#) (5.54842e+12)
	7	4.63559e+06 (1) (1.16046e+06)	-	3.30751e+34 (6) (1.64443e+35)	1.13652e+34 (5#) (4.32516e+34)	5.79508e+44 (7#) (3.17407e+45)	3.64604e+07 (2#) (8.12182e+06)	3.85977e+07 (3#) (2.27241e+07)	8.26655e+14 (4#) (4.52429e+15)

TABLE SM-16

RIESZ S-ENERGY RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE DTLZ^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
DTLZ1^{-1}	2	2.09191e+08 (3#) (3.26938e+06)	5.09095e+11 (7) (2.64076e+12)	2.41459e+11 (6) (5.95411e+11)	1.11738e+16 (8#) (6.12013e+16)	1.70878e+08 (1) (1.25020e+06)	3.12408e+08 (5#) (1.61102e+07)	1.95582e+08 (2#) (4.17603e+05)	2.11145e+08 (4#) (4.31500e+06)
	3	9.74784e+06 (1) (2.57928e+05)	1.78096e+07 (5) (1.49332e+06)	3.52113e+15 (7) (1.90177e+16)	1.12497e+07 (2#) (8.20474e+05)	1.53860e+17 (8) (8.42329e+17)	1.54913e+07 (4#) (1.04992e+06)	1.42765e+07 (3#) (7.80532e+05)	2.36375e+07 (6#) (7.14952e+07)
	5	1.07945e+07 (1) (6.87256e+05)	-	2.89525e+29 (6) (1.58579e+30)	6.98910e+07 (3#) (2.40567e+08)	4.04737e+44 (7) (2.16702e+45)	1.29413e+07 (2#) (1.10768e+06)	3.37538e+20 (5#) (1.76145e+21)	3.25587e+09 (4#) (1.77714e+10)
	7	4.21649e+08 (2) (3.33846e+07)	-	2.07145e+15 (5) (8.92426e+15)	1.80798e+12 (4#) (9.22570e+12)	1.88466e+93 (7) (7.76546e+93)	1.39725e+08 (1) (1.19252e+07)	4.42389e+27 (6#) (2.42306e+28)	1.08007e+09 (3) (8.54743e+08)
DTLZ2^{-1}	2	2.09352e+08 (3) (4.65686e+06)	2.33168e+09 (7) (7.86487e+09)	4.98265e+09 (8) (1.65743e+10)	3.71144e+08 (4#) (8.90213e+08)	4.52283e+08 (5) (4.22717e+06)	7.04174e+08 (6#) (7.61172e+07)	1.79206e+08 (2) (3.21712e+06)	1.69601e+08 (1) (6.28516e+06)
	3	3.73351e+06 (1) (9.28653e+04)	1.66727e+07 (4) (2.13196e+06)	4.53820e+19 (8) (2.14156e+20)	1.12191e+07 (3#) (4.17213e+07)	1.09616e+07 (2) (4.17907e+05)	2.51965e+07 (6#) (3.33098e+06)	6.27509e+15 (7#) (3.42429e+16)	2.07952e+07 (5#) (6.26229e+07)
	5	5.25059e+05 (1) (2.69794e+04)	-	2.29982e+29 (5) (1.25966e+30)	7.33433e+05 (2#) (4.44025e+04)	1.50692e+33 (6) (8.25375e+33)	1.59813e+07 (4#) (2.60141e+06)	1.22551e+38 (7#) (6.71240e+38)	1.69150e+06 (3#) (1.46527e+05)
	7	1.44033e+06 (1) (7.76311e+04)	-	1.89941e+12 (5) (8.39004e+12)	1.82155e+06 (2#) (1.74715e+05)	8.02783e+48 (7#) (4.03094e+49)	6.64915e+07 (4#) (1.18833e+07)	1.50125e+35 (6#) (8.22269e+35)	5.30464e+06 (3#) (5.71919e+05)
DTLZ3^{-1}	2	2.14268e+08 (3) (8.67827e+06)	3.79360e+10 (6) (1.22667e+11)	2.29232e+11 (7) (8.37390e+11)	7.13357e+26 (8#) (3.90722e+27)	4.65024e+08 (4) (1.40234e+07)	7.26309e+08 (5#) (7.30785e+07)	1.78466e+08 (1) (4.14568e+06)	1.82016e+08 (2) (1.98339e+07)
	3	3.78479e+06 (1) (1.20134e+05)	7.14685e+07 (4) (6.90211e+07)	1.12752e+10 (5) (5.32523e+10)	2.76140e+10 (6#) (1.29943e+11)	2.66294e+11 (7) (8.25867e+11)	2.49879e+07 (3#) (3.72132e+06)	4.81412e+16 (8#) (1.43662e+17)	6.95143e+06 (2#) (7.99500e+06)
	5	5.61152e+05 (1) (2.39879e+04)	-	3.30791e+21 (6) (1.78227e+22)	4.47949e+07 (4#) (2.32872e+08)	4.42369e+29 (7) (2.41925e+30)	1.76895e+07 (3#) (5.13564e+06)	1.85858e+21 (5#) (1.01793e+22)	1.86074e+06 (2#) (6.38565e+05)
	7	1.83636e+06 (1) (1.75530e+05)	-	2.13917e+12 (4) (6.07330e+12)	5.25822e+12 (5#) (2.88003e+13)	5.62758e+45 (7#) (3.08214e+46)	7.45462e+07 (3#) (1.45195e+07)	7.72224e+17 (6#) (4.22964e+18)	5.98940e+06 (2#) (8.23265e+05)
