On the adaptation of reference sets using niching and pair-potential energy functions for multi-objective optimization

Supplementary material

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Abstract

This supplementary material provides additional tables and figures to further discuss the performance of MOEAs using our adaptation method on MOPs with regular and irregular PF shapes. First, the tables with the performance assessment of MOEAs containing the complete numerical results are provided. Then, the final populations obtained by all MOEAs on each MOP are shown. Finally, additional convergence and diversity graphs of MOEAs on MOPs with regular and irregular PF shapes are given.

1 Numerical results

Tables 5 to 10 of the main paper present the ranks obtained by MOEAs using the same algorithmic framework (i.e., MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks) in terms of HV and SPD on MOPs with regular and irregular PF shapes. Additionally, such tables show if A-NSGA-III and all versions of NSGA-III-Ada$\mathcal{K}$, RVEA* and all versions of RVEA-Ada$\mathcal{K}$, and AdaW and all versions of MOEA/D-Ada$\mathcal{K}$ perform significantly better, significantly worse, or statistically equivalent than NSGA-III, RVEA, and MOEA/D, respectively. Thus, in this supplementary material, we include the tables that contain the mean and standard deviations of MOEAs among 30 independent runs on each MOP.

1.1 Regular PF shapes

Tables 1 and 2 present the results of NSGA-III, A-NSGA-III, and all versions of NSGA-III-Ada$\mathcal{K}$ on MOPs with regular PF shapes in terms of HV and SPD, respectively. Then, the performance comparison of RVEA, RVEA*, and all versions of RVEA-Ada$\mathcal{K}$ on MOPs with regular PF shapes based on HV and SPD is shown in Tables 3 and 4, respectively. Finally, Tables 5 and 6 contain the results of MOEA/D, AdaW, and all versions of MOEA/D-Ada$\mathcal{K}$ on MOPs with regular PF shapes in terms of HV and SPD, respectively. Among the obtained results, it can be seen that all versions of NSGA-III-Ada$\mathcal{K}$, RVEA-Ada$\mathcal{K}$, and MOEA/D-Ada$\mathcal{K}$ can maintain or improve the performance of NSGA-III, RVEA, and MOEA/D, respectively, on most MOPs in terms of HV and SPD. In contrast, A-NSGA-III and RVEA* degrade the performance of their original versions on most MOPs in terms of HV and SPD. Also, AdaW degrades the performance of MOEA/D on most MOPs in terms of HV, while it maintains or improves the performance of MOEA/D on slightly more than half of the MOPs in terms of SPD. However, all versions of MOEA/D-Ada$\mathcal{K}$ maintain or improve the performance of MOEA/D on more MOPs than AdaW based on HV and SPD. Thus, results show that our proposed adaptation method avoids degrading the performance of MOEAs that use predefined WVRSs on most MOPs with regular PF shapes regardless of their algorithmic framework.

1.2 Irregular PF shapes

The performance comparison ofNSGA-III, A-NSGA-III, and all versions of NSGA-III-Ada$\mathcal{K}$ on MOPs with irregular PF shapes based on HV and SPD can be observed in Tables 7 and 8, respectively. Then, Tables 9 and 10 show the results of RVEA, RVEA*, and all versions of RVEA-Ada$\mathcal{K}$ on MOPs with irregular PF shapes in terms of HV and SPD, respectively. Finally, the results of MOEA/D, AdaW, and all versions of

Table 1: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the NSGA-III framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to NSGA-III based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to NSGA-III. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	NSGA-III	A-NSGA-III	NSGA-III-AdaRSE	NSGA-III-AdaGAE	NSGA-III-AdaMPT	NSGA-III-AdaCOU	NSGA-III-AdaPT	NSGA-III-AdaKRA
DTLZ1	3	400	7.7868e+0^{7} (2.36e−3)	7.7845e+0^{8} (3.65e−3) −	7.7872e+0^{3} (1.44e−3) =	7.7872e+0^{4} (1.96e−3) =	7.7873e+0^{2} (1.59e−3) =	7.7871e+0^{5} (2.19e−3) =	7.7877e+0^{1} (1.15e−3) =	7.7869e+0^{6} (1.80e−3) =
	5	600	3.1967e+1^{1} (1.19e−4)	3.1967e+1^{8} (3.10e−4) −	3.1967e+1^{5} (1.97e−4) =	3.1967e+1^{3} (1.38e−4) =	3.1967e+1^{4} (1.41e−4) =	3.1967e+1^{6} (1.85e−4) =	3.1967e+1^{2} (1.10e−4) =	3.1967e+1^{7} (2.03e−4) =
	8	750	2.5599e+2^{1} (1.20e−4)	2.5599e+2^{7} (3.11e−4) −	2.5599e+2^{2} (9.23e−5) =	2.5599e+2^{5} (1.42e−4) =	2.5599e+2^{3} (1.13e−4) =	2.5599e+2^{4} (1.63e−4) =	2.5599e+2^{6} (6.93e−4) =	2.5599e+2^{8} (2.31e−3) =
	10	1000	1.0240e+3^{2} (9.45e−6)	1.0240e+3^{7} (3.35e−5) =	1.0240e+3^{4} (1.29e−5) =	1.0240e+3^{1} (8.42e−6) =	1.0240e+3^{5} (1.56e−5) =	1.0240e+3^{3} (1.45e−5) =	1.0240e+3^{8} (4.74e−4) =	1.0240e+3^{6} (1.34e−5) =
DTLZ2	3	250	7.4134e+0^{4} (1.01e−4)	7.4116e+0^{8} (9.75e−4) −	7.4134e+0^{3} (1.34e−4) =	7.4134e+0^{2} (1.44e−4) =	7.4134e+0^{5} (1.48e−4) =	7.4134e+0^{7} (1.52e−4) =	7.4134e+0^{1} (1.39e−4) =	7.4134e+0^{6} (1.32e−4) =
	5	350	3.1697e+1^{4} (1.97e−4)	3.1696e+1^{8} (9.59e−4) −	3.1697e+1^{5} (1.53e−4) =	3.1697e+1^{3} (1.96e−4) =	3.1697e+1^{6} (1.35e−4) =	3.1697e+1^{1} (1.44e−4) =	3.1697e+1^{2} (1.76e−4) =	3.1697e+1^{7} (1.90e−4) =
	8	500	2.5584e+2^{1} (3.97e−4)	2.5584e+2^{8} (1.35e−3) −	2.5584e+2^{4} (4.38e−4) =	2.5584e+2^{7} (3.03e−4) −	2.5584e+2^{6} (4.60e−4) =	2.5584e+2^{2} (3.13e−4) =	2.5584e+2^{3} (3.45e−4) =	2.5584e+2^{5} (4.01e−4) =
	10	750	1.0239e+3^{5} (1.55e−4)	1.0239e+3^{8} (3.88e−4) =	1.0239e+3^{7} (1.71e−4) =	1.0239e+3^{3} (1.40e−4) =	1.0239e+3^{6} (1.32e−4) =	1.0239e+3^{2} (1.42e−4) =	1.0239e+3^{1} (1.57e−4) =	1.0239e+3^{4} (1.51e−4) =
DTLZ3	3	1000	7.4072e+0^{4} (5.50e−3)	7.4037e+0^{8} (6.27e−3) −	7.4072e+0^{5} (3.41e−3) =	7.4066e+0^{6} (7.00e−3) =	7.4066e+0^{7} (5.91e−3) =	7.4083e+0^{1} (4.20e−3) =	7.4075e+0^{3} (3.95e−3) =	7.4075e+0^{2} (5.11e−3) =
	5	1000	3.1696e+1^{1} (2.28e−3)	3.1694e+1^{8} (2.80e−3) −	3.1695e+1^{7} (2.22e−3) =	3.1695e+1^{2} (1.88e−3) =	3.1695e+1^{6} (2.58e−3) =	3.1695e+1^{5} (2.59e−3) =	3.1695e+1^{4} (1.87e−3) =	3.1695e+1^{3} (2.03e−3) =
	8	1000	2.5582e+2^{4} (9.60e−3)	2.5582e+2^{5} (9.16e−3) =	2.5583e+2^{2} (9.31e−3) =	2.5582e+2^{6} (9.03e−3) =	2.5581e+2^{8} (7.86e−2) =	2.5583e+2^{1} (5.92e−3) +	2.5583e+2^{3} (7.25e−3) =	2.5582e+2^{7} (1.34e−2) =
	10	1500	1.0239e+3^{5} (1.20e−3)	1.0239e+3^{8} (1.94e−3) =	1.0239e+3^{3} (1.13e−3) =	1.0239e+3^{7} (1.54e−3) =	1.0239e+3^{6} (1.05e−3) =	1.0239e+3^{4} (1.77e−3) =	1.0239e+3^{1} (9.40e−4) +	1.0239e+3^{2} (6.98e−4) =
DTLZ4	3	600	7.1862e+0^{5} (8.66e−1)	7.2980e+0^{3} (6.23e−1) =	7.0044e+0^{8} (1.05e+0) =	7.2661e+0^{4} (6.44e−1) =	7.3000e+0^{2} (6.23e−1) =	7.4110e+0^{1} (1.49e−2) =	7.1862e+0^{7} (8.66e−1) =	7.1862e+0^{6} (8.66e−1) =
	5	1000	3.1698e+1^{6} (2.57e−4)	3.1698e+1^{8} (3.32e−4) =	3.1698e+1^{5} (1.27e−4) =	3.1698e+1^{3} (1.12e−4) =	3.1698e+1^{2} (2.38e−4) +	3.1698e+1^{1} (8.91e−5) =	3.1698e+1^{7} (1.71e−4) =	3.1698e+1^{4} (1.44e−4) =
	8	1250	2.5584e+2^{4} (1.82e−4)	2.5584e+2^{8} (6.05e−4) =	2.5584e+2^{3} (2.23e−4) =	2.5584e+2^{7} (2.10e−4) =	2.5584e+2^{1} (1.99e−4) =	2.5584e+2^{2} (1.78e−4) =	2.5584e+2^{5} (1.95e−4) =	2.5584e+2^{6} (1.63e−4) =
	10	2000	1.0239e+3^{1} (7.24e−5)	1.0239e+3^{7} (2.84e−4) −	1.0239e+3^{8} (1.24e−4) −	1.0239e+3^{2} (1.20e−4) =	1.0239e+3^{5} (1.24e−4) =	1.0239e+3^{4} (9.71e−5) =	1.0239e+3^{6} (8.69e−5) −	1.0239e+3^{3} (1.05e−4) =
WFG1	3	400	5.3974e+0^{8} (1.92e−2)	5.4059e+0^{7} (2.11e−2) =	5.4305e+0^{1} (2.67e−2) +	5.4182e+0^{5} (1.94e−2) +	5.4188e+0^{4} (2.31e−2) +	5.4225e+0^{3} (2.48e−2) +	5.4228e+0^{2} (2.47e−2) +	5.4179e+0^{6} (2.38e−2) +
	5	750	2.0487e+1^{1} (8.62e−2)	2.0339e+1^{8} (7.50e−2) −	2.0455e+1^{6} (6.17e−2) =	2.0441e+1^{7} (6.84e−2) −	2.0465e+1^{5} (7.36e−2) =	2.0479e+1^{3} (5.99e−2) =	2.0485e+1^{2} (8.53e−2) =	2.0474e+1^{4} (6.60e−2) =
	8	1500	1.6764e+2^{1} (3.65e+0)	1.6363e+2^{8} (3.86e+0) −	1.6668e+2^{3} (3.85e+0) =	1.6631e+2^{5} (3.71e+0) =	1.6606e+2^{6} (3.18e+0) −	1.6597e+2^{7} (3.24e+0) −	1.6759e+2^{2} (3.74e+0) =	1.6647e+2^{4} (3.14e+0) =
	10	2000	7.8149e+2^{1} (1.47e+1)	7.8061e+2^{2} (2.36e+1) =	7.5135e+2^{8} (1.81e+1) −	7.5482e+2^{7} (2.41e+1) −	7.5692e+2^{6} (1.91e+1) −	7.7138e+2^{3} (2.00e+1) −	7.6203e+2^{5} (2.03e+1) −	7.6446e+2^{4} (1.90e+1) −
WFG4	3	400	7.3736e+0^{3} (5.60e−3)	7.3657e+0^{8} (7.61e−3) −	7.3717e+0^{6} (6.14e−3) =	7.3716e+0^{7} (5.73e−3) =	7.3743e+0^{1} (6.13e−3) =	7.3731e+0^{4} (6.96e−3) =	7.3738e+0^{2} (5.76e−3) =	7.3730e+0^{5} (5.03e−3) =
	5	750	3.1558e+1^{3} (1.81e−2)	3.1535e+1^{8} (2.18e−2) −	3.1557e+1^{4} (2.46e−2) =	3.1554e+1^{6} (2.23e−2) =	3.1550e+1^{7} (2.09e−2) =	3.1561e+1^{1} (1.67e−2) =	3.1560e+1^{2} (1.80e−2) =	3.1556e+1^{5} (1.66e−2) =
	8	1500	2.5539e+2^{4} (1.18e−1)	2.5534e+2^{8} (1.21e−1) =	2.5541e+2^{2} (9.31e−2) =	2.5542e+2^{1} (1.08e−1) =	2.5539e+2^{5} (1.12e−1) =	2.5538e+2^{6} (1.20e−1) =	2.5538e+2^{7} (1.20e−1) =	2.5540e+2^{3} (9.77e−2) =
	10	2000	1.0229e+3^{5} (2.20e−1)	1.0229e+3^{7} (2.82e−1) =	1.0230e+3^{2} (2.70e−1) +	1.0230e+3^{3} (2.70e−1) =	1.0230e+3^{1} (2.57e−1) +	1.0229e+3^{4} (2.76e−1) =	1.0229e+3^{6} (2.52e−1) =	1.0228e+3^{8} (3.16e−1) =
WFG5	3	400	7.2281e+0^{4} (1.45e−3)	7.2258e+0^{8} (3.53e−3) −	7.2281e+0^{5} (1.05e−3) =	7.2279e+0^{7} (1.63e−3) =	7.2282e+0^{3} (1.10e−3) =	7.2284e+0^{1} (1.05e−3) =	7.2284e+0^{2} (1.27e−3) =	7.2281e+0^{6} (1.37e−3) =
	5	750	3.0787e+1^{5} (1.62e−3)	3.0785e+1^{8} (2.92e−3) −	3.0787e+1^{1} (1.49e−3) =	3.0787e+1^{6} (2.51e−3) =	3.0787e+1^{3} (1.59e−3) =	3.0787e+1^{2} (1.75e−3) =	3.0787e+1^{4} (1.85e−3) =	3.0786e+1^{7} (1.91e−3) =
	8	1500	2.4724e+2^{7} (6.38e−3)	2.4724e+2^{8} (6.13e−3) =	2.4725e+2^{2} (4.39e−3) =	2.4725e+2^{4} (4.85e−3) =	2.4725e+2^{5} (5.06e−3) =	2.4724e+2^{6} (3.99e−3) =	2.4725e+2^{3} (5.45e−3) =	2.4725e+2^{1} (3.59e−3) =
	10	2000	9.8697e+2^{6} (7.25e−3)	9.8697e+2^{8} (1.42e−2) =	9.8697e+2^{7} (7.07e−3) =	9.8697e+2^{2} (6.35e−3) =	9.8697e+2^{3} (8.82e−3) =	9.8697e+2^{5} (6.51e−3) =	9.8697e+2^{4} (6.72e−3) =	9.8697e+2^{1} (5.17e−3) =
WFG6	3	400	7.2288e+0^{5} (2.23e−2)	7.2333e+0^{4} (2.30e−2) =	7.2263e+0^{7} (2.06e−2) =	7.2344e+0^{2} (1.99e−2) =	7.2264e+0^{6} (1.97e−2) =	7.2440e+0^{1} (1.82e−2) +	7.2258e+0^{8} (2.11e−2) =	7.2340e+0^{3} (1.75e−2) =
	5	750	3.0808e+1^{4} (8.98e−2)	3.0806e+1^{5} (8.75e−2) =	3.0828e+1^{1} (6.73e−2) =	3.0801e+1^{8} (7.81e−2) =	3.0824e+1^{2} (7.33e−2) =	3.0804e+1^{6} (7.41e−2) =	3.0803e+1^{7} (6.19e−2) =	3.0813e+1^{3} (9.35e−2) =
	8	1500	2.4714e+2^{7} (1.20e+0)	2.4702e+2^{8} (1.10e+0) =	2.4730e+2^{4} (1.18e+0) =	2.4742e+2^{2} (1.30e+0) =	2.4739e+2^{3} (1.10e+0) =	2.4725e+2^{6} (1.33e+0) =	2.4761e+2^{1} (1.24e+0) =	2.4728e+2^{5} (1.20e+0) =
	10	2000	9.8544e+2^{1} (3.97e+0)	9.8390e+2^{3} (4.75e+0) =	9.8439e+2^{2} (6.63e+0) =	9.8359e+2^{7} (5.07e+0) =	9.8361e+2^{6} (6.37e+0) =	9.8364e+2^{5} (3.99e+0) =	9.8241e+2^{8} (4.86e+0) −	9.8387e+2^{4} (3.41e+0) =
WFG7	3	400	7.3857e+0^{1} (3.56e−3)	7.3801e+0^{8} (5.28e−3) −	7.3852e+0^{4} (4.14e−3) =	7.3841e+0^{7} (4.85e−3) =	7.3855e+0^{2} (4.22e−3) =	7.3843e+0^{5} (5.01e−3) =	7.3842e+0^{6} (4.98e−3) =	7.3854e+0^{3} (4.24e−3) =
	5	750	3.1640e+1^{3} (7.89e−3)	3.1631e+1^{8} (1.23e−2) −	3.1643e+1^{1} (8.41e−3) =	3.1639e+1^{7} (9.58e−3) =	3.1639e+1^{6} (9.81e−3) =	3.1643e+1^{2} (7.12e−3) =	3.1640e+1^{4} (8.25e−3) =	3.1639e+1^{5} (9.65e−3) =
	8	1500	2.5574e+2^{1} (2.95e−2)	2.5570e+2^{8} (4.75e−2) −	2.5573e+2^{3} (3.63e−2) =	2.5573e+2^{4} (2.77e−2) =	2.5573e+2^{6} (3.15e−2) =	2.5572e+2^{7} (3.62e−2) =	2.5573e+2^{5} (2.64e−2) =	2.5574e+2^{2} (2.64e−2) =
	10	2000	1.0237e+3^{7} (7.68e−2)	1.0236e+3^{8} (8.28e−2) −	1.0237e+3^{3} (5.64e−2) =	1.0237e+3^{2} (4.58e−2) =	1.0237e+3^{5} (5.65e−2) =	1.0237e+3^{4} (5.90e−2) =	1.0237e+3^{6} (5.37e−2) =	1.0237e+3^{1} (5.16e−2) +
WFG8	3	400	7.2306e+0^{5} (1.53e−2)	7.2039e+0^{8} (3.27e−2) −	7.2277e+0^{7} (1.60e−2) =	7.2304e+0^{6} (1.95e−2) =	7.2327e+0^{4} (1.48e−2) =	7.2381e+0^{1} (1.43e−2) +	7.2344e+0^{2} (1.42e−2) =	7.2332e+0^{3} (1.52e−2) =
	5	750	3.1142e+1^{1} (5.03e−2)	3.1072e+1^{8} (5.65e−2) −	3.1136e+1^{2} (4.29e−2) =	3.1121e+1^{6} (5.37e−2) =	3.1135e+1^{3} (5.10e−2) =	3.1124e+1^{5} (4.62e−2) =	3.1135e+1^{4} (4.01e−2) =	3.1111e+1^{7} (4.29e−2) −
	8	1500	2.5239e+2^{6} (4.76e−1)	2.5126e+2^{8} (6.33e−1) −	2.5233e+2^{7} (5.01e−1) =	2.5247e+2^{2} (3.76e−1) =	2.5242e+2^{4} (4.62e−1) =	2.5244e+2^{3} (4.02e−1) =	2.5241e+2^{5} (3.82e−1) =	2.5255e+2^{1} (4.79e−1) =
	10	2000	1.0157e+3^{3} (1.34e+0)	1.0097e+3^{8} (2.29e+0) −	1.0154e+3^{5} (1.18e+0) =	1.0159e+3^{2} (1.23e+0) =	1.0153e+3^{6} (1.18e+0) =	1.0163e+3^{1} (1.09e+0) +	1.0156e+3^{4} (1.15e+0) =	1.0153e+3^{7} (1.46e+0) =
WFG9	3	400	7.1726e+0^{3} (8.56e−2)	7.1696e+0^{4} (8.14e−2) =	7.1668e+0^{7} (7.87e−2) =	7.1676e+0^{6} (6.86e−2) =	7.1852e+0^{1} (5.93e−2) =	7.1686e+0^{5} (7.31e−2) =	7.1608e+0^{8} (7.29e−2) −	7.1765e+0^{2} (6.32e−2) =
	5	750	3.0826e+1^{7} (2.75e−1)	3.0845e+1^{6} (2.16e−1) =	3.0823e+1^{8} (2.24e−1) =	3.0904e+1^{2} (7.82e−2) =	3.0906e+1^{1} (1.04e−1) =	3.0871e+1^{5} (2.23e−1) =	3.0902e+1^{3} (1.44e−1) =	3.0877e+1^{4} (2.19e−1) =
	8	1500	2.4832e+2^{3} (2.35e+0)	2.4806e+2^{6} (3.40e+0) =	2.4825e+2^{4} (2.48e+0) =	2.4796e+2^{7} (3.25e+0) =	2.4769e+2^{8} (3.23e+0) =	2.4812e+2^{5} (2.70e+0) =	2.4841e+2^{2} (2.44e+0) =	2.4890e+2^{1} (9.02e−1) =
	10	2000	9.9777e+2^{4} (1.26e+1)	9.9770e+2^{5} (1.26e+1) =	9.9502e+2^{8} (1.72e+1) =	1.0000e+3^{1} (2.69e+0) =	9.9696e+2^{6} (1.26e+1) =	9.9952e+2^{3} (2.35e+0) =	9.9961e+2^{2} (1.92e+0) =	9.9544e+2^{7} (1.63e+1) =
+/−/=				0/23/21	2/2/40	1/3/40	3/2/39	5/2/37	2/4/38	2/2/40
% of satisfaction				47.73%	95.45%	93.18%	95.45%	95.45%	90.91%	95.45%

MOEA/D-Ada$\mathcal{K}$ on MOPs with irregular PF shapes in terms of HV and SPD are shown in Tables 11 and 12, respectively. The obtained results indicate that all MOEAs with our adaptation method improve the performance of their original versions on most MOPs in terms of HV and SDP. Also, RVEA* and AdaW can enhance the performance of RVEA and MOEA/D on most MOPs in terms of HV and SPD. However, A-NSGA-III cannot improve the performance of NSGA-III on most MOPs based on HV and SPD. Additionally, it can be seen that RVEA-AdaCOU, RVEA-AdaPT, and RVEA-AdaKRA enhance the performance of RVEA on more MOPs than RVEA* in terms of HV, while all versions of RVEA-Ada$\mathcal{K}$ improve the performance of RVEA on more MOPs than RVEA* in terms of SPD. Also, results show that all versions of MOEA/D-Ada$\mathcal{K}$ enhance the performance of MOEA/D on more MOPs than AdaW in terms of HV. However, in terms of SPD, AdaW can improve the performance of MOEA/D on all MOPs, while all versions of MOEA/D-Ada$\mathcal{K}$ enhance the performance of MOEA/D on more than 95% of MOPs. The obtained results demonstrate that our adaptation method can significantly improve the performance of MOEAs that use predefined WVRSs on most MOPs with irregular PF shapes independently of their algorithmic framework.

2 Final populations

Figures 3 to 6 of the main paper present the final populations with the median HV value among 30 independent runs obtained by some MOEAs on DTLZ1 and DTLZ1^{-1} with 3 and 10 objective functions. Therefore, this section of the supplementary material includes the final populations with the median HV value among 30 independent runs obtained by all MOEAs on each MOP with 3, 5, 8, and 10 objective functions.