DTLZ4^{-1}	2	1.31022e+17 (8) (5.16656e+17)	1.22272e+10 (5) (6.11923e+10)	1.72682e+11 (6) (7.66660e+11)	2.63434e+11 (7#) (1.39947e+12)	4.51238e+08 (3) (3.89105e+06)	6.82999e+08 (4#) (6.30647e+07)	1.78285e+08 (2) (3.55657e+06)	1.70981e+08 (1) (7.92038e+06)
	3	4.72715e+06 (2) (4.72568e+05)	1.83687e+07 (5) (4.20324e+06)	2.91516e+18 (8) (1.24462e+19)	3.51106e+06 (1) (9.64812e+04)	1.33344e+11 (6) (5.07416e+11)	1.73325e+07 (4#) (2.04025e+06)	2.08809e+17 (7#) (1.09486e+18)	4.79669e+06 (3#) (8.79325e+05)
	5	9.23826e+05 (2) (1.04284e+05)	-	1.33975e+89 (7) (7.33809e+89)	6.43863e+05 (1) (2.59367e+04)	4.87738e+49 (6) (2.67106e+50)	6.41178e+06 (4) (8.79617e+05)	3.85060e+26 (5) (1.11907e+27)	2.66549e+06 (3) (7.42745e+06)
	7	2.71261e+06 (2) (2.82286e+05)	-	5.06721e+12 (5) (1.67821e+13)	1.40684e+06 (1) (2.96926e+05)	2.88820e+126 (7) (1.58193e+127)	2.50282e+07 (4) (3.71682e+06)	3.00190e+35 (6) (1.14241e+36)	3.24055e+06 (3) (3.08914e+05)
DTLZ5^{-1}	2	2.09352e+08 (3) (4.65686e+06)	2.33168e+09 (7) (7.86487e+09)	4.98265e+09 (8) (1.65743e+10)	3.71144e+08 (4#) (8.90213e+08)	4.52283e+08 (5) (4.22717e+06)	7.04174e+08 (6#) (7.61172e+07)	1.79206e+08 (2) (3.21712e+06)	1.69601e+08 (1) (6.28516e+06)
	3	6.45348e+06 (2) (1.61247e+05)	2.80462e+07 (4) (4.81597e+06)	2.20955e+17 (8) (1.17584e+18)	6.29811e+06 (1) (4.66025e+05)	3.22687e+14 (7) (1.75343e+15)	2.91356e+07 (5#) (3.17365e+06)	4.69080e+13 (6#) (2.32380e+14)	1.06750e+07 (3#) (1.27416e+07)
	5	1.60758e+06 (1) (6.46766e+04)	-	3.01427e+27 (5) (1.24331e+28)	3.21144e+06 (2#) (7.17322e+06)	7.75946e+37 (7) (4.25003e+38)	2.23724e+07 (4#) (4.58279e+06)	3.73832e+27 (6#) (8.25556e+27)	3.70955e+06 (3#) (1.06191e+06)
	7	9.70380e+06 (1) (9.86850e+05)	-	8.90936e+12 (5) (1.90126e+13)	9.97754e+09 (4#) (5.46066e+10)	8.69951e+39 (7#) (4.76467e+40)	1.24076e+08 (3#) (1.59907e+07)	3.00943e+35 (6#) (1.14246e+36)	2.94842e+07 (2#) (5.90832e+07)
DTLZ6^{-1}	2	2.10120e+08 (4) (3.45630e+06)	2.15981e+10 (8) (1.12024e+11)	4.46993e+08 (5) (4.16902e+06)	1.51948e+08 (1) (3.03972e+06)	4.48632e+08 (6) (1.31326e+06)	7.28107e+08 (7#) (6.38853e+07)	1.80221e+08 (3) (3.69991e+06)	1.67884e+08 (2) (7.04774e+06)
	3	4.23997e+06 (2) (1.10571e+05)	2.08083e+07 (4) (7.28476e+06)	2.10571e+21 (8) (1.15302e+22)	4.12285e+06 (1) (6.87536e+04)	7.98738e+11 (6) (4.37480e+12)	2.48230e+07 (5#) (3.43661e+06)	2.01489e+15 (7#) (1.06854e+16)	6.01163e+06 (3#) (3.60351e+05)
	5	7.32380e+05 (1) (3.62464e+04)	-	4.16455e+33 (6) (2.18066e+34)	8.91303e+05 (2#) (2.74372e+04)	4.44630e+41 (7) (2.43534e+42)	1.70018e+07 (4#) (3.40104e+06)	8.93358e+24 (5#) (3.05611e+25)	1.99591e+06 (3#) (1.91901e+05)
	7	2.64405e+06 (2) (1.71670e+05)	-	4.70143e+15 (5) (9.42980e+15)	2.62640e+06 (1) (8.93125e+05)	2.85812e+55 (7) (1.56546e+56)	7.37968e+07 (4) (1.21677e+07)	2.14880e+32 (6) (4.02493e+32)	1.51895e+07 (3) (4.28530e+09)
DTLZ7^{-1}	2	2.69002e+09 (2) (6.61503e+07)	3.09243e+10 (5) (1.08788e+11)	5.72101e+21 (8) (3.12199e+22)	2.18374e+11 (6#) (1.06436e+12)	6.72073e+13 (7) (3.68069e+14)	1.19241e+10 (4#) (2.56954e+09)	2.87645e+09 (3) (1.11874e+08)	2.46435e+09 (1) (9.83663e+07)
	3	1.32857e+08 (1) (4.88939e+06)	7.90536e+08 (4) (2.16839e+08)	4.21413e+25 (8) (2.29095e+26)	2.14413e+13 (6#) (4.02041e+13)	2.82710e+19 (7) (6.86328e+19)	1.37465e+09 (5#) (2.06415e+08)	3.92272e+08 (2#) (3.21925e+07)	5.45764e+08 (3#) (6.29037e+07)
	5	1.43392e+06 (1) (2.33389e+05)	-	6.52453e+39 (6) (3.47820e+40)	4.54479e+21 (5#) (9.25021e+21)	1.12784e+43 (7) (6.17713e+43)	1.73839e+09 (4#) (4.03686e+08)	1.74665e+08 (2#) (3.37026e+07)	5.14547e+08 (3#) (3.13323e+08)
	7	7.90006e+06 (1) (2.79001e+06)	-	3.43531e+43 (7) (1.88154e+44)	3.66527e+28 (5#) (2.00755e+29)	3.33862e+39 (6#) (9.22073e+39)	1.90835e+09 (2#) (2.47804e+08)	5.30410e+17 (4#) (2.90518e+18)	5.06042e+15 (3#) (2.77156e+16)

TABLE SM-17

RIESZ S-ENERGY RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE WFG PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_\mathbb{R}$	MOACO$_\mathbb{R}$	iMOACO$_\mathbb{R}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1	2	1.36449e+09 (1) (1.89385e+08)	7.71588e+11 (4) (4.21529e+12)	7.55263e+12 (6) (3.09836e+13)	9.37389e+16 (8#) (3.50748e+17)	1.75851e+16 (7) (5.95124e+16)	2.05427e+09 (2#) (1.00232e+09)	1.02428e+12 (5#) (5.14386e+12)	6.20322e+09 (3#) (1.89851e+10)
	3	9.99183e+08 (4) (2.27591e+08)	2.20890e+10 (5) (4.74752e+09)	1.42589e+18 (6) (6.05217e+18)	4.99742e+21 (8) (2.18534e+22)	1.50324e+18 (7) (6.07083e+18)	3.43223e+08 (3#) (4.92463e+07)	1.12442e+08 (2#) (1.32678e+07)	1.07801e+08 (1) (1.20857e+07)
	5	8.81807e+09 (3) (2.80335e+09)	-	6.14396e+42 (7) (3.36264e+43)	5.02551e+31 (6) (2.17462e+32)	7.73872e+27 (5) (3.25938e+28)	6.49164e+10 (4#) (3.10759e+10)	5.49453e+09 (2#) (3.11294e+09)	5.24646e+09 (1) (6.12288e+09)
	7	3.95787e+12 (1) (4.29228e+12)	-	3.74099e+55 (7) (2.04463e+56)	3.09815e+39 (6#) (1.11072e+40)	4.62286e+37 (5#) (1.96245e+38)	7.05124e+14 (2#) (3.69772e+14)	3.96101e+18 (3#) (2.16953e+19)	4.28137e+20 (4#) (2.34500e+21)
WFG2	2	6.55186e+08 (1) (1.87639e+07)	4.07537e+10 (5) (2.14873e+11)	1.75376e+14 (6) (9.54200e+14)	5.81248e+17 (8#) (3.17220e+18)	4.63728e+15 (7) (2.42968e+16)	1.29413e+10 (4#) (2.64255e+09)	1.68689e+09 (2#) (4.51583e+08)	1.91216e+09 (3#) (5.96861e+08)
	3	1.73205e+07 (1) (1.27005e+06)	2.35780e+08 (3) (1.09068e+09)	3.94977e+16 (7) (1.30918e+17)	3.54199e+18 (8#) (1.55447e+19)	1.65535e+14 (6) (7.46314e+14)	9.40594e+08 (4#) (6.30262e+08)	3.17453e+09 (5#) (1.17091e+10)	1.33159e+08 (2#) (7.96715e+07)
	5	4.90701e+08 (1) (8.96409e+07)	-	1.81346e+37 (7) (9.63644e+37)	1.85714e+27 (5#) (1.00247e+28)	5.35388e+10 (2) (2.88133e+11)	1.53061e+11 (3#) (1.99888e+11)	1.38466e+32 (6#) (7.58411e+32)	6.86049e+14 (4#) (3.75703e+15)
	7	6.55384e+12 (1) (6.89129e+12)	-	1.53169e+49 (7) (5.90285e+49)	4.69254e+31 (6#) (2.51274e+32)	7.71929e+14 (4#) (4.21540e+15)	5.13077e+14 (3#) (1.01410e+15)	3.06780e+30 (5#) (1.68030e+31)	4.10569e+14 (2#) (1.43506e+15)
WFG3	2	2.22566e+08 (3#) (2.91725e+06)	1.80916e+09 (6) (6.00893e+09)	1.18981e+11 (8) (5.79051e+11)	9.13653e+10 (7#) (3.11088e+11)	2.02821e+08 (1) (4.17713e+07)	3.27974e+08 (5#) (1.88873e+07)	2.12693e+08 (2#) (3.85164e+06)	2.30034e+08 (4#) (9.44466e+06)
	3	5.25085e+07 (1) (9.05214e+06)	1.28578e+08 (2) (2.20384e+07)	1.96506e+17 (8) (7.34325e+17)	6.07366e+11 (5#) (1.85202e+12)	6.58991e+16 (7) (2.88246e+17)	8.49489e+08 (4#) (1.95827e+08)	2.26642e+12 (6#) (6.84110e+12)	1.85737e+08 (3#) (1.07003e+08)