Table 2: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the NSGA-III framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to NSGA-III based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to NSGA-III. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	NSGA-III	A-NSGA-III	NSGA-III-AdaRSE	NSGA-III-AdaGAE	NSGA-III-AdaMPT	NSGA-III-AdaCOU	NSGA-III-AdaPT	NSGA-III-AdaKRA
DTLZ1	3	400	$2.3395e{+}1^{1}$ (1.09e−1)	$2.3325e{+}1^{8}$ (2.30e−1) −	$2.3379e{+}1^{4}$ (6.90e−2) =	$2.3377e{+}1^{5}$ (9.43e−2) =	$2.3371e{+}1^{6}$ (7.74e−2) =	$2.3381e{+}1^{3}$ (1.04e−1) =	$2.3357e{+}1^{7}$ (5.52e−2) =	$2.3388e{+}1^{2}$ (8.27e−2) =
	5	600	$7.3039e{+}1^{7}$ (1.02e−1)	$7.2767e{+}1^{8}$ (3.60e−1) −	$7.3070e{+}1^{3}$ (1.63e−1) =	$7.3049e{+}1^{6}$ (1.07e−1) =	$7.3055e{+}1^{5}$ (1.13e−1) =	$7.3098e{+}1^{2}$ (1.49e−1) +	$7.3056e{+}1^{4}$ (1.01e−1) =	$7.3104e{+}1^{1}$ (1.64e−1) =
	8	750	$1.0869e{+}2^{3}$ (3.79e−1)	$1.0800e{+}2^{8}$ (9.47e−1) −	$1.0866e{+}2^{5}$ (2.65e−1) =	$1.0882e{+}2^{1}$ (3.98e−1) =	$1.0876e{+}2^{2}$ (3.50e−1) =	$1.0868e{+}2^{4}$ (3.48e−1) =	$1.0846e{+}2^{6}$ (1.17e+0) =	$1.0811e{+}2^{7}$ (2.42e+0) =
	10	1000	$1.7699e{+}2^{3}$ (3.30e−1)	$1.7662e{+}2^{7}$ (5.99e−1) −	$1.7698e{+}2^{4}$ (3.16e−1) =	$1.7683e{+}2^{6}$ (1.75e−1) −	$1.7697e{+}2^{5}$ (2.79e−1) =	$1.7701e{+}2^{2}$ (4.53e−1) =	$1.7607e{+}2^{8}$ (4.66e+0) =	$1.7702e{+}2^{1}$ (4.04e−1) =
DTLZ2	3	250	$3.2763e{+}1^{3}$ (4.15e−3)	$3.2614e{+}1^{8}$ (1.15e−1) −	$3.2765e{+}1^{1}$ (6.86e−3) =	$3.2760e{+}1^{7}$ (8.46e−3) −	$3.2763e{+}1^{4}$ (5.42e−3) =	$3.2763e{+}1^{2}$ (3.97e−3) =	$3.2762e{+}1^{6}$ (4.86e−3) =	$3.2762e{+}1^{5}$ (6.09e−3) =
	5	350	$1.3954e{+}2^{4}$ (4.02e−2)	$1.3898e{+}2^{8}$ (3.44e−1) −	$1.3955e{+}2^{1}$ (4.25e−2) =	$1.3954e{+}2^{2}$ (3.06e−2) =	$1.3954e{+}2^{3}$ (2.93e−2) =	$1.3952e{+}2^{7}$ (3.04e−2) =	$1.3954e{+}2^{6}$ (2.63e−2) =	$1.3954e{+}2^{5}$ (2.51e−2) =
	8	500	$1.4787e{+}2^{7}$ (5.15e−2)	$1.4753e{+}2^{8}$ (3.01e−1) −	$1.4790e{+}2^{1}$ (6.38e−2) =	$1.4790e{+}2^{2}$ (6.71e−2) =	$1.4788e{+}2^{6}$ (5.98e−2) =	$1.4789e{+}2^{3}$ (5.34e−2) =	$1.4788e{+}2^{4}$ (6.40e−2) =	$1.4788e{+}2^{5}$ (4.62e−2) =
	10	750	$2.6059e{+}2^{2}$ (8.06e−2)	$2.6026e{+}2^{8}$ (2.55e−1) −	$2.6058e{+}2^{5}$ (9.03e−2) =	$2.6058e{+}2^{6}$ (6.85e−2) =	$2.6058e{+}2^{4}$ (5.88e−2) =	$2.6060e{+}2^{1}$ (8.73e−2) =	$2.6059e{+}2^{3}$ (8.27e−2) =	$2.6057e{+}2^{7}$ (8.42e−2) =
DTLZ3	3	1000	$3.2921e{+}1^{4}$ (1.36e−1)	$3.2819e{+}1^{8}$ (1.90e−1) −	$3.2926e{+}1^{3}$ (8.37e−2) =	$3.2936e{+}1^{2}$ (1.78e−1) =	$3.2939e{+}1^{1}$ (1.50e−1) =	$3.2893e{+}1^{7}$ (1.06e−1) =	$3.2915e{+}1^{5}$ (1.00e−1) =	$3.2915e{+}1^{6}$ (1.29e−1) =
	5	1000	$1.3975e{+}2^{7}$ (2.65e−1)	$1.3918e{+}2^{8}$ (6.46e−1) −	$1.3981e{+}2^{3}$ (2.61e−1) =	$1.3975e{+}2^{6}$ (2.21e−1) =	$1.3982e{+}2^{2}$ (3.15e−1) =	$1.3982e{+}2^{1}$ (3.43e−1) =	$1.3978e{+}2^{4}$ (2.23e−1) =	$1.3977e{+}2^{5}$ (2.33e−1) =
	8	1000	$1.4809e{+}2^{1}$ (2.81e−1)	$1.4712e{+}2^{8}$ (6.91e−1) −	$1.4785e{+}2^{5}$ (7.25e−1) =	$1.4798e{+}2^{2}$ (7.00e−1) =	$1.4786e{+}2^{4}$ (9.00e−1) =	$1.4775e{+}2^{6}$ (7.90e−1) −	$1.4769e{+}2^{7}$ (1.50e+0) =	$1.4791e{+}2^{3}$ (9.78e−1) =
	10	1500	$2.6059e{+}2^{4}$ (1.37e−1)	$2.6014e{+}2^{8}$ (4.58e−1) −	$2.6060e{+}2^{2}$ (1.75e−1) =	$2.6063e{+}2^{1}$ (1.90e−1) =	$2.6059e{+}2^{3}$ (1.49e−1) =	$2.6056e{+}2^{5}$ (1.26e−1) =	$2.6053e{+}2^{7}$ (1.37e−1) =	$2.6054e{+}2^{6}$ (1.11e−1) =
DTLZ4	3	600	$3.0639e{+}1^{7}$ (8.06e+0)	$3.1497e{+}1^{3}$ (5.81e+0) =	$2.7958e{+}1^{8}$ (1.10e+1) =	$3.0891e{+}1^{4}$ (7.16e+0) =	$3.1698e{+}1^{2}$ (5.80e+0) =	$3.2325e{+}1^{1}$ (2.36e+0) =	$3.0640e{+}1^{5}$ (8.06e+0) =	$3.0639e{+}1^{6}$ (8.06e+0) =
	5	1000	$1.3946e{+}2^{2}$ (2.66e−2)	$1.3938e{+}2^{8}$ (1.41e−1) −	$1.3946e{+}2^{1}$ (2.95e−2) =	$1.3945e{+}2^{4}$ (1.75e−2) =	$1.3945e{+}2^{7}$ (3.05e−2) −	$1.3945e{+}2^{6}$ (2.01e−2) =	$1.3946e{+}2^{3}$ (3.02e−2) =	$1.3945e{+}2^{5}$ (2.79e−2) =
	8	1250	$1.4785e{+}2^{5}$ (5.18e−2)	$1.4782e{+}2^{8}$ (1.39e−1) =	$1.4785e{+}2^{3}$ (4.46e−2) =	$1.4785e{+}2^{2}$ (4.14e−2) =	$1.4785e{+}2^{7}$ (4.60e−2) =	$1.4785e{+}2^{4}$ (5.33e−2) =	$1.4787e{+}2^{1}$ (3.84e−2) +	$1.4785e{+}2^{6}$ (4.82e−2) =
	10	2000	$2.6056e{+}2^{7}$ (6.71e−2)	$2.6049e{+}2^{8}$ (2.25e−1) =	$2.6059e{+}2^{3}$ (6.46e−2) +	$2.6058e{+}2^{4}$ (5.79e−2) =	$2.6060e{+}2^{2}$ (6.29e−2) +	$2.6058e{+}2^{5}$ (7.18e−2) =	$2.6060e{+}2^{1}$ (7.18e−2) +	$2.6058e{+}2^{6}$ (7.63e−2) =
WFG1	3	400	$1.7603e{+}1^{1}$ (5.07e−1)	$1.7188e{+}1^{2}$ (5.33e−1) −	$1.6597e{+}1^{3}$ (4.49e−1) −	$1.6329e{+}1^{8}$ (4.00e−1) −	$1.6446e{+}1^{6}$ (3.39e−1) −	$1.6370e{+}1^{7}$ (3.58e−1) −	$1.6465e{+}1^{5}$ (3.02e−1) −	$1.6531e{+}1^{4}$ (3.76e−1) −
	5	750	$3.3548e{+}1^{1}$ (6.48e−1)	$3.2939e{+}1^{7}$ (6.24e−1) −	$3.3411e{+}1^{2}$ (6.81e−1) =	$3.2868e{+}1^{8}$ (6.89e−1) −	$3.3077e{+}1^{4}$ (7.20e−1) −	$3.3039e{+}1^{6}$ (7.74e−1) −	$3.3043e{+}1^{5}$ (8.20e−1) −	$3.3137e{+}1^{3}$ (7.84e−1) −
	8	1500	$3.9677e{+}1^{6}$ (2.41e+0)	$3.7928e{+}1^{8}$ (2.74e+0) −	$3.9594e{+}1^{7}$ (2.19e+0) =	$4.0223e{+}1^{3}$ (2.41e+0) =	$4.0426e{+}1^{1}$ (2.89e+0) =	$4.0091e{+}1^{4}$ (2.03e+0) =	$4.0008e{+}1^{5}$ (2.20e+0) =	$4.0335e{+}1^{2}$ (2.42e+0) =
	10	2000	$3.7512e{+}1^{7}$ (2.04e+0)	$3.3866e{+}1^{8}$ (1.96e+0) −	$4.0868e{+}1^{4}$ (2.90e+0) +	$3.9948e{+}1^{6}$ (2.91e+0) +	$4.0487e{+}1^{5}$ (3.13e+0) +	$4.0900e{+}1^{3}$ (3.48e+0) +	$4.1395e{+}1^{2}$ (3.76e+0) +	$4.1833e{+}1^{1}$ (3.61e+0) +
WFG4	3	400	$3.2743e{+}1^{1}$ (1.39e−2)	$3.2575e{+}1^{8}$ (1.11e−1) −	$3.2730e{+}1^{7}$ (3.22e−2) −	$3.2740e{+}1^{2}$ (1.66e−2) =	$3.2737e{+}1^{3}$ (1.52e−2) −	$3.2735e{+}1^{6}$ (2.17e−2) =	$3.2736e{+}1^{4}$ (2.42e−2) =	$3.2735e{+}1^{5}$ (1.90e−2) =
	5	750	$1.3919e{+}2^{5}$ (5.32e−2)	$1.3875e{+}2^{8}$ (3.70e−1) −	$1.3920e{+}2^{1}$ (6.26e−2) =	$1.3920e{+}2^{2}$ (4.82e−2) =	$1.3919e{+}2^{7}$ (5.55e−2) =	$1.3920e{+}2^{3}$ (4.96e−2) =	$1.3919e{+}2^{6}$ (5.16e−2) =	$1.3919e{+}2^{4}$ (4.57e−2) =
	8	1500	$1.4780e{+}2^{3}$ (3.97e−2)	$1.4778e{+}2^{7}$ (9.78e−2) =	$1.4781e{+}2^{1}$ (4.41e−2) =	$1.4778e{+}2^{6}$ (4.61e−2) −	$1.4778e{+}2^{5}$ (4.47e−2) =	$1.4780e{+}2^{2}$ (4.60e−2) =	$1.4778e{+}2^{8}$ (4.75e−2) −	$1.4779e{+}2^{4}$ (3.36e−2) =
	10	2000	$2.6054e{+}2^{3}$ (6.12e−2)	$2.6047e{+}2^{8}$ (1.64e−1) −	$2.6054e{+}2^{2}$ (6.83e−2) =	$2.6053e{+}2^{7}$ (6.55e−2) =	$2.6054e{+}2^{4}$ (6.15e−2) =	$2.6053e{+}2^{6}$ (6.64e−2) =	$2.6053e{+}2^{5}$ (5.86e−2) =	$2.6056e{+}2^{1}$ (6.45e−2) =
WFG5	3	400	$3.2725e{+}1^{4}$ (1.46e−2)	$3.2595e{+}1^{8}$ (1.25e−1) −	$3.2723e{+}1^{5}$ (1.22e−2) =	$3.2717e{+}1^{7}$ (3.13e−2) =	$3.2729e{+}1^{1}$ (1.27e−2) =	$3.2727e{+}1^{2}$ (1.29e−2) =	$3.2726e{+}1^{3}$ (2.09e−2) =	$3.2718e{+}1^{6}$ (2.44e−2) =
	5	750	$1.3931e{+}2^{5}$ (2.00e−2)	$1.3900e{+}2^{8}$ (3.50e−1) −	$1.3931e{+}2^{1}$ (1.70e−2) =	$1.3931e{+}2^{4}$ (2.15e−2) =	$1.3931e{+}2^{2}$ (1.70e−2) =	$1.3930e{+}2^{6}$ (2.01e−2) =	$1.3931e{+}2^{3}$ (1.96e−2) =	$1.3930e{+}2^{7}$ (1.93e−2) =
	8	1500	$1.4779e{+}2^{5}$ (1.36e−2)	$1.4777e{+}2^{8}$ (1.24e−1) =	$1.4779e{+}2^{4}$ (1.19e−2) =	$1.4779e{+}2^{6}$ (1.08e−2) =	$1.4778e{+}2^{7}$ (1.08e−2) −	$1.4779e{+}2^{3}$ (9.12e−3) =	$1.4779e{+}2^{1}$ (1.84e−2) =	$1.4779e{+}2^{2}$ (1.25e−2) =
	10	2000	$2.6045e{+}2^{2}$ (2.59e−2)	$2.6036e{+}2^{8}$ (1.76e−1) −	$2.6044e{+}2^{5}$ (2.75e−2) =	$2.6044e{+}2^{6}$ (2.60e−2) =	$2.6044e{+}2^{7}$ (1.51e−2) −	$2.6044e{+}2^{4}$ (2.96e−2) =	$2.6045e{+}2^{1}$ (2.72e−2) =	$2.6045e{+}2^{3}$ (3.08e−2) =
WFG6	3	400	$3.2763e{+}1^{4}$ (1.15e−2)	$3.2554e{+}1^{8}$ (1.30e−1) −	$3.2767e{+}1^{1}$ (1.96e−2) =	$3.2765e{+}1^{2}$ (1.27e−2) =	$3.2764e{+}1^{3}$ (1.15e−2) =	$3.2760e{+}1^{6}$ (1.04e−2) =	$3.2761e{+}1^{5}$ (1.45e−2) =	$3.2760e{+}1^{7}$ (1.57e−2) =
	5	750	$1.3935e{+}2^{6}$ (2.60e−2)	$1.3905e{+}2^{8}$ (2.77e−1) −	$1.3937e{+}2^{1}$ (2.15e−2) +	$1.3935e{+}2^{5}$ (1.88e−2) =	$1.3935e{+}2^{7}$ (2.85e−2) =	$1.3936e{+}2^{4}$ (2.20e−2) =	$1.3936e{+}2^{3}$ (1.91e−2) =	$1.3936e{+}2^{2}$ (2.52e−2) =
	8	1500	$1.4783e{+}2^{2}$ (2.86e−2)	$1.4780e{+}2^{8}$ (1.02e−1) −	$1.4783e{+}2^{3}$ (3.62e−2) =	$1.4784e{+}2^{1}$ (3.96e−2) =	$1.4783e{+}2^{6}$ (2.92e−2) =	$1.4783e{+}2^{5}$ (3.50e−2) =	$1.4783e{+}2^{4}$ (4.24e−2) =	$1.4782e{+}2^{7}$ (3.36e−2) =
	10	2000	$2.6054e{+}2^{1}$ (5.48e−2)	$2.6039e{+}2^{8}$ (2.94e−1) =	$2.6053e{+}2^{5}$ (6.05e−2) =	$2.6052e{+}2^{6}$ (6.20e−2) =	$2.6054e{+}2^{3}$ (6.43e−2) =	$2.6053e{+}2^{4}$ (5.68e−2) =	$2.6054e{+}2^{2}$ (6.49e−2) =	$2.6051e{+}2^{7}$ (6.20e−2) −
WFG7	3	400	$3.2848e{+}1^{6}$ (2.37e−2)	$3.2642e{+}1^{8}$ (1.47e−1) −	$3.2850e{+}1^{4}$ (2.19e−2) =	$3.2853e{+}1^{2}$ (2.10e−2) =	$3.2849e{+}1^{5}$ (2.41e−2) =	$3.2852e{+}1^{3}$ (2.10e−2) =	$3.2859e{+}1^{1}$ (2.76e−2) +	$3.2846e{+}1^{7}$ (2.03e−2) =
	5	750	$1.3970e{+}2^{5}$ (7.95e−2)	$1.3933e{+}2^{8}$ (3.35e−1) −	$1.3969e{+}2^{7}$ (5.94e−2) =	$1.3972e{+}2^{2}$ (6.64e−2) =	$1.3970e{+}2^{6}$ (7.71e−2) =	$1.3970e{+}2^{3}$ (6.95e−2) =	$1.3970e{+}2^{4}$ (8.08e−2) =	$1.3973e{+}2^{1}$ (7.47e−2) =
	8	1500	$1.4791e{+}2^{6}$ (4.17e−2)	$1.4789e{+}2^{8}$ (1.16e−1) =	$1.4791e{+}2^{5}$ (4.27e−2) =	$1.4794e{+}2^{1}$ (4.57e−2) =	$1.4791e{+}2^{7}$ (4.37e−2) =	$1.4793e{+}2^{2}$ (4.16e−2) =	$1.4793e{+}2^{3}$ (5.36e−2) +	$1.4792e{+}2^{4}$ (4.09e−2) =
	10	2000	$2.6079e{+}2^{3}$ (1.04e−1)	$2.6051e{+}2^{8}$ (2.96e−1) −	$2.6077e{+}2^{4}$ (1.81e−1) =	$2.6079e{+}2^{2}$ (1.16e−1) =	$2.6076e{+}2^{6}$ (1.06e−1) =	$2.6076e{+}2^{7}$ (1.39e−1) =	$2.6081e{+}2^{1}$ (9.97e−2) =	$2.6077e{+}2^{5}$ (9.98e−2) =
WFG8	3	400	$3.2455e{+}1^{7}$ (9.43e−2)	$3.2273e{+}1^{8}$ (2.34e−1) −	$3.2581e{+}1^{2}$ (8.96e−2) +	$3.2559e{+}1^{3}$ (8.26e−2) +	$3.2552e{+}1^{4}$ (8.12e−2) +	$3.2587e{+}1^{1}$ (9.36e−2) +	$3.2547e{+}1^{6}$ (9.05e−2) +	$3.2548e{+}1^{5}$ (9.16e−2) +
	5	750	$1.3910e{+}2^{4}$ (7.35e−2)	$1.3858e{+}2^{8}$ (4.20e−1) −	$1.3910e{+}2^{3}$ (1.00e−1) =	$1.3908e{+}2^{6}$ (8.45e−2) =	$1.3909e{+}2^{5}$ (1.06e−1) =	$1.3908e{+}2^{7}$ (6.63e−2) =	$1.3911e{+}2^{2}$ (1.01e−1) =	$1.3911e{+}2^{1}$ (8.16e−2) =
	8	1500	$1.4737e{+}2^{7}$ (2.51e−1)	$1.4649e{+}2^{8}$ (6.02e−1) −	$1.4774e{+}2^{3}$ (1.21e−1) +	$1.4774e{+}2^{2}$ (1.63e−1) +	$1.4775e{+}2^{1}$ (1.79e−1) +	$1.4760e{+}2^{6}$ (1.15e−1) +	$1.4766e{+}2^{5}$ (1.83e−1) +	$1.4773e{+}2^{4}$ (1.56e−1) +
	10	2000	$2.6019e{+}2^{7}$ (6.70e−1)	$2.5850e{+}2^{8}$ (9.73e−1) −	$2.6083e{+}2^{4}$ (8.91e−1) +	$2.6096e{+}2^{1}$ (5.70e−1) +	$2.6090e{+}2^{2}$ (7.61e−1) +	$2.6031e{+}2^{6}$ (6.38e−1) =	$2.6073e{+}2^{5}$ (7.36e−1) +	$2.6090e{+}2^{3}$ (5.86e−1) +
WFG9	3	400	$3.1803e{+}1^{1}$ (1.87e−1)	$3.1470e{+}1^{8}$ (2.15e−1) −	$3.1645e{+}1^{6}$ (1.78e−1) −	$3.1690e{+}1^{5}$ (1.77e−1) −	$3.1699e{+}1^{3}$ (1.36e−1) −	$3.1749e{+}1^{2}$ (2.03e−1) =	$3.1633e{+}1^{7}$ (1.74e−1) −	$3.1697e{+}1^{4}$ (2.00e−1) −
	5	750	$1.3541e{+}2^{1}$ (3.32e−1)	$1.3459e{+}2^{8}$ (6.92e−1) −	$1.3523e{+}2^{5}$ (4.86e−1) =	$1.3527e{+}2^{3}$ (3.53e−1) =	$1.3530e{+}2^{2}$ (3.22e−1) =	$1.3511e{+}2^{7}$ (3.12e−1) −	$1.3526e{+}2^{4}$ (4.30e−1) =	$1.3523e{+}2^{6}$ (3.34e−1) −
	8	1500	$1.4683e{+}2^{3}$ (1.38e−1)	$1.4661e{+}2^{8}$ (4.89e−1) −	$1.4683e{+}2^{2}$ (1.19e−1) =	$1.4686e{+}2^{1}$ (1.09e−1) =	$1.4682e{+}2^{5}$ (1.01e−1) =	$1.4682e{+}2^{4}$ (1.13e−1) =	$1.4680e{+}2^{7}$ (1.18e−1) =	$1.4681e{+}2^{6}$ (1.06e−1) =
	10	2000	$2.5862e{+}2^{4}$ (1.58e−1)	$2.5825e{+}2^{8}$ (5.52e−1) −	$2.5866e{+}2^{1}$ (1.65e−1) =	$2.5862e{+}2^{5}$ (1.79e−1) =	$2.5864e{+}2^{3}$ (1.11e−1) =	$2.5860e{+}2^{7}$ (1.63e−1) =	$2.5864e{+}2^{2}$ (1.60e−1) =	$2.5861e{+}2^{6}$ (1.78e−1) =
+/−/=				0/36/8	6/3/35	4/6/34	5/7/32	4/4/36	8/4/32	4/5/35
% of satisfaction				18.18%	93.18%	86.36%	84.09%	90.91%	90.91%	88.64%

2.1 Regular PF shapes

Figures 1 to 44 show the final populations with the median HV value among 30 independent runs obtained by all MOEAs on MOPs with regular PF shapes with 3, 5, 8 and 10 objective functions. It can be seen that NSGA-III, RVEA, and MOEA/D aim to obtain the uniform distribution given by the SLD on these MOPs. Also, all versions of NSGA-III-Ada$\mathcal{K}$, RVEA-Ada$\mathcal{K}$, and MOEA/D-Ada$\mathcal{K}$ get similar distributions to their original versions on most MOPs. In contrast, A-NSGA-III, RVEA*, and AdaW do not obtain the same distribution of NSGA-III, RVEA, and MOEA/D, respectively. It is worth noting that MOEA/D and all versions of MOEA/D-Ada$\mathcal{K}$ have difficulties preserving extreme solutions on DTLZ1, DTLZ3, and DTLZ4 with 8 and 10 objective functions due to the multi-modality of DTLZ1 and DTLZ3 and the bias difficulty of DTLZ4. Also, MOEA/D and all versions of MOEA/D-Ada$\mathcal{K}$ cannot obtain the distribution given by the SLD on all instances of WFG8 and WFG9. Finally, it can be seen that all versions of RVEA-Ada$\mathcal{K}$ and MOEA/D-Ada$\mathcal{K}$ have difficulties preserving the distribution obtained by RVEA and MOEA/D, respectively, on all instances of WFG1 due to the bias difficulty. Figures 1 to 44 highlight that our adaptation method promotes preserving the original performance of MOEAs that use predefined WVRSs on most MOPs with regular PF shapes.

2.2 Irregular PF shapes

Final populations with the median HV value among 30 independent runs obtained by all MOEAs on MOPs with irregular PF shapes with 3, 5, 8, and 10 objective functions are shown in Figures 45 to 128. They