	5	6.53856e+07 (1) (1.55225e+07)	-	5.89156e+31 (6) (3.06022e+32)	1.62961e+16 (4#) (8.84935e+16)	1.21128e+27 (5) (6.63408e+27)	1.17615e+09 (2#) (4.10414e+08)	7.37399e+40 (7#) (2.83074e+41)	3.24210e+11 (3#) (1.76085e+12)
	7	5.39112e+09 (1) (4.56998e+09)	-	8.80941e+42 (6) (4.79572e+43)	3.94525e+20 (4#) (2.16090e+21)	5.26430e+23 (5#) (1.68177e+24)	6.72005e+10 (2#) (2.97255e+10)	1.10283e+51 (7#) (5.88545e+51)	2.76861e+20 (3#) (1.50843e+21)
WFG4	2	1.71802e+08 (1) (5.21886e+06)	1.61484e+10 (5) (8.40523e+10)	5.48012e+11 (7) (2.23017e+12)	2.07488e+11 (6#) (6.39401e+11)	1.08979e+12 (8) (3.80036e+12)	6.77969e+08 (4#) (5.89663e+07)	2.14924e+08 (2#) (4.36907e+06)	2.40268e+08 (3#) (1.55384e+07)
	3	4.20189e+06 (1) (1.34430e+05)	1.97691e+07 (2) (2.99860e+06)	2.54356e+12 (6) (1.32050e+13)	1.33571e+13 (7#) (6.04275e+13)	7.48745e+10 (5) (3.66358e+11)	2.42330e+07 (3#) (3.84701e+06)	4.88072e+20 (8#) (2.67328e+21)	3.65973e+08 (4#) (1.33067e+09)
	5	1.40427e+06 (2) (1.18765e+05)	-	3.91988e+31 (7) (2.14682e+32)	2.54926e+16 (6#) (1.39431e+17)	1.19889e+06 (1) (2.72211e+05)	1.67924e+07 (3#) (3.84136e+06)	3.05930e+15 (4#) (1.62418e+16)	6.93933e+15 (5#) (3.80078e+16)
	7	6.44987e+06 (1) (1.16848e+06)	-	1.59093e+21 (6) (7.66376e+21)	1.98235e+20 (5#) (1.08481e+21)	2.39416e+17 (4#) (1.31133e+18)	1.74594e+08 (2#) (7.03677e+07)	3.20797e+21 (7#) (1.75389e+22)	1.78924e+13 (3#) (7.98542e+13)
WFG5	2	1.68925e+08 (1) (1.66047e+07)	9.86756e+10 (5) (5.30998e+11)	1.67300e+11 (6) (4.16287e+11)	5.35239e+13 (8#) (1.60334e+14)	6.88756e+11 (7) (2.46697e+12)	5.77689e+08 (4#) (5.30860e+07)	1.89282e+08 (2#) (3.47408e+06)	2.11677e+08 (3#) (9.30672e+06)
	3	4.43179e+06 (1) (1.33406e+05)	2.75340e+07 (3) (3.97890e+06)	3.10097e+15 (8) (1.60625e+16)	7.16242e+11 (7#) (3.91916e+12)	1.02661e+11 (6) (4.08925e+11)	2.32245e+07 (2#) (4.01105e+06)	1.34327e+08 (4#) (6.26798e+08)	1.49846e+10 (5#) (6.80886e+10)
	5	2.13718e+06 (1) (2.17111e+05)	-	5.30537e+17 (6) (1.33604e+18)	2.73026e+14 (4#) (1.48119e+15)	2.88215e+18 (7) (1.57862e+19)	2.25295e+07 (2#) (5.59896e+06)	4.26404e+14 (5#) (2.32707e+15)	1.84532e+13 (3#) (9.05478e+13)
	7	9.50040e+06 (1) (2.22797e+06)	-	2.76727e+24 (7) (8.52301e+24)	1.33531e+16 (4#) (5.73863e+16)	2.51148e+19 (5#) (1.37559e+20)	2.14426e+08 (2#) (1.43666e+08)	7.21027e+22 (6#) (3.64247e+23)	2.56161e+11 (3#) (1.32833e+12)
WFG6	2	1.58579e+08 (1) (1.74771e+06)	8.24271e+09 (5) (3.94622e+10)	1.63726e+10 (6) (5.26498e+10)	2.47916e+12 (7#) (7.28697e+12)	5.74455e+14 (8) (3.11270e+15)	6.81653e+08 (4#) (6.73706e+07)	2.16367e+08 (2#) (2.04687e+07)	2.34832e+08 (3#) (3.51665e+07)
	3	4.70293e+06 (1) (1.71104e+05)	1.71284e+07 (2) (2.76565e+06)	3.06248e+16 (8) (1.66744e+17)	5.94224e+12 (7#) (2.18511e+13)	1.40070e+11 (6) (6.94572e+11)	2.81269e+07 (3#) (2.84180e+06)	5.59674e+09 (5#) (2.76480e+10)	4.98068e+07 (4#) (1.32015e+08)
	5	1.53653e+06 (2) (1.39974e+05)	-	1.49488e+34 (6) (8.11089e+34)	2.18967e+19 (5#) (1.19872e+20)	1.12216e+06 (1) (3.58625e+05)	2.97457e+07 (3#) (8.52020e+06)	1.75361e+36 (7#) (6.66936e+36)	1.35467e+12 (4#) (7.41981e+12)
	7	9.37663e+06 (2) (2.30569e+06)	-	1.06409e+46 (7) (5.82824e+46)	1.58078e+27 (5#) (8.65827e+27)	8.50518e+06 (1) (5.44887e+06)	3.71913e+08 (3#) (1.90379e+08)	1.32191e+43 (6#) (7.23984e+43)	5.83440e+17 (4#) (2.33011e+18)
WFG7	2	1.47462e+08 (1) (3.18053e+06)	2.95320e+09 (5) (1.04253e+10)	3.72178e+11 (7) (9.37763e+11)	7.82027e+11 (8#) (1.95616e+12)	9.54258e+10 (6) (5.18178e+11)	6.28906e+08 (4#) (5.56920e+07)	1.90570e+08 (2#) (2.74880e+06)	2.03928e+08 (3#) (9.50040e+06)
	3	4.37594e+06 (1) (1.58842e+05)	1.89957e+07 (3) (4.54977e+06)	7.71563e+19 (8) (4.22600e+20)	1.71383e+13 (7#) (6.60201e+13)	5.26267e+06 (2) (4.96243e+05)	2.85518e+07 (4#) (4.01716e+06)	2.08176e+12 (6#) (1.13983e+13)	1.42698e+08 (5#) (4.65047e+08)
	5	1.43145e+06 (1) (1.17370e+05)	-	4.05798e+36 (7) (2.19171e+37)	4.50526e+13 (4#) (1.58500e+14)	6.93173e+06 (2) (2.87527e+07)	2.03580e+07 (3#) (6.42286e+06)	2.14494e+16 (6#) (9.38599e+16)	5.88273e+13 (5#) (3.15217e+14)
	7	1.63609e+07 (2) (4.55809e+06)	-	6.97388e+51 (7) (3.45718e+52)	3.49778e+25 (6#) (1.88349e+26)	5.38885e+06 (1) (2.01448e+06)	1.64620e+08 (3#) (6.98713e+07)	1.76560e+24 (5#) (9.62414e+24)	4.76704e+16 (4#) (2.60406e+17)
WFG8	2	2.29622e+08 (1) (2.78092e+07)	4.68497e+09 (5) (2.39816e+10)	8.03089e+10 (6) (1.63481e+11)	4.37362e+15 (8#) (2.39184e+16)	4.38390e+11 (7) (1.17914e+12)	6.28446e+08 (4#) (7.72585e+07)	2.83718e+08 (2#) (3.49308e+07)	2.89775e+08 (3#) (2.99428e+07)
	3	5.38076e+06 (1) (3.03377e+05)	1.75617e+07 (2) (2.48984e+06)	2.50529e+12 (5) (7.57479e+12)	3.55852e+15 (7#) (1.87817e+16)	5.77237e+12 (6) (2.45846e+13)	2.65204e+07 (3#) (3.39460e+06)	3.58086e+21 (8#) (1.96124e+22)	1.35903e+11 (4#) (3.99401e+11)
	5	2.18860e+06 (1) (2.08771e+05)	-	3.12944e+37 (7) (1.60832e+38)	9.10815e+14 (4#) (3.85914e+15)	6.70188e+16 (5) (3.65087e+17)	1.48810e+07 (2#) (3.46536e+06)	7.92771e+26 (6#) (4.34218e+27)	1.26200e+13 (3#) (5.05819e+13)
	7	3.50008e+07 (1) (7.36935e+06)	-	1.26163e+52 (7) (6.91016e+52)	4.99146e+16 (4#) (2.72286e+17)	3.57780e+43 (6#) (1.95964e+44)	1.76540e+08 (2#) (6.09377e+07)	8.02276e+20 (5#) (4.35677e+21)	8.61214e+14 (3#) (3.23314e+15)
WFG9	2	1.98712e+08 (1) (2.88557e+07)	1.94739e+09 (5) (5.95482e+09)	6.25621e+11 (6) (2.12304e+12)	1.23320e+12 (7#) (4.52011e+12)	4.31810e+12 (8) (2.31934e+13)	6.73189e+08 (4#) (6.70148e+07)	2.24140e+08 (2#) (4.93256e+06)	2.45558e+08 (3#) (2.10498e+07)
	3	5.25992e+06 (1) (1.84046e+05)	1.88385e+07 (2) (2.41738e+06)	1.73041e+15 (6) (5.59435e+15)	8.56919e+21 (8#) (4.69354e+22)	2.76964e+11 (5) (1.51616e+12)	2.54759e+07 (3#) (3.71813e+06)	2.99796e+15 (7#) (1.64205e+16)	5.38398e+10 (4#) (1.74089e+11)
	5	3.14785e+06 (1) (5.46821e+05)	-	3.59211e+23 (6) (9.63661e+23)	6.54931e+10 (4#) (2.53523e+11)	6.66667e+16 (5) (3.65148e+17)	2.05981e+07 (2#) (5.48681e+06)	2.53457e+28 (7#) (1.38824e+29)	8.26932e+08 (3#) (3.61192e+09)
	7	2.08851e+07 (1) (4.96641e+06)	-	1.24975e+32 (7) (5.52223e+32)	1.62191e+15 (5#) (8.01786e+15)	2.26331e+14 (4#) (7.87376e+14)	2.44560e+08 (2#) (9.93200e+07)	1.39268e+21 (6#) (7.28111e+21)	2.13991e+11 (3#) (6.68556e+11)

TABLE SM-18

RIESZ S-ENERGY RESULTS FOR THE COMPARED MULTI-OBJECTIVE ALGORITHMS ON THE WFG^{-1} PROBLEMS. WE SHOW THE MEAN AND STANDARD DEVIATION (IN PARENTHESES). THE TWO BEST VALUES ARE SHOWN IN GRAY SCALE, WHERE THE DARKER TONE CORRESPONDS TO THE BEST ONE. THE RANK FOR EACH VALUE IS SHOWN IN PARENTHESES BETWEEN THE MEAN AND THE STANDARD DEVIATION. THE SYMBOL # IS PLACED WHERE THE BEST RANKED VALUE PERFORMS BETTER IN A STATISTICALLY SIGNIFICANT WAY THAN THE REST OF THE VALUES.