Table 3: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the RVEA framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to RVEA based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to RVEA. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	RVEA	RVEA*	RVEA-AdaRSE	RVEA-AdaGAE	RVEA-AdaMPT	RVEA-AdaCOU	RVEA-AdaPT	RVEA-AdaKRA
DTLZ1	3	400	7.7876e+0^{3} (2.09e−3)	7.7705e+0^{8} (6.04e−3) −	7.7880e+0^{1} (1.72e−3) =	7.7878e+0^{2} (1.55e−3) =	7.7873e+0^{7} (1.89e−3) =	7.7875e+0^{4} (1.42e−3) =	7.7874e+0^{5} (2.52e−3) =	7.7874e+0^{6} (2.37e−3) =
	5	600	3.1967e+1^{6} (1.30e−4)	3.1958e+1^{8} (2.04e−3) −	3.1967e+1^{5} (1.13e−4) =	3.1967e+1^{4} (1.03e−4) =	3.1967e+1^{1} (8.08e−5) =	3.1967e+1^{3} (8.64e−5) =	3.1967e+1^{7} (1.29e−4) =	3.1967e+1^{2} (1.35e−4) =
	8	750	2.5599e+2^{7} (6.09e−4)	2.5599e+2^{8} (5.51e−3) −	2.5599e+2^{6} (4.43e−4) +	2.5599e+2^{1} (7.34e−5) +	2.5599e+2^{5} (2.63e−4) =	2.5599e+2^{2} (7.34e−5) +	2.5599e+2^{4} (2.13e−4) +	2.5599e+2^{3} (1.15e−4) +
	10	1000	1.0240e+3^{7} (2.67e−5)	1.0240e+3^{8} (5.02e−3) −	1.0240e+3^{6} (3.15e−5) =	1.0240e+3^{3} (6.98e−6) +	1.0240e+3^{1} (3.86e−6) +	1.0240e+3^{4} (7.65e−6) +	1.0240e+3^{5} (4.90e−6) +	1.0240e+3^{2} (8.14e−6) +
DTLZ2	3	250	7.4131e+0^{3} (1.41e−4)	7.3889e+0^{8} (6.23e−3) −	7.4131e+0^{5} (2.11e−4) =	7.4132e+0^{1} (2.11e−4) =	7.4131e+0^{6} (2.54e−4) =	7.4131e+0^{4} (2.03e−4) =	7.4131e+0^{7} (2.17e−4) =	7.4131e+0^{2} (1.81e−4) =
	5	350	3.1698e+1^{4} (1.21e−4)	3.1666e+1^{8} (8.65e−3) −	3.1698e+1^{7} (1.40e−4) =	3.1698e+1^{3} (1.23e−4) =	3.1698e+1^{1} (1.05e−4) =	3.1698e+1^{6} (1.09e−4) =	3.1698e+1^{2} (1.16e−4) =	3.1698e+1^{5} (1.03e−4) =
	8	500	2.5584e+2^{3} (1.27e−4)	2.5583e+2^{8} (4.95e−3) −	2.5584e+2^{7} (1.62e−4) =	2.5584e+2^{5} (1.35e−4) =	2.5584e+2^{1} (1.74e−4) =	2.5584e+2^{4} (1.75e−4) =	2.5584e+2^{6} (1.36e−4) =	2.5584e+2^{2} (1.65e−4) =
	10	750	1.0239e+3^{7} (4.97e−5)	1.0239e+3^{8} (6.60e−3) −	1.0239e+3^{3} (5.75e−5) =	1.0239e+3^{1} (6.47e−5) +	1.0239e+3^{5} (5.58e−5) =	1.0239e+3^{2} (5.99e−5) =	1.0239e+3^{4} (6.64e−5) =	1.0239e+3^{6} (5.14e−5) =
DTLZ3	3	1000	7.4085e+0^{3} (2.98e−3)	7.3844e+0^{8} (1.00e−2) −	7.4066e+0^{7} (5.91e−3) =	7.4089e+0^{1} (4.33e−3) =	7.4088e+0^{2} (3.54e−3) =	7.4077e+0^{5} (5.19e−3) =	7.4069e+0^{6} (5.03e−3) =	7.4079e+0^{4} (4.21e−3) =
	5	1000	3.1696e+1^{4} (1.55e−3)	3.1670e+1^{8} (7.40e−3) −	3.1696e+1^{7} (1.79e−3) =	3.1696e+1^{5} (1.49e−3) =	3.1696e+1^{3} (1.82e−3) =	3.1696e+1^{6} (1.60e−3) =	3.1697e+1^{2} (1.41e−3) =	3.1697e+1^{1} (9.22e−4) =
	8	1000	2.5583e+2^{7} (4.22e−3)	2.5581e+2^{8} (1.04e−2) −	2.5583e+2^{6} (4.10e−3) =	2.5583e+2^{5} (4.37e−3) =	2.5583e+2^{3} (3.26e−3) =	2.5583e+2^{4} (3.61e−3) =	2.5583e+2^{2} (4.23e−3) =	2.5583e+2^{1} (3.40e−3) +
	10	1500	1.0239e+3^{4} (5.24e−4)	1.0239e+3^{8} (5.09e−3) −	1.0239e+3^{1} (4.89e−4) =	1.0239e+3^{6} (4.35e−4) =	1.0239e+3^{2} (3.88e−4) =	1.0239e+3^{5} (6.51e−4) =	1.0239e+3^{7} (4.54e−4) =	1.0239e+3^{3} (4.87e−4) =
DTLZ4	3	600	7.4138e+0^{6} (8.27e−5)	7.0202e+0^{8} (7.17e−1) −	7.4138e+0^{2} (3.20e−5) =	7.4138e+0^{1} (3.34e−5) =	7.3802e+0^{7} (1.84e−1) =	7.4138e+0^{3} (3.57e−5) =	7.4138e+0^{5} (5.38e−5) =	7.4138e+0^{4} (3.05e−5) =
	5	1000	3.1698e+1^{2} (2.36e−5)	3.1681e+1^{8} (7.08e−3) −	3.1698e+1^{3} (2.55e−5) =	3.1698e+1^{5} (2.77e−5) =	3.1698e+1^{6} (2.59e−5) −	3.1698e+1^{7} (3.03e−5) =	3.1698e+1^{4} (2.25e−5) =	3.1698e+1^{1} (2.14e−5) =
	8	1250	2.5584e+2^{3} (1.06e−4)	2.5583e+2^{4} (1.54e−3) −	2.5581e+2^{8} (1.68e−1) =	2.5584e+2^{2} (6.06e−5) =	2.5584e+2^{1} (6.52e−5) +	2.5583e+2^{6} (4.06e−2) =	2.5581e+2^{7} (7.79e−2) =	2.5583e+2^{5} (4.04e−2) =
	10	2000	1.0239e+3^{3} (4.64e−5)	1.0239e+3^{8} (2.00e−3) −	1.0239e+3^{1} (4.29e−5) =	1.0239e+3^{2} (3.83e−5) =	1.0239e+3^{6} (3.43e−5) =	1.0239e+3^{7} (4.53e−5) =	1.0239e+3^{4} (3.40e−5) =	1.0239e+3^{5} (3.34e−5) =
WFG1	3	400	5.3371e+0^{1} (4.70e−2)	5.2803e+0^{4} (3.41e−2) −	5.2736e+0^{8} (3.66e−2) −	5.2812e+0^{3} (4.19e−2) −	5.2795e+0^{5} (3.80e−2) −	5.2747e+0^{7} (3.66e−2) −	5.2786e+0^{6} (3.79e−2) −	5.2824e+0^{2} (4.08e−2) −
	5	750	2.1186e+1^{1} (3.40e−1)	1.9492e+1^{8} (1.21e−1) −	2.0866e+1^{4} (2.03e−1) −	2.0789e+1^{5} (2.35e−1) −	2.0902e+1^{3} (2.77e−1) −	2.0920e+1^{2} (2.47e−1) −	2.0759e+1^{6} (1.95e−1) −	2.0727e+1^{7} (1.81e−1) −
	8	1500	1.8773e+2^{1} (4.95e+0)	1.5316e+2^{8} (1.46e+0) −	1.7263e+2^{6} (3.73e+0) −	1.7266e+2^{5} (4.73e+0) −	1.7169e+2^{7} (3.93e+0) −	1.7366e+2^{3} (4.47e+0) −	1.7341e+2^{4} (4.77e+0) −	1.7371e+2^{2} (4.34e+0) −
	10	2000	9.1928e+2^{1} (2.15e+1)	7.1806e+2^{8} (2.38e+1) −	7.7076e+2^{7} (1.99e+1) −	7.7482e+2^{6} (1.99e+1) −	7.8111e+2^{4} (2.07e+1) −	7.8851e+2^{2} (1.85e+1) −	7.8249e+2^{3} (1.73e+1) −	7.7888e+2^{5} (1.95e+1) −
WFG4	3	400	7.3563e+0^{1} (6.18e−3)	7.3042e+0^{8} (2.38e−2) −	7.3543e+0^{4} (1.10e−2) =	7.3543e+0^{5} (6.88e−3) =	7.3526e+0^{7} (7.97e−3) −	7.3539e+0^{6} (8.42e−3) =	7.3562e+0^{2} (9.83e−3) =	7.3549e+0^{3} (8.45e−3) =
	5	750	3.1564e+1^{1} (1.84e−2)	3.1209e+1^{8} (4.83e−2) −	3.1561e+1^{3} (2.14e−2) =	3.1558e+1^{5} (1.99e−2) =	3.1562e+1^{2} (2.05e−2) =	3.1557e+1^{6} (2.41e−2) =	3.1559e+1^{4} (1.89e−2) =	3.1554e+1^{7} (2.34e−2) −
	8	1500	2.5539e+2^{1} (9.39e−2)	2.5263e+2^{8} (4.51e−1) −	2.5534e+2^{5} (1.35e−1) =	2.5529e+2^{7} (1.37e−1) −	2.5534e+2^{6} (1.31e−1) =	2.5535e+2^{4} (1.44e−1) =	2.5537e+2^{2} (1.37e−1) =	2.5536e+2^{3} (1.13e−1) =
	10	2000	1.0231e+3^{1} (1.81e−1)	1.0165e+3^{8} (1.26e+0) −	1.0229e+3^{5} (2.77e−1) −	1.0229e+3^{6} (3.41e−1) −	1.0229e+3^{7} (2.33e−1) −	1.0230e+3^{3} (2.55e−1) =	1.0231e+3^{2} (2.22e−1) =	1.0230e+3^{4} (2.40e−1) =
WFG5	3	400	7.2228e+0^{3} (2.91e−3)	7.1859e+0^{8} (1.98e−2) −	7.2199e+0^{7} (1.47e−2) =	7.2234e+0^{2} (1.46e−3) =	7.2235e+0^{1} (1.79e−3) =	7.2225e+0^{4} (2.18e−3) =	7.2222e+0^{5} (3.12e−3) =	7.2220e+0^{6} (3.90e−3) =
	5	750	3.0788e+1^{5} (1.83e−3)	3.0663e+1^{8} (4.22e−2) −	3.0788e+1^{7} (2.23e−3) =	3.0788e+1^{4} (1.91e−3) =	3.0788e+1^{3} (1.49e−3) =	3.0788e+1^{1} (1.56e−3) =	3.0788e+1^{2} (1.85e−3) =	3.0788e+1^{6} (2.13e−3) =
	8	1500	2.4725e+2^{7} (2.75e−3)	2.4678e+2^{8} (8.57e−2) −	2.4725e+2^{2} (2.76e−3) =	2.4725e+2^{3} (2.91e−3) =	2.4725e+2^{1} (1.88e−3) +	2.4725e+2^{5} (3.29e−3) =	2.4725e+2^{6} (2.97e−3) =	2.4725e+2^{4} (2.49e−3) =
	10	2000	9.8697e+2^{5} (5.02e−3)	9.8613e+2^{8} (1.93e−1) −	9.8697e+2^{7} (5.26e−3) =	9.8698e+2^{2} (4.58e−3) =	9.8697e+2^{3} (4.18e−3) =	9.8698e+2^{1} (3.01e−3) =	9.8697e+2^{6} (4.35e−3) =	9.8697e+2^{4} (4.06e−3) =
WFG6	3	400	7.2119e+0^{6} (1.68e−2)	7.1699e+0^{8} (2.64e−2) −	7.2084e+0^{7} (2.27e−2) =	7.2137e+0^{5} (2.12e−2) =	7.2196e+0^{3} (2.55e−2) =	7.2192e+0^{4} (2.31e−2) =	7.2211e+0^{2} (2.43e−2) +	7.2214e+0^{1} (1.82e−2) +
	5	750	3.0840e+1^{5} (9.96e−2)	3.0539e+1^{8} (8.48e−2) −	3.0874e+1^{2} (1.00e−1) =	3.0837e+1^{6} (8.47e−2) =	3.0878e+1^{1} (9.29e−2) =	3.0832e+1^{7} (8.71e−2) =	3.0842e+1^{4} (1.18e−1) =	3.0858e+1^{3} (9.60e−2) =
	8	1500	2.4725e+2^{4} (1.44e+0)	2.4534e+2^{8} (1.37e+0) −	2.4732e+2^{2} (1.59e+0) =	2.4685e+2^{6} (1.40e+0) =	2.4682e+2^{7} (1.65e+0) =	2.4750e+2^{1} (1.20e+0) =	2.4730e+2^{3} (1.72e+0) =	2.4705e+2^{5} (1.53e+0) =
	10	2000	9.8498e+2^{2} (6.57e+0)	9.7843e+2^{8} (6.16e+0) −	9.8390e+2^{3} (7.55e+0) =	9.8351e+2^{5} (7.64e+0) =	9.8376e+2^{4} (6.95e+0) =	9.8341e+2^{6} (7.85e+0) =	9.8322e+2^{7} (7.36e+0) =	9.8520e+2^{1} (5.07e+0) =
WFG7	3	400	7.3701e+0^{2} (7.26e−3)	7.3362e+0^{8} (1.93e−2) −	7.3660e+0^{7} (8.29e−3) −	7.3662e+0^{6} (5.52e−3) −	7.3714e+0^{1} (5.55e−3) =	7.3694e+0^{3} (6.02e−3) =	7.3677e+0^{5} (4.32e−3) =	7.3685e+0^{4} (6.17e−3) =
	5	750	3.1649e+1^{1} (8.17e−3)	3.1461e+1^{8} (3.68e−2) −	3.1642e+1^{4} (9.38e−3) −	3.1642e+1^{5} (7.51e−3) −	3.1640e+1^{7} (7.68e−3) −	3.1642e+1^{3} (8.99e−3) −	3.1644e+1^{2} (7.05e−3) −	3.1641e+1^{6} (8.03e−3) −
	8	1500	2.5568e+2^{1} (3.70e−2)	2.5407e+2^{8} (3.92e−1) −	2.5549e+2^{6} (1.03e−1) −	2.5547e+2^{7} (1.72e−1) −	2.5550e+2^{5} (1.25e−1) −	2.5559e+2^{3} (7.14e−2) −	2.5558e+2^{4} (7.14e−2) −	2.5559e+2^{2} (6.87e−2) −
	10	2000	1.0236e+3^{1} (9.66e−2)	1.0196e+3^{8} (1.01e+0) −	1.0233e+3^{6} (2.23e−1) −	1.0232e+3^{7} (2.52e−1) −	1.0233e+3^{5} (2.31e−1) −	1.0235e+3^{2} (1.09e−1) −	1.0235e+3^{4} (1.56e−1) −	1.0235e+3^{3} (1.19e−1) −
WFG8	3	400	7.2117e+0^{1} (1.37e−2)	7.1906e+0^{6} (1.41e−2) −	7.1956e+0^{4} (2.92e−2) −	7.1831e+0^{8} (4.16e−2) −	7.1916e+0^{5} (3.00e−2) −	7.2041e+0^{2} (2.43e−2) =	7.2002e+0^{3} (2.78e−2) =	7.1897e+0^{7} (3.54e−2) −
	5	750	3.0969e+1^{2} (7.33e−2)	3.0622e+1^{8} (1.12e−1) −	3.0948e+1^{4} (6.96e−2) =	3.0943e+1^{6} (7.26e−2) =	3.0939e+1^{7} (7.60e−2) =	3.0956e+1^{3} (7.05e−2) =	3.0972e+1^{1} (8.14e−2) =	3.0944e+1^{5} (7.48e−2) =
	8	1500	2.4135e+2^{6} (8.54e+0)	2.2950e+2^{8} (6.46e+0) −	2.3847e+2^{7} (1.12e+1) =	2.4167e+2^{3} (6.07e+0) =	2.4148e+2^{5} (6.18e+0) =	2.4173e+2^{1} (4.04e+0) =	2.4171e+2^{2} (8.98e+0) =	2.4162e+2^{4} (6.66e+0) =
	10	2000	9.5069e+2^{2} (5.70e+1)	9.1865e+2^{8} (5.46e+1) −	9.3560e+2^{5} (5.72e+1) =	9.4663e+2^{4} (5.89e+1) =	9.2628e+2^{7} (6.26e+1) −	9.5266e+2^{1} (4.96e+1) =	9.4938e+2^{3} (6.41e+1) =	9.3337e+2^{6} (6.71e+1) =
WFG9	3	400	7.1480e+0^{4} (8.01e−2)	7.1227e+0^{8} (7.33e−2) −	7.1431e+0^{6} (6.67e−2) =	7.1419e+0^{7} (7.48e−2) =	7.1612e+0^{1} (6.88e−2) =	7.1608e+0^{2} (5.63e−2) =	7.1559e+0^{3} (5.55e−2) =	7.1432e+0^{5} (7.04e−2) =
	5	750	3.0849e+1^{2} (8.82e−2)	3.0356e+1^{8} (1.92e−1) −	3.0812e+1^{7} (1.50e−1) =	3.0838e+1^{4} (9.76e−2) =	3.0847e+1^{3} (1.22e−1) =	3.0835e+1^{6} (1.31e−1) =	3.0837e+1^{5} (1.56e−1) =	3.0863e+1^{1} (1.14e−1) =
	8	1500	2.4725e+2^{7} (3.17e+0)	2.4436e+2^{8} (2.22e+0) −	2.4857e+2^{2} (1.31e+0) =	2.4874e+2^{1} (1.25e+0) +	2.4804e+2^{5} (2.08e+0) =	2.4829e+2^{3} (1.56e+0) =	2.4780e+2^{6} (2.09e+0) =	2.4811e+2^{4} (1.48e+0) =
	10	2000	9.9794e+2^{4} (1.35e+1)	9.8610e+2^{8} (4.26e+0) −	9.9816e+2^{3} (6.05e+0) =	9.9944e+2^{1} (4.21e+0) =	9.9773e+2^{6} (6.83e+0) =	9.9587e+2^{7} (1.41e+1) =	9.9775e+2^{5} (5.60e+0) −	9.9937e+2^{2} (4.36e+0) =
+/−/=				0/44/0	1/10/33	4/11/29	3/12/29	2/7/35	3/8/33	4/9/31
% of satisfaction				0.00%	77.27%	75.00%	72.73%	84.09%	81.82%	79.55%

show that MOEAs with adaptation methods enhance the distribution of solutions obtained by their original MOEAs on most MOPs. However, A-NSGA-III cannot improve the distribution of solutions of NSGA-III on MOPs with inverted linear and inverted convex PF shapes with 8 and 10 objective functions. Furthermore, RVEA*, AdaW, and MOEAs with our adaptation method using $\mathcal{K}_{\text{RSE}}$, $\mathcal{K}_{\text{GAE}}$, and $\mathcal{K}_{\text{MPT}}$ have difficulties reaching extreme solutions on these MOPs. In addition, it is worth noting that all versions of MOEA/D-Ada$\mathcal{K}$ present crowded regions near the extreme solutions on MOPs with inverted convex PF shapes with 3 objective functions. These crowded regions are generated by solutions related to useful weight vectors, similar to the distribution achieved by MOEA/D on these MOPs. Also, it can be seen that RVEA and all versions of RVEA-Ada$\mathcal{K}$ may include dominated solutions in their final populations on some MOPs since they do not filter such solutions. Additionally, we can observe that MOEAs with our adaptation method do not improve the distribution of solutions on WFG2 since most original weight vectors are detected as useful weight vectors on this MOP. Finally, it can be seen that some MOEAs with our adaptation method have difficulties in fully covering the PF of WFG1^{-1} due to the bias difficulty. Figures 45 to 128 show that our adaptation method is useful in improving the performance of MOEAs using predefined WVRSs on most MOPs with irregular PF shapes.

3 Convergence and diversity graphs

Figure 7 of the main paper shows the convergence and diversity graphs generated with the mean HV value and the mean SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D