MOP	Dim	GI-MOACO$_{\mathbb{R}}$	MOACO$_{\mathbb{R}}$	iMOACO$_{\mathbb{R}}$	AdaW	AR-MOEA	SPEA2+SDE	Two_Arch2	RVEA-iGNG
WFG1^{-1}	2	3.10302e+08 (3) (4.94928e+07)	3.50523e+11 (6) (1.89062e+12)	3.01303e+12 (8) (7.94609e+12)	1.03003e+12 (7#) (2.92447e+12)	2.13585e+11 (5) (1.04248e+12)	5.94765e+08 (4#) (6.72194e+07)	1.96834e+08 (1) (2.15215e+06)	2.32685e+08 (2) (3.87530e+07)
	3	2.58983e+08 (4) (5.05686e+07)	2.37711e+10 (5) (1.97457e+10)	7.48516e+22 (8) (2.47584e+23)	6.08623e+15 (6) (3.06504e+16)	2.44387e+21 (7) (9.98537e+21)	8.32822e+07 (3) (1.28458e+07)	3.67280e+07 (1) (2.45773e+06)	3.67466e+07 (2) (1.33513e+07)
	5	2.56507e+09 (2) (6.79296e+08)	-	6.47903e+40 (7) (3.54871e+41)	2.69739e+27 (5) (1.46426e+28)	5.58088e+28 (6) (2.00801e+29)	1.96469e+09 (1) (2.21836e+09)	7.78839e+09 (4#) (2.80411e+10)	7.69651e+09 (3) (1.28720e+10)
	7	1.21367e+12 (2) (6.05700e+11)	-	2.49795e+26 (4) (6.91560e+26)	4.98716e+40 (7#) (2.73155e+41)	5.29591e+37 (6) (1.16349e+38)	2.11946e+11 (1) (7.77572e+10)	4.57842e+27 (5#) (2.50770e+28)	1.43759e+14 (3) (3.10065e+14)
WFG2^{-1}	2	6.34392e+09 (6) (1.77086e+10)	5.17168e+09 (5) (1.87048e+10)	2.11826e+11 (8) (5.64389e+11)	1.93909e+11 (7#) (9.98513e+11)	3.73409e+08 (3) (1.17107e+08)	6.21259e+08 (4#) (5.74037e+07)	3.01221e+08 (1) (4.73008e+06)	3.59853e+08 (2) (8.57151e+06)
	3	8.77144e+06 (1) (1.74364e+06)	2.86729e+07 (3) (2.26731e+07)	1.43073e+15 (8) (5.99817e+15)	6.67291e+12 (6#) (3.57794e+13)	5.92451e+13 (7) (2.17547e+14)	1.45925e+08 (4#) (4.43341e+07)	5.20862e+12 (5#) (2.85258e+13)	1.34610e+07 (2#) (2.87327e+07)
	5	3.37306e+07 (1) (3.88605e+06)	-	7.71189e+24 (6) (3.98090e+25)	2.91096e+10 (5#) (1.15810e+11)	1.27635e+25 (7) (5.90132e+25)	3.48558e+09 (4#) (1.82718e+09)	4.30419e+08 (3#) (1.06072e+08)	1.17549e+08 (2#) (1.42817e+08)
	7	6.52316e+09 (1) (1.20995e+09)	-	1.13391e+29 (6) (6.21070e+29)	7.65103e+22 (5#) (4.18819e+23)	2.04529e+36 (7#) (8.85625e+36)	1.26989e+12 (3#) (6.14095e+11)	3.65444e+19 (4#) (2.00162e+20)	1.61117e+10 (2#) (7.82195e+09)
WFG3^{-1}	2	2.46204e+08 (3#) (8.19418e+06)	1.67515e+09 (6) (4.71229e+09)	2.00046e+10 (8) (4.74395e+10)	3.19142e+09 (7#) (8.64721e+09)	2.04218e+08 (1) (3.02845e+06)	3.77441e+08 (5#) (3.28673e+07)	2.32586e+08 (2#) (5.00473e+06)	2.46580e+08 (4#) (6.21000e+06)
	3	1.30569e+07 (1) (5.99240e+05)	6.67408e+07 (4) (9.46046e+06)	2.41939e+14 (7) (7.79663e+14)	8.03009e+07 (5#) (2.72710e+08)	6.53332e+14 (8) (2.78741e+15)	3.72111e+07 (2#) (4.82255e+06)	4.26077e+07 (3#) (1.05531e+08)	6.06775e+09 (6#) (3.30195e+10)
	5	1.78645e+07 (1) (1.25207e+06)	-	1.59919e+28 (6) (8.75907e+28)	4.42458e+11 (4#) (2.42334e+12)	2.04482e+28 (7) (8.84028e+28)	3.73592e+08 (2#) (1.12156e+08)	1.18519e+15 (5#) (6.48525e+15)	3.30632e+09 (3#) (1.79301e+10)
	7	9.64006e+08 (1) (1.56806e+08)	-	4.49734e+16 (5) (1.79261e+17)	6.14155e+12 (4#) (3.25995e+13)	1.48731e+44 (7#) (8.14634e+44)	3.20280e+10 (3#) (2.65430e+10)	6.62175e+21 (6#) (3.62566e+22)	1.10886e+10 (2#) (1.14770e+10)