Table 4: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the RVEA framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to RVEA based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to RVEA. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	RVEA	RVEA*	RVEA-AdaRSE	RVEA-AdaGAE	RVEA-AdaMPT	RVEA-AdaCOU	RVEA-AdaPT	RVEA-AdaKRA
DTLZ1	3	400	2.3357e+1^{5} (9.76e−2)	2.2423e+1^{8} (1.95e−1) −	2.3339e+1^{7} (7.91e−2) =	2.3349e+1^{6} (6.97e−2) =	2.3372e+1^{1} (9.00e−2) =	2.3364e+1^{4} (7.11e−2) =	2.3368e+1^{2} (1.27e−1) =	2.3365e+1^{3} (1.11e−1) =
	5	600	7.3023e+1^{2} (1.12e−1)	6.6500e+1^{8} (7.02e−1) −	7.3008e+1^{5} (1.07e−1) =	7.3016e+1^{3} (8.68e−2) =	7.2995e+1^{7} (6.72e−2) =	7.3008e+1^{4} (7.08e−2) =	7.3036e+1^{1} (1.08e−1) =	7.3006e+1^{6} (1.06e−1) =
	8	750	1.0782e+2^{7} (5.92e−1)	9.6977e+1^{8} (2.12e+0) −	1.0803e+2^{6} (4.70e−1) +	1.0810e+2^{3} (2.80e−1) +	1.0805e+2^{4} (4.61e−1) +	1.0824e+2^{1} (2.05e−1) +	1.0804e+2^{5} (3.82e−1) =	1.0819e+2^{2} (2.12e−1) +
	10	1000	1.7619e+2^{7} (5.13e−1)	1.5156e+2^{8} (3.16e+0) −	1.7636e+2^{6} (4.77e−1) +	1.7638e+2^{5} (3.86e−1) +	1.7647e+2^{4} (2.48e−1) +	1.7656e+2^{2} (2.27e−1) +	1.7652e+2^{3} (1.91e−1) +	1.7657e+2^{1} (2.36e−1) +
DTLZ2	3	250	3.2775e+1^{1} (4.45e−3)	3.2171e+1^{8} (1.49e−1) −	3.2769e+1^{5} (1.85e−2) =	3.2767e+1^{7} (1.65e−2) −	3.2772e+1^{4} (1.53e−2) =	3.2775e+1^{3} (7.22e−3) =	3.2775e+1^{2} (1.32e−2) =	3.2768e+1^{6} (1.84e−2) −
	5	350	1.3955e+2^{2} (2.75e−2)	1.3817e+2^{8} (4.70e−1) −	1.3954e+2^{7} (2.81e−2) =	1.3955e+2^{1} (2.11e−2) =	1.3954e+2^{6} (2.36e−2) =	1.3954e+2^{3} (2.51e−2) =	1.3954e+2^{4} (2.31e−2) =	1.3954e+2^{5} (2.69e−2) =
	8	500	1.4781e+2^{6} (1.83e−1)	1.4964e+2^{1} (1.18e−1) +	1.4786e+2^{3} (2.81e−2) =	1.4780e+2^{7} (1.82e−1) −	1.4785e+2^{5} (3.03e−2) =	1.4786e+2^{2} (2.78e−2) =	1.4785e+2^{4} (2.35e−2) =	1.4778e+2^{8} (2.20e−1) =
	10	750	2.6051e+2^{2} (1.38e−1)	2.6400e+2^{1} (3.76e−1) +	2.6044e+2^{7} (2.29e−1) =	2.6047e+2^{6} (1.80e−1) −	2.6050e+2^{4} (1.29e−1) =	2.6051e+2^{3} (1.22e−1) =	2.6049e+2^{5} (1.28e−1) =	2.6043e+2^{8} (3.00e−1) =
DTLZ3	3	1000	3.2889e+1^{5} (7.20e−2)	3.2461e+1^{8} (2.43e−1) −	3.2936e+1^{1} (1.44e−1) =	3.2877e+1^{7} (1.10e−1) =	3.2884e+1^{6} (9.04e−2) =	3.2911e+1^{3} (1.27e−1) =	3.2924e+1^{2} (1.23e−1) =	3.2907e+1^{4} (1.07e−1) =
	5	1000	1.3965e+2^{5} (1.86e−1)	1.3833e+2^{8} (7.48e−1) −	1.3971e+2^{1} (2.19e−1) =	1.3967e+2^{3} (1.84e−1) =	1.3965e+2^{4} (2.21e−1) =	1.3968e+2^{2} (1.91e−1) =	1.3961e+2^{6} (1.67e−1) =	1.3961e+2^{7} (1.14e−1) =
	8	1000	1.4796e+2^{4} (2.18e−1)	1.4951e+2^{1} (2.98e−1) +	1.4799e+2^{2} (1.30e−1) =	1.4798e+2^{3} (1.46e−1) =	1.4795e+2^{6} (1.15e−1) =	1.4796e+2^{5} (1.18e−1) =	1.4791e+2^{7} (2.45e−1) =	1.4781e+2^{8} (5.43e−1) −
	10	1500	2.6051e+2^{4} (7.92e−2)	2.6408e+2^{1} (3.20e−1) +	2.6047e+2^{6} (1.28e−1) =	2.6052e+2^{2} (5.65e−2) =	2.6046e+2^{8} (1.88e−1) =	2.6047e+2^{7} (1.32e−1) =	2.6048e+2^{5} (1.43e−1) =	2.6051e+2^{3} (6.39e−2) =
DTLZ4	3	600	3.2758e+1^{1} (2.71e−3)	2.4895e+1^{8} (1.14e+1) −	3.2757e+1^{6} (9.88e−4) =	3.2757e+1^{4} (9.31e−4) =	3.1954e+1^{7} (4.40e+0) =	3.2757e+1^{5} (1.07e−3) =	3.2757e+1^{2} (1.44e−3) =	3.2757e+1^{3} (1.18e−3) =
	5	1000	1.3943e+2^{6} (5.82e−3)	1.3771e+2^{8} (4.46e−1) −	1.3943e+2^{2} (5.73e−3) =	1.3943e+2^{5} (6.54e−3) =	1.3943e+2^{4} (5.37e−3) =	1.3943e+2^{1} (7.01e−3) +	1.3943e+2^{3} (4.81e−3) =	1.3943e+2^{7} (4.88e−3) =
	8	1250	1.4785e+2^{3} (2.93e−2)	1.4951e+2^{1} (1.99e−1) +	1.4581e+2^{7} (1.10e+1) =	1.4784e+2^{4} (2.44e−2) =	1.4785e+2^{2} (2.46e−2) =	1.4645e+2^{6} (5.30e+0) =	1.4526e+2^{8} (6.67e+0) =	1.4714e+2^{5} (3.86e+0) =
	10	2000	2.6055e+2^{2} (4.31e−2)	2.6501e+2^{1} (1.85e−1) +	2.6052e+2^{5} (1.17e−1) =	2.6049e+2^{8} (1.77e−1) =	2.6051e+2^{6} (1.65e−1) =	2.6055e+2^{3} (1.19e−1) =	2.6050e+2^{7} (1.81e−1) =	2.6053e+2^{4} (1.09e−1) =
WFG1	3	400	1.7499e+1^{1} (2.33e−1)	1.5934e+1^{2} (4.43e−1) −	1.5657e+1^{5} (1.03e+0) −	1.5829e+1^{3} (9.89e−1) −	1.5493e+1^{6} (1.24e+0) −	1.5112e+1^{8} (1.21e+0) −	1.5698e+1^{4} (1.09e+0) −	1.5384e+1^{7} (1.19e+0) −
	5	750	3.0556e+1^{1} (7.75e−1)	2.8783e+1^{2} (8.15e−1) −	2.7317e+1^{6} (1.62e+0) −	2.7567e+1^{5} (2.43e+0) −	2.6860e+1^{8} (1.71e+0) −	2.7305e+1^{7} (2.16e+0) −	2.8131e+1^{4} (2.24e+0) −	2.8477e+1^{3} (1.99e+0) −
	8	1500	2.3293e+1^{8} (2.56e+0)	2.3680e+1^{7} (2.31e+0) =	3.2689e+1^{3} (2.14e+0) +	3.1619e+1^{6} (1.60e+0) +	3.2455e+1^{5} (1.87e+0) +	3.2497e+1^{4} (1.58e+0) +	3.4046e+1^{2} (1.83e+0) +	3.4732e+1^{1} (2.36e+0) +
	10	2000	2.4462e+1^{8} (2.04e+0)	2.8583e+1^{7} (1.46e+0) +	3.9023e+1^{4} (2.63e+0) +	3.8408e+1^{6} (2.37e+0) +	3.8720e+1^{5} (2.17e+0) +	4.0177e+1^{3} (2.45e+0) +	4.2794e+1^{2} (2.38e+0) +	4.2965e+1^{1} (2.17e+0) +
WFG4	3	400	3.2795e+1^{7} (8.90e−2)	3.1056e+1^{8} (3.12e−1) −	3.2806e+1^{4} (1.08e−1) =	3.2811e+1^{2} (8.80e−2) =	3.2807e+1^{3} (1.02e−1) =	3.2800e+1^{5} (1.25e−1) =	3.2825e+1^{1} (8.63e−2) =	3.2795e+1^{6} (9.00e−2) =
	5	750	1.3914e+2^{2} (9.61e−2)	1.2184e+2^{8} (1.64e+0) −	1.3910e+2^{7} (8.59e−2) −	1.3912e+2^{5} (8.34e−2) =	1.3910e+2^{6} (8.89e−2) =	1.3912e+2^{4} (8.60e−2) =	1.3913e+2^{3} (1.07e−1) =	1.3915e+2^{1} (7.10e−2) =
	8	1500	1.4740e+2^{3} (2.54e−1)	1.3071e+2^{8} (1.78e+0) −	1.4737e+2^{5} (2.75e−1) =	1.4739e+2^{4} (2.11e−1) =	1.4732e+2^{6} (3.42e−1) =	1.4743e+2^{2} (1.99e−1) =	1.4744e+2^{1} (2.82e−1) =	1.4731e+2^{7} (3.37e−1) =
	10	2000	2.5844e+2^{5} (9.96e−1)	1.9407e+2^{8} (2.94e+0) −	2.5886e+2^{1} (6.76e−1) =	2.5874e+2^{2} (6.22e−1) =	2.5844e+2^{4} (1.10e+0) =	2.5831e+2^{6} (8.10e−1) =	2.5874e+2^{3} (8.12e−1) =	2.5819e+2^{7} (9.95e−1) =
WFG5	3	400	3.2800e+1^{3} (4.60e−2)	3.0862e+1^{8} (2.68e−1) −	3.2759e+1^{7} (2.38e−1) =	3.2810e+1^{1} (3.35e−2) =	3.2807e+1^{2} (3.84e−2) =	3.2781e+1^{5} (6.41e−2) =	3.2782e+1^{4} (9.03e−2) =	3.2765e+1^{6} (1.34e−1) =
	5	750	1.3933e+2^{3} (4.21e−2)	1.1881e+2^{8} (9.47e−1) −	1.3933e+2^{5} (4.95e−2) =	1.3933e+2^{4} (4.90e−2) =	1.3932e+2^{7} (3.14e−2) =	1.3933e+2^{2} (2.58e−2) =	1.3933e+2^{1} (3.64e−2) =	1.3933e+2^{6} (4.52e−2) =
	8	1500	1.4737e+2^{1} (2.06e−1)	1.2926e+2^{8} (1.76e+0) −	1.4732e+2^{5} (2.28e−1) =	1.4734e+2^{3} (2.09e−1) =	1.4729e+2^{7} (1.93e−1) −	1.4735e+2^{2} (1.77e−1) =	1.4732e+2^{4} (2.42e−1) =	1.4731e+2^{6} (2.37e−1) =
	10	2000	2.5847e+2^{5} (8.43e−1)	1.8586e+2^{8} (2.67e+0) −	2.5851e+2^{4} (7.09e−1) =	2.5853e+2^{3} (5.46e−1) =	2.5856e+2^{2} (7.99e−1) =	2.5843e+2^{6} (7.56e−1) =	2.5859e+2^{1} (8.32e−1) =	2.5838e+2^{7} (7.85e−1) =
WFG6	3	400	3.2853e+1^{1} (8.69e−2)	3.1243e+1^{8} (2.68e−1) −	3.2822e+1^{5} (1.23e−1) =	3.2820e+1^{6} (1.02e−1) =	3.2823e+1^{4} (8.82e−2) =	3.2813e+1^{7} (1.32e−1) =	3.2828e+1^{2} (1.17e−1) =	3.2827e+1^{3} (1.15e−1) =
	5	750	1.3940e+2^{1} (3.27e−2)	1.2076e+2^{8} (1.36e+0) −	1.3939e+2^{3} (5.44e−2) =	1.3939e+2^{5} (4.07e−2) =	1.3939e+2^{2} (4.65e−2) =	1.3939e+2^{4} (6.08e−2) −	1.3938e+2^{7} (3.70e−2) −	1.3939e+2^{6} (3.67e−2) =
	8	1500	1.4654e+2^{1} (8.15e−1)	1.2761e+2^{8} (2.54e+0) −	1.4599e+2^{6} (6.88e−1) −	1.4605e+2^{5} (1.02e+0) −	1.4567e+2^{7} (8.04e−1) −	1.4613e+2^{4} (8.94e−1) −	1.4620e+2^{3} (9.03e−1) =	1.4625e+2^{2} (1.03e+0) =
	10	2000	2.5726e+2^{4} (1.13e+0)	1.9057e+2^{8} (3.16e+0) −	2.5711e+2^{6} (1.10e+0) =	2.5753e+2^{2} (1.17e+0) =	2.5703e+2^{7} (9.21e−1) =	2.5719e+2^{5} (1.33e+0) =	2.5729e+2^{3} (1.08e+0) =	2.5755e+2^{1} (9.10e−1) =
WFG7	3	400	3.2964e+1^{5} (1.00e−1)	3.1178e+1^{8} (3.46e−1) −	3.2955e+1^{7} (9.43e−2) =	3.2965e+1^{4} (8.82e−2) =	3.2957e+1^{6} (8.00e−2) =	3.2996e+1^{1} (8.35e−2) =	3.2994e+1^{2} (6.86e−2) =	3.2991e+1^{3} (8.37e−2) =
	5	750	1.3971e+2^{1} (6.29e−2)	1.2123e+2^{8} (1.30e+0) −	1.3971e+2^{2} (6.29e−2) =	1.3968e+2^{6} (6.50e−2) −	1.3966e+2^{7} (7.62e−2) −	1.3971e+2^{3} (7.13e−2) =	1.3970e+2^{4} (7.37e−2) =	1.3970e+2^{5} (8.27e−2) =
	8	1500	1.4705e+2^{1} (4.54e−1)	1.2764e+2^{8} (2.14e+0) −	1.4646e+2^{7} (5.25e−1) −	1.4657e+2^{6} (4.93e−1) −	1.4672e+2^{5} (5.38e−1) −	1.4689e+2^{4} (4.70e−1) =	1.4704e+2^{2} (3.92e−1) =	1.4690e+2^{3} (4.17e−1) −
	10	2000	2.5560e+2^{5} (9.65e−1)	1.8759e+2^{8} (3.42e+0) −	2.5633e+2^{1} (1.14e+0) +	2.5592e+2^{3} (9.95e−1) =	2.5609e+2^{2} (8.59e−1) +	2.5546e+2^{7} (9.68e−1) =	2.5572e+2^{4} (1.01e+0) =	2.5548e+2^{6} (1.30e+0) =
WFG8	3	400	3.2289e+1^{7} (2.02e−1)	3.1010e+1^{8} (2.59e−1) −	3.2449e+1^{4} (2.49e−1) +	3.2360e+1^{6} (2.31e−1) =	3.2460e+1^{3} (2.11e−1) +	3.2469e+1^{2} (1.90e−1) +	3.2529e+1^{1} (1.68e−1) +	3.2411e+1^{5} (1.89e−1) +
	5	750	1.3894e+2^{6} (1.62e−1)	1.2212e+2^{8} (1.12e+0) −	1.3895e+2^{5} (1.90e−1) =	1.3897e+2^{3} (1.76e−1) =	1.3899e+2^{2} (2.59e−1) =	1.3896e+2^{4} (2.15e−1) =	1.3892e+2^{7} (1.50e−1) =	1.3899e+2^{1} (2.09e−1) =
	8	1500	1.4495e+2^{4} (1.30e+0)	1.3521e+2^{8} (1.50e+0) −	1.4501e+2^{3} (1.18e+0) =	1.4480e+2^{6} (9.73e−1) =	1.4517e+2^{1} (9.32e−1) =	1.4480e+2^{7} (9.69e−1) =	1.4506e+2^{2} (8.69e−1) =	1.4484e+2^{5} (7.88e−1) =
	10	2000	2.5586e+2^{4} (1.05e+0)	1.9585e+2^{8} (7.25e+0) −	2.5526e+2^{7} (1.83e+0) =	2.5542e+2^{6} (1.93e+0) =	2.5609e+2^{1} (1.57e+0) =	2.5566e+2^{5} (1.26e+0) =	2.5605e+2^{2} (1.39e+0) =	2.5598e+2^{3} (1.44e+0) =
WFG9	3	400	3.1843e+1^{2} (2.29e−1)	3.0293e+1^{8} (2.96e−1) −	3.1756e+1^{7} (2.33e−1) =	3.1794e+1^{5} (2.31e−1) =	3.1840e+1^{4} (3.14e−1) =	3.1854e+1^{1} (1.77e−1) =	3.1841e+1^{3} (2.40e−1) =	3.1779e+1^{6} (2.45e−1) =
	5	750	1.3519e+2^{3} (3.49e−1)	1.1606e+2^{8} (1.30e+0) −	1.3515e+2^{5} (4.00e−1) =	1.3520e+2^{1} (3.06e−1) =	1.3517e+2^{4} (3.38e−1) =	1.3511e+2^{7} (3.88e−1) =	1.3520e+2^{2} (3.55e−1) =	1.3514e+2^{6} (3.38e−1) =
	8	1500	1.4564e+2^{5} (5.97e−1)	1.2891e+2^{8} (2.44e+0) −	1.4571e+2^{3} (7.72e−1) =	1.4548e+2^{7} (6.06e−1) =	1.4586e+2^{1} (5.79e−1) =	1.4575e+2^{2} (6.39e−1) =	1.4561e+2^{6} (5.46e−1) =	1.4569e+2^{4} (6.47e−1) =
	10	2000	2.5630e+2^{5} (8.09e−1)	1.8536e+2^{8} (3.49e+0) −	2.5606e+2^{7} (9.64e−1) =	2.5653e+2^{2} (7.89e−1) =	2.5636e+2^{4} (9.64e−1) =	2.5650e+2^{3} (6.91e−1) =	2.5613e+2^{6} (9.12e−1) =	2.5656e+2^{1} (8.03e−1) =
+/−/=				7/36/1	6/5/33	4/8/32	6/6/32	6/4/34	4/3/37	5/5/34
% of satisfaction				18.18%	88.64%	81.82%	86.36%	90.91%	93.18%	88.64%

frameworks on DTLZ1^{-1} with 5 objective functions. This supplementary material includes such convergence and diversity graphs on DTLZ1, WFG4, DTLZ1^{-1}, and WFG4^{-1} with 3, 5, 8, and 10 objective functions. Due to its high computational cost, the HV value is calculated at each $0.025 \cdot g_{\max}$ generations on MOPs with 10 objective functions, where $g_{\max}$ is the maximum number of generations.

3.1 Regular PF shapes

Figures 129 to 136 present the convergence and diversity graphs with the mean values of HV and SPD among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 and WFG4 with 3, 5, 8 and 10 objective functions. It can be seen that A-NSGA-III, all versions of NSGA-III-Ada$\mathcal{K}$, all versions of RVEA-Ada$\mathcal{K}$, and all versions of MOEA/D-Ada$\mathcal{K}$ present a similar behavior to their original versions on all instances of DTLZ1 and WFG4. In contrast, RVEA* and AdaW obtain different diversity graphs than RVEA and MOEA/D, respectively. Furthermore, RVEA* gets a worse final SPD value than RVEA on all instances of DTLZ1 and WFG4. Similarly, AdaW obtains a worse final SPD value than MOEA/D on all cases of DTLZ1 and WFG4 with 3 and 5 objective functions. Also, AdaW has the best final SPD value among MOEAs using the MOEA/D framework on WFG4 with 8 and 10 objective functions. However, it gets the worst final HV value among MOEAs using the MOEA/D framework on all instances of WFG4. In addition, it can be seen that all versions of RVEA-Ada$\mathcal{K}$ and MOEA/D-Ada$\mathcal{K}$ present a brief degradation of the diversity during the first adaptations on MOPs with regular PF shapes due to the inclusion of new weight vectors into the WVRS since all useful weight vectors have not been detected. AdaW presents

Table 5: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the MOEA/D framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to MOEA/D based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to MOEA/D. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	MOEA/D	AdaW	MOEA/D-AdaRSE	MOEA/D-AdaGAE	MOEA/D-AdaMPT	MOEA/D-AdaCOU	MOEA/D-AdaPT	MOEA/D-AdaKRA
DTLZ1	3	400	7.7871e+0^{2} (1.25e−3)	7.7843e+0^{8} (1.82e−3) −	7.7870e+0^{5} (1.27e−3) =	7.7865e+0^{7} (1.93e−3) =	7.7869e+0^{6} (1.72e−3) =	7.7873e+0^{1} (9.42e−4) =	7.7871e+0^{4} (1.03e−3) =	7.7871e+0^{3} (1.18e−3) =
	5	600	3.1960e+1^{7} (1.94e−2)	3.1965e+1^{1} (2.67e−3) =	3.1964e+1^{2} (9.88e−3) =	3.1964e+1^{3} (8.10e−3) =	3.1955e+1^{8} (2.43e−2) =	3.1963e+1^{4} (9.57e−3) =	3.1962e+1^{6} (1.17e−2) =	3.1963e+1^{5} (1.16e−2) =
	8	750	2.5594e+2^{6} (5.02e−2)	2.5594e+2^{8} (1.02e−1) =	2.5596e+2^{3} (5.14e−2) =	2.5595e+2^{5} (6.26e−2) =	2.5594e+2^{7} (7.43e−2) =	2.5596e+2^{4} (8.21e−2) +	2.5596e+2^{2} (4.63e−2) +	2.5597e+2^{1} (2.17e−2) =
	10	1000	1.0239e+3^{7} (1.62e−1)	1.0240e+3^{1} (4.60e−2) +	1.0239e+3^{2} (8.56e−2) =	1.0239e+3^{5} (1.18e−1) =	1.0239e+3^{3} (7.44e−2) =	1.0238e+3^{8} (1.99e−1) =	1.0239e+3^{4} (9.56e−2) =	1.0239e+3^{6} (1.10e−1) =
DTLZ2	3	250	7.4134e+0^{2} (1.53e−4)	7.4022e+0^{8} (9.28e−3) −	7.4134e+0^{4} (1.94e−4) =	7.4134e+0^{3} (1.57e−4) =	7.4133e+0^{6} (2.26e−4) =	7.4133e+0^{5} (1.80e−4) =	7.4134e+0^{1} (1.88e−4) =	7.4133e+0^{7} (1.85e−4) =
	5	350	3.1695e+1^{5} (1.10e−2)	3.1669e+1^{8} (1.68e−2) −	3.1697e+1^{3} (1.08e−3) =	3.1696e+1^{4} (4.62e−3) =	3.1692e+1^{7} (1.80e−2) =	3.1694e+1^{6} (1.69e−2) =	3.1697e+1^{1} (1.79e−4) =	3.1697e+1^{2} (2.70e−4) =
	8	500	2.5581e+2^{3} (6.70e−2)	2.5568e+2^{8} (6.35e−2) −	2.5579e+2^{6} (8.46e−2) =	2.5580e+2^{5} (1.53e−1) =	2.5578e+2^{7} (1.69e−1) =	2.5581e+2^{4} (1.10e−1) =	2.5584e+2^{1} (6.84e−3) +	2.5583e+2^{2} (2.50e−2) +
	10	750	1.0238e+3^{8} (3.33e−1)	1.0238e+3^{7} (3.93e−2) =	1.0239e+3^{3} (8.05e−2) +	1.0239e+3^{6} (2.28e−1) =	1.0239e+3^{5} (1.09e−1) =	1.0239e+3^{4} (7.86e−2) +	1.0239e+3^{2} (7.54e−3) +	1.0239e+3^{1} (1.76e−3) +
DTLZ3	3	1000	7.4111e+0^{1} (1.64e−3)	7.3988e+0^{8} (1.29e−2) −	7.4100e+0^{5} (3.07e−3) =	7.4096e+0^{7} (2.41e−3) −	7.4105e+0^{3} (1.82e−3) =	7.4107e+0^{2} (2.40e−3) =	7.4104e+0^{4} (2.09e−3) =	7.4098e+0^{6} (3.45e−3) =
	5	1000	3.1695e+1^{1} (1.60e−3)	3.1659e+1^{5} (2.04e−2) −	3.1662e+1^{4} (8.58e−2) =	3.1634e+1^{8} (1.56e−1) =	3.1648e+1^{6} (1.85e−1) =	3.1643e+1^{7} (1.30e−1) =	3.1690e+1^{2} (3.22e−2) =	3.1687e+1^{3} (2.86e−2) =
	8	1000	2.5530e+2^{6} (1.12e+0)	2.5529e+2^{7} (5.98e−1) −	2.5561e+2^{1} (4.40e−1) =	2.5541e+2^{4} (6.75e−1) =	2.5520e+2^{8} (1.40e+0) =	2.5535e+2^{5} (7.31e−1) =	2.5557e+2^{3} (5.92e−1) =	2.5559e+2^{2} (5.12e−1) =
	10	1500	1.0237e+3^{2} (2.52e−1)	1.0234e+3^{5} (5.57e−1) −	1.0232e+3^{8} (1.70e+0) =	1.0233e+3^{7} (1.04e+0) =	1.0233e+3^{6} (1.92e+0) =	1.0235e+3^{3} (7.73e−1) =	1.0235e+3^{4} (1.92e+0) =	1.0239e+3^{1} (7.07e−2) +
DTLZ4	3	600	7.2784e+0^{3} (3.50e−1)	7.4099e+0^{1} (6.65e−3) =	7.1650e+0^{6} (6.92e−1) =	7.2114e+0^{4} (4.11e−1) =	7.1056e+0^{8} (4.67e−1) =	7.3459e+0^{2} (2.57e−1) =	7.1452e+0^{7} (4.52e−1) =	7.1787e+0^{5} (4.32e−1) =
	5	1000	3.1517e+1^{5} (4.32e−1)	3.1675e+1^{1} (9.27e−2) =	3.1590e+1^{2} (2.18e−1) =	3.1536e+1^{4} (4.27e−1) =	3.1538e+1^{3} (2.44e−1) =	3.1429e+1^{7} (5.40e−1) −	3.1471e+1^{6} (4.12e−1) =	3.1329e+1^{8} (6.16e−1) −
	8	1250	2.5553e+2^{7} (3.63e−1)	2.5578e+2^{1} (6.66e−2) +	2.5562e+2^{4} (2.58e−1) =	2.5559e+2^{6} (3.53e−1) =	2.5571e+2^{2} (1.93e−1) +	2.5551e+2^{8} (3.69e−1) =	2.5560e+2^{5} (3.06e−1) =	2.5567e+2^{3} (1.94e−1) =
	10	2000	1.0236e+3^{8} (2.84e−1)	1.0239e+3^{1} (9.42e−3) +	1.0237e+3^{3} (1.21e−1) +	1.0237e+3^{4} (2.32e−1) +	1.0237e+3^{5} (2.94e−1) +	1.0236e+3^{7} (2.64e−1) =	1.0237e+3^{2} (1.55e−1) +	1.0236e+3^{6} (2.73e−1) =
WFG1	3	400	5.5941e+0^{7} (4.88e−2)	5.4299e+0^{8} (2.57e−2) −	5.6138e+0^{3} (6.20e−2) =	5.6151e+0^{2} (5.13e−2) +	5.6156e+0^{1} (6.98e−2) =	5.5946e+0^{6} (5.70e−2) =	5.6082e+0^{4} (5.72e−2) =	5.5965e+0^{5} (6.93e−2) =
	5	750	2.5795e+1^{7} (1.07e+0)	2.1581e+1^{8} (3.47e−1) −	2.7081e+1^{3} (6.80e−1) +	2.6763e+1^{5} (7.57e−1) +	2.7059e+1^{4} (7.93e−1) +	2.6684e+1^{6} (7.63e−1) +	2.7083e+1^{2} (8.23e−1) +	2.7098e+1^{1} (8.88e−1) +
	8	1500	2.2085e+2^{1} (1.00e+1)	1.7255e+2^{8} (4.58e+0) −	2.0373e+2^{6} (6.18e+0) −	2.0423e+2^{5} (6.28e+0) −	2.0372e+2^{7} (6.38e+0) −	2.0549e+2^{4} (6.12e+0) −	2.1696e+2^{2} (6.24e+0) −	2.1622e+2^{3} (5.59e+0) −
	10	2000	9.3962e+2^{7} (3.34e+1)	7.3907e+2^{8} (2.71e+1) −	9.6527e+2^{2} (1.37e+1) +	9.6149e+2^{5} (1.98e+1) =	9.6286e+2^{4} (1.90e+1) +	9.5269e+2^{6} (2.25e+1) =	9.6406e+2^{3} (1.48e+1) +	9.7036e+2^{1} (1.34e+1) +
WFG4	3	400	7.3813e+0^{4} (5.38e−3)	7.3397e+0^{8} (1.37e−2) −	7.3813e+0^{3} (6.13e−3) =	7.3814e+0^{2} (6.64e−3) =	7.3779e+0^{6} (1.46e−2) =	7.3821e+0^{1} (6.02e−3) =	7.3768e+0^{7} (1.77e−2) =	7.3801e+0^{5} (5.14e−3) =
	5	750	3.1625e+1^{7} (1.54e−2)	3.1488e+1^{8} (3.31e−2) −	3.1627e+1^{5} (1.74e−2) =	3.1632e+1^{2} (1.43e−2) =	3.1626e+1^{6} (1.76e−2) =	3.1631e+1^{3} (1.33e−2) =	3.1633e+1^{1} (1.79e−2) +	3.1630e+1^{4} (1.12e−2) =
	8	1500	2.5557e+2^{1} (9.23e−2)	2.5372e+2^{8} (4.49e−1) −	2.5553e+2^{7} (9.14e−2) −	2.5554e+2^{6} (7.85e−2) =	2.5555e+2^{4} (7.57e−2) =	2.5554e+2^{5} (8.23e−2) =	2.5555e+2^{2} (7.78e−2) =	2.5555e+2^{3} (8.02e−2) =
	10	2000	1.0234e+3^{3} (1.53e−1)	1.0185e+3^{8} (1.37e+0) −	1.0234e+3^{2} (2.06e−1) =	1.0234e+3^{1} (2.30e−1) =	1.0233e+3^{7} (2.03e−1) =	1.0233e+3^{6} (1.89e−1) =	1.0234e+3^{4} (1.50e−1) =	1.0233e+3^{5} (1.91e−1) =
WFG5	3	400	7.1945e+0^{2} (3.97e−2)	7.1714e+0^{6} (3.31e−2) −	7.1691e+0^{7} (4.77e−2) −	7.1874e+0^{5} (4.26e−2) =	7.1960e+0^{1} (4.47e−2) =	7.1673e+0^{8} (5.02e−2) −	7.1938e+0^{3} (4.51e−2) =	7.1898e+0^{4} (4.34e−2) =
	5	750	3.0785e+1^{3} (1.70e−2)	3.0700e+1^{8} (4.96e−2) −	3.0785e+1^{5} (1.66e−2) =	3.0787e+1^{2} (2.12e−3) =	3.0788e+1^{1} (1.76e−3) =	3.0785e+1^{6} (1.69e−2) =	3.0785e+1^{4} (1.60e−2) =	3.0784e+1^{7} (1.65e−2) −
	8	1500	2.4717e+2^{7} (5.23e−2)	2.4633e+2^{8} (2.19e−1) −	2.4719e+2^{1} (2.23e−2) =	2.4719e+2^{2} (2.07e−2) =	2.4717e+2^{6} (3.41e−2) =	2.4718e+2^{3} (2.70e−2) =	2.4717e+2^{5} (2.28e−2) =	2.4718e+2^{4} (2.70e−2) =
	10	2000	9.8681e+2^{4} (4.22e−2)	9.8537e+2^{8} (4.63e−1) −	9.8682e+2^{1} (4.32e−2) =	9.8681e+2^{6} (3.73e−2) =	9.8681e+2^{5} (4.24e−2) =	9.8682e+2^{2} (4.85e−2) =	9.8681e+2^{3} (4.43e−2) =	9.8680e+2^{7} (4.74e−2) =
WFG6	3	400	7.2387e+0^{7} (2.75e−2)	7.2260e+0^{8} (3.24e−2) =	7.2401e+0^{6} (3.41e−2) =	7.2493e+0^{4} (2.56e−2) +	7.2476e+0^{5} (2.97e−2) =	7.2527e+0^{1} (2.49e−2) +	7.2509e+0^{3} (1.90e−2) +	7.2517e+0^{2} (2.37e−2) +
	5	750	3.0922e+1^{1} (1.39e−1)	3.0784e+1^{8} (1.64e−1) −	3.0914e+1^{3} (1.53e−1) =	3.0887e+1^{7} (1.64e−1) =	3.0916e+1^{2} (1.47e−1) =	3.0897e+1^{6} (1.63e−1) =	3.0912e+1^{4} (1.67e−1) =	3.0903e+1^{5} (1.54e−1) =
	8	1500	2.4775e+2^{3} (1.72e+0)	2.4646e+2^{8} (1.78e+0) −	2.4753e+2^{5} (1.67e+0) =	2.4776e+2^{2} (2.02e+0) =	2.4736e+2^{6} (1.91e+0) =	2.4733e+2^{7} (1.66e+0) =	2.4756e+2^{4} (1.84e+0) =	2.4778e+2^{1} (1.76e+0) =
	10	2000	9.8631e+2^{3} (9.53e+0)	9.8271e+2^{7} (9.98e+0) =	9.8349e+2^{5} (8.25e+0) =	9.8755e+2^{1} (1.02e+1) =	9.8240e+2^{8} (9.57e+0) =	9.8294e+2^{6} (1.01e+1) =	9.8744e+2^{2} (1.29e+1) =	9.8599e+2^{4} (9.61e+0) =
WFG7	3	400	7.4034e+0^{1} (1.52e−3)	7.3787e+0^{8} (1.14e−2) −	7.4025e+0^{6} (1.92e−3) −	7.4026e+0^{5} (1.84e−3) −	7.4024e+0^{7} (1.43e−3) −	7.4033e+0^{3} (1.60e−3) =	7.4034e+0^{2} (1.99e−3) =	7.4028e+0^{4} (1.88e−3) =
	5	750	3.1675e+1^{4} (3.85e−3)	3.1559e+1^{8} (2.26e−2) −	3.1673e+1^{5} (3.92e−3) −	3.1670e+1^{6} (2.57e−2) =	3.1669e+1^{7} (2.88e−2) =	3.1676e+1^{1} (3.56e−3) =	3.1675e+1^{3} (4.23e−3) =	3.1675e+1^{2} (3.88e−3) =
	8	1500	2.5573e+2^{4} (2.96e−2)	2.5391e+2^{8} (4.31e−1) −	2.5573e+2^{3} (3.18e−2) =	2.5572e+2^{6} (2.82e−2) =	2.5572e+2^{7} (3.30e−2) =	2.5573e+2^{1} (2.37e−2) =	2.5573e+2^{5} (3.10e−2) =	2.5573e+2^{2} (2.48e−2) =
	10	2000	1.0236e+3^{2} (1.16e−1)	1.0191e+3^{8} (1.26e+0) −	1.0236e+3^{3} (9.22e−2) =	1.0236e+3^{4} (8.16e−2) =	1.0236e+3^{6} (9.57e−2) =	1.0236e+3^{5} (9.27e−2) =	1.0236e+3^{1} (9.44e−2) =	1.0236e+3^{7} (1.08e−1) =
WFG8	3	400	7.2254e+0^{2} (1.37e−2)	7.2062e+0^{8} (3.07e−2) −	7.2258e+0^{1} (1.51e−2) =	7.2115e+0^{6} (2.52e−2) −	7.2100e+0^{7} (1.61e−2) −	7.2150e+0^{5} (3.25e−2) =	7.2205e+0^{4} (1.56e−2) =	7.2205e+0^{3} (1.87e−2) =
	5	750	3.0998e+1^{5} (3.83e−2)	3.1026e+1^{4} (6.51e−2) +	3.0991e+1^{6} (9.22e−2) =	3.0966e+1^{7} (9.47e−2) −	3.0937e+1^{8} (8.38e−2) −	3.1116e+1^{1} (7.48e−2) +	3.1080e+1^{3} (8.23e−2) +	3.1094e+1^{2} (7.50e−2) +
	8	1500	2.5456e+2^{4} (2.51e−1)	2.4902e+2^{8} (9.00e−1) −	2.5447e+2^{6} (1.99e−1) −	2.5449e+2^{5} (2.10e−1) −	2.5446e+2^{7} (1.82e−1) −	2.5463e+2^{1} (8.47e−2) =	2.5460e+2^{2} (1.07e−1) =	2.5458e+2^{3} (1.16e−1) =
	10	2000	1.0219e+3^{4} (3.39e−1)	1.0092e+3^{8} (2.60e+0) −	1.0217e+3^{6} (4.92e−1) =	1.0216e+3^{7} (4.19e−1) −	1.0218e+3^{5} (3.21e−1) −	1.0222e+3^{1} (1.78e−1) +	1.0221e+3^{2} (1.63e−1) +	1.0220e+3^{3} (2.12e−1) +
WFG9	3	400	7.1780e+0^{4} (8.59e−2)	7.0898e+0^{8} (7.97e−2) −	7.1560e+0^{6} (1.00e−1) =	7.1597e+0^{5} (8.68e−2) =	7.1886e+0^{2} (9.80e−2) =	7.1976e+0^{1} (7.61e−2) =	7.1519e+0^{7} (9.84e−2) =	7.1826e+0^{3} (8.26e−2) =
	5	750	2.9915e+1^{7} (4.30e−1)	2.9704e+1^{8} (3.21e−1) −	3.0204e+1^{2} (6.51e−1) +	3.0153e+1^{3} (5.91e−1) +	3.0032e+1^{5} (4.93e−1) =	3.0222e+1^{1} (6.30e−1) +	3.0018e+1^{6} (4.91e−1) +	3.0102e+1^{4} (5.87e−1) =
	8	1500	2.4851e+2^{4} (5.08e+0)	2.3506e+2^{8} (4.38e+0) −	2.4836e+2^{5} (5.12e+0) =	2.4869e+2^{3} (4.53e+0) =	2.4817e+2^{6} (5.78e+0) =	2.4759e+2^{7} (5.47e+0) =	2.4932e+2^{1} (3.99e+0) =	2.4930e+2^{2} (4.51e+0) =
	10	2000	9.9390e+2^{6} (2.88e+1)	9.4268e+2^{8} (1.93e+1) −	9.9431e+2^{5} (2.56e+1) =	9.9573e+2^{4} (2.45e+1) =	1.0003e+3^{2} (1.93e+1) =	1.0024e+3^{1} (1.53e+1) =	9.9368e+2^{7} (2.55e+1) =	1.0002e+3^{3} (1.91e+1) =
+/−/=				4/33/7	5/6/33	5/7/32	4/6/34	7/3/34	11/1/32	8/3/33
% of satisfaction				25.00%	86.36%	84.09%	86.36%	93.18%	97.73%	93.18%