WFG4^{-1}	2	2.32284e+08 (2) (7.91905e+06)	4.92172e+09 (6) (1.81932e+10)	2.21598e+11 (7) (1.02200e+12)	8.90983e+12 (8#) (3.38544e+13)	6.33166e+08 (4) (5.57015e+08)	6.95581e+08 (5#) (6.85887e+07)	2.06400e+08 (1) (1.15937e+07)	2.40584e+08 (3) (1.35103e+07)
	3	4.75905e+06 (1) (1.39504e+05)	2.44254e+07 (4) (4.27383e+06)	1.90545e+12 (7) (7.73687e+12)	3.83317e+10 (6#) (2.09918e+11)	6.46641e+16 (8) (3.35439e+17)	3.63980e+07 (5#) (5.75801e+06)	1.04790e+07 (3#) (8.69192e+06)	8.81538e+06 (2#) (9.22695e+05)
	5	9.61828e+05 (1) (5.09655e+04)	-	2.07685e+17 (6) (1.12674e+18)	2.03305e+06 (2#) (5.96028e+05)	3.87842e+21 (7) (1.48745e+22)	7.10624e+07 (4#) (1.62002e+07)	5.45637e+06 (3#) (1.21134e+06)	2.37770e+11 (5#) (1.30229e+12)
	7	3.10040e+06 (1) (2.58061e+05)	-	2.92247e+13 (6) (1.23712e+14)	1.54176e+07 (2#) (2.22616e+07)	1.00010e+24 (7#) (1.94755e+24)	8.72560e+08 (5#) (1.97610e+08)	2.50634e+08 (4#) (1.17183e+09)	3.35463e+07 (3#) (4.10788e+06)
WFG5^{-1}	2	2.51519e+08 (3) (3.96971e+07)	3.26613e+09 (6) (1.51796e+10)	4.00633e+11 (8) (1.20627e+12)	9.41714e+10 (7#) (2.95268e+11)	4.32217e+08 (4) (1.74262e+07)	6.08478e+08 (5#) (5.04045e+07)	1.94948e+08 (1) (7.98875e+06)	2.46261e+08 (2) (1.96453e+07)
	3	5.30017e+06 (1) (1.49497e+05)	2.19775e+07 (3) (3.15109e+06)	2.09045e+12 (7) (7.16601e+12)	3.73125e+07 (4#) (1.71370e+08)	1.72802e+14 (8) (5.96621e+14)	4.05147e+07 (5#) (4.75979e+06)	1.24522e+09 (6#) (5.82010e+09)	1.00384e+07 (2#) (1.56571e+06)
	5	1.12629e+06 (1) (5.85200e+04)	-	1.30164e+14 (6) (4.22316e+14)	1.83661e+06 (2#) (1.24432e+05)	9.49628e+21 (7) (3.95835e+22)	7.70474e+07 (5#) (2.11687e+07)	3.31100e+07 (4#) (9.95735e+07)	5.68435e+06 (3#) (8.02393e+05)
	7	6.38559e+06 (1) (8.10846e+05)	-	1.11340e+13 (5) (2.51096e+13)	9.90488e+06 (2#) (4.59635e+06)	2.23064e+28 (7#) (1.08131e+29)	1.08371e+09 (4#) (2.86045e+08)	1.76291e+16 (6#) (9.65340e+16)	3.89188e+07 (3#) (4.01413e+06)
WFG6^{-1}	2	2.41852e+08 (2) (1.49246e+07)	1.31081e+09 (6) (4.03131e+09)	2.75288e+10 (7) (8.24072e+10)	1.60876e+12 (8#) (4.91520e+12)	5.18113e+08 (4) (4.05056e+07)	7.61607e+08 (5#) (6.43384e+07)	2.20287e+08 (1) (2.32663e+07)	2.67024e+08 (3) (3.56572e+07)
	3	4.96358e+06 (1) (1.43511e+05)	1.74730e+07 (5) (2.93104e+06)	1.10729e+10 (7) (3.87041e+10)	5.34838e+06 (2#) (5.96804e+05)	6.15279e+14 (8) (3.34656e+15)	3.90306e+07 (6#) (5.68989e+06)	8.47373e+06 (3#) (1.12968e+06)	1.47593e+07 (4#) (2.84765e+07)
	5	9.26024e+05 (1) (4.40355e+04)	-	6.93281e+24 (7) (2.85198e+25)	1.46494e+06 (2#) (8.70936e+04)	6.75194e+19 (6) (2.14981e+20)	7.17319e+07 (4#) (1.47468e+07)	3.64306e+08 (5#) (1.96957e+09)	4.57512e+06 (3#) (6.38863e+05)
	7	3.58516e+06 (1) (2.80677e+05)	-	1.88634e+16 (6) (1.03279e+17)	6.19099e+06 (2#) (7.45941e+05)	4.39074e+26 (7#) (2.17816e+27)	9.40820e+08 (5#) (2.20335e+08)	4.67070e+08 (4#) (2.27211e+09)	3.15185e+07 (3#) (9.18615e+06)
WFG7^{-1}	2	2.20580e+08 (2) (2.28687e+07)	9.94780e+09 (6) (5.02270e+10)	3.11728e+10 (7) (1.03659e+11)	7.26945e+11 (8#) (2.96894e+12)	4.94658e+08 (4) (1.19477e+08)	6.65284e+08 (5#) (6.02325e+07)	2.01405e+08 (1) (1.26601e+07)	2.40469e+08 (3) (1.78671e+07)
	3	4.61970e+06 (1) (1.05885e+05)	2.55592e+07 (5) (4.61989e+06)	1.04347e+18 (8) (5.71526e+18)	7.24523e+06 (2#) (8.98945e+06)	9.67991e+15 (7) (5.28775e+16)	3.52757e+07 (6#) (6.51129e+06)	7.71957e+06 (3#) (7.12366e+05)	1.16066e+07 (4#) (1.55989e+07)
	5	9.66303e+05 (1) (5.10686e+04)	-	9.99162e+23 (6) (5.13414e+24)	2.45472e+06 (2#) (1.59154e+06)	8.10484e+26 (7) (3.93280e+27)	6.44547e+07 (5#) (2.88391e+07)	1.79027e+07 (4#) (4.54019e+07)	7.08901e+06 (3#) (8.57060e+06)
	7	2.87688e+06 (1) (2.77237e+05)	-	7.54876e+12 (6) (1.66975e+13)	1.23865e+08 (3#) (5.81411e+08)	2.31012e+25 (7#) (1.06602e+26)	7.44897e+08 (5#) (1.71408e+08)	4.13453e+07 (2#) (2.63540e+07)	2.62878e+08 (4#) (9.95505e+08)
WFG8^{-1}	2	2.13358e+08 (2) (4.72506e+06)	4.60851e+10 (8) (2.50405e+11)	2.16137e+10 (7) (4.13544e+10)	2.97308e+08 (4#) (4.68226e+08)	5.07708e+08 (5) (1.17149e+08)	7.28351e+08 (6#) (9.63126e+07)	2.04454e+08 (1) (1.54498e+07)	2.53894e+08 (3) (2.77604e+07)
	3	4.82061e+06 (1) (1.00066e+05)	1.87886e+07 (4) (3.59908e+06)	3.56045e+14 (6) (1.16017e+15)	4.85080e+06 (2#) (2.37696e+05)	4.75463e+15 (7) (2.05153e+16)	4.25808e+07 (5#) (4.95127e+06)	1.29092e+20 (8#) (7.07068e+20)	9.33644e+06 (3#) (7.31173e+05)
	5	9.83328e+05 (1) (3.86495e+04)	-	2.00186e+34 (7) (1.09633e+35)	1.73357e+06 (2#) (6.86138e+05)	5.99453e+25 (6) (2.96700e+26)	9.60879e+07 (4#) (3.17886e+07)	2.42139e+08 (5#) (9.47085e+08)	5.30164e+06 (3#) (6.80844e+05)
	7	3.38260e+06 (1) (2.06481e+05)	-	3.97725e+14 (6) (1.62424e+15)	6.90777e+06 (2#) (3.10979e+06)	4.94928e+29 (7#) (2.70968e+30)	1.03839e+09 (4#) (1.99556e+08)	6.93989e+11 (5#) (3.80096e+12)	2.97550e+07 (3#) (1.00870e+07)
WFG9^{-1}	2	2.59183e+08 (3) (4.27132e+07)	2.80977e+09 (6) (1.24970e+10)	3.40595e+10 (8) (1.28705e+11)	1.63294e+10 (7#) (4.18370e+10)	6.43591e+08 (5) (7.63469e+08)	6.21158e+08 (4#) (5.13711e+07)	1.99525e+08 (1) (1.05313e+07)	2.45413e+08 (2) (2.57585e+07)
	3	4.80756e+06 (1) (1.11270e+05)	2.10827e+07 (4) (3.23018e+06)	5.17848e+12 (7) (1.99487e+13)	2.12024e+08 (6#) (7.10830e+08)	7.47431e+13 (8) (3.87027e+14)	3.10170e+07 (5#) (4.26733e+06)	1.44078e+07 (3#) (2.05806e+07)	9.63616e+06 (2#) (6.18644e+06)
	5	1.45038e+06 (1) (8.42186e+04)	-	5.26167e+16 (6) (2.13194e+17)	7.82455e+06 (2#) (9.64620e+06)	1.97771e+20 (7) (1.06568e+21)	5.02307e+07 (4#) (1.31746e+07)	1.80739e+09 (5#) (5.45000e+09)	2.52955e+07 (3#) (1.00573e+08)
	7	5.47648e+06 (1) (6.09213e+05)	-	3.40752e+13 (5) (1.23132e+14)	7.10143e+13 (6#) (3.79723e+14)	1.18548e+24 (7#) (2.79046e+24)	6.38954e+08 (3#) (1.27077e+08)	3.25026e+08 (2#) (1.49971e+09)	9.25058e+08 (4#) (4.78494e+09)

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