the contrary behavior, where the diversity is improved at each adaptation step but decreases during the next generations. This behavior is due to including solutions from the archive into the main population at each adaptation step. Finally, Figures 133 and 134 show that the HV value and SPD value of all versions of RVEA-Ada$\mathcal{K}$ decrease after the first adaptation, but they increase after the second adaptation. This behavior occurs because the WVRS is adapted at each $0.05 \cdot g_{\max}$ generations. However, the information on the ranges of objective functions is included in the WVRS at each $0.1 \cdot g_{\max}$ generations following the RVEA framework. Thus, generating a WVRS with this updated information leads to better guidance toward the PF, especially on MOPs with differently scaled objective functions. The obtained results indicate that the inclusion of our adaptation method does not strongly modify the behavior of MOEAs that use predefined WVRSs on MOPs with regular PF shapes.

3.2 Irregular PF shapes

The convergence and diversity graphs generated with the mean HV and the mean SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} and WFG4^{-1} with 3, 5, 8 and 10 objective functions are shown in Figures 137 to 144. They show that RVEA*, AdaW, and all versions of NSGA-III-Ada$\mathcal{K}$, RVEA-Ada$\mathcal{K}$, and MOEA/D-Ada$\mathcal{K}$ improve the convergence and diversity of their original versions on all instances of DTLZ1^{-1} and WFG4^{-1}. However, A-NSGA-III cannot improve the performance of NSGA-III on DTLZ1^{-1} and WFG4^{-1} with 8 and 10 objective functions. Also, it can be seen that RVEA* maintains a better performance than all versions of RVEA-Ada$\mathcal{K}$ at the beginning of the

Table 6: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the MOEA/D framework on MOPs with regular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to MOEA/D based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better or statistically equivalent to MOEA/D. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	MOEA/D	AdaW	MOEA/D-AdaRSE	MOEA/D-AdaGAE	MOEA/D-AdaMPT	MOEA/D-AdaCOU	MOEA/D-AdaPT	MOEA/D-AdaKRA
DTLZ1	3	400	2.3292e+1^5 (7.42e−2)	2.2924e+1^8 (1.35e−1) −	2.3294e+1^3 (5.12e−2) =	2.3269e+1^7 (1.58e−1) =	2.3315e+1^1 (9.78e−2) =	2.3279e+1^6 (6.11e−2) =	2.3293e+1^4 (5.92e−2) =	2.3298e+1^2 (5.48e−2) =
	5	600	7.1189e+1^6 (4.45e+0)	6.6112e+1^8 (1.96e+0) −	7.2329e+1^1 (2.07e+0) =	7.1993e+1^4 (2.68e+0) =	7.0120e+1^7 (5.65e+0) =	7.2023e+1^3 (2.11e+0) =	7.1805e+1^5 (2.82e+0) =	7.2280e+1^2 (2.20e+0) =
	8	750	9.4488e+1^6 (1.38e+1)	7.6885e+1^8 (6.30e+0) −	9.7578e+1^4 (1.16e+1) =	9.6831e+1^5 (1.34e+1) =	9.4327e+1^7 (1.35e+1) =	1.0020e+2^3 (1.37e+1) +	1.0047e+2^2 (1.17e+1) +	1.0391e+2^1 (7.24e+0) +
	10	1000	1.4262e+2^5 (2.26e+1)	9.6369e+1^8 (7.73e+0) −	1.6008e+2^2 (1.57e+1) +	1.3724e+2^7 (2.54e+1) =	1.5726e+2^3 (1.74e+1) +	1.3944e+2^6 (3.43e+1) =	1.5483e+2^4 (2.05e+1) +	1.6524e+2^1 (1.29e+1) +
DTLZ2	3	250	3.2626e+1^4 (4.73e−2)	3.2149e+1^8 (2.22e−1) −	3.2611e+1^6 (2.84e−2) −	3.2632e+1^1 (3.97e−2) =	3.2609e+1^7 (3.37e−2) −	3.2632e+1^2 (3.50e−2) =	3.2631e+1^3 (3.02e−2) =	3.2618e+1^5 (3.40e−2) =
	5	350	1.3644e+2^5 (5.64e+0)	1.3451e+2^8 (1.17e+0) −	1.3698e+2^3 (2.85e+0) =	1.3657e+2^4 (3.78e+0) =	1.3551e+2^7 (7.34e+0) =	1.3642e+2^6 (5.21e+0) =	1.3770e+2^2 (5.01e−1) =	1.3777e+2^1 (6.32e−1) =
	8	500	1.3904e+2^6 (8.57e+0)	1.4825e+2^1 (7.09e−1) +	1.3777e+2^8 (8.07e+0) =	1.4042e+2^5 (7.82e+0) =	1.3825e+2^7 (1.03e+1) =	1.4090e+2^4 (8.17e+0) +	1.4195e+2^3 (6.86e+0) +	1.4218e+2^2 (5.42e+0) +
	10	750	2.3936e+2^8 (3.23e+1)	2.5895e+2^1 (1.74e+0) +	2.5266e+2^3 (1.09e+1) =	2.4875e+2^6 (1.71e+1) =	2.4412e+2^7 (1.78e+1) =	2.4989e+2^5 (1.57e+1) =	2.5265e+2^4 (8.05e+0) =	2.5408e+2^2 (5.99e+0) +
DTLZ3	3	1000	3.2770e+1^7 (4.55e−2)	3.1751e+1^8 (4.94e−1) −	3.2775e+1^3 (1.37e−1) =	3.2801e+1^1 (7.78e−2) +	3.2770e+1^5 (5.01e−2) =	3.2773e+1^4 (5.72e−2) =	3.2770e+1^6 (6.99e−2) =	3.2794e+1^2 (9.29e−2) =
	5	1000	1.3923e+2^1 (2.30e−1)	1.2371e+2^8 (8.42e+0) −	1.3468e+2^5 (8.93e+0) −	1.3206e+2^6 (1.50e+1) −	1.3544e+2^4 (1.00e+1) −	1.3139e+2^7 (1.45e+1) −	1.3719e+2^2 (4.35e+0) −	1.3626e+2^3 (6.78e+0) −
	8	1000	1.2078e+2^6 (3.00e+1)	9.6715e+1^8 (2.16e+1) −	1.2993e+2^1 (1.12e+1) =	1.2409e+2^4 (1.34e+1) =	1.2313e+2^5 (1.86e+1) =	1.1572e+2^7 (1.81e+1) −	1.2850e+2^2 (1.57e+1) =	1.2663e+2^3 (1.52e+1) =
	10	1500	2.2377e+2^4 (3.53e+1)	1.6965e+2^8 (3.77e+1) −	2.1330e+2^6 (3.93e+1) =	2.1504e+2^5 (3.67e+1) =	2.2622e+2^3 (3.70e+1) =	2.1147e+2^7 (3.84e+1) =	2.2836e+2^2 (3.48e+1) =	2.4391e+2^1 (1.56e+1) +
DTLZ4	3	600	2.9445e+1^3 (8.30e+0)	3.2338e+1^1 (2.17e−1) =	2.8436e+1^4 (9.77e+0) =	2.7892e+1^5 (9.78e+0) =	2.4815e+1^8 (1.13e+1) =	3.1083e+1^2 (6.10e+0) =	2.6296e+1^7 (1.08e+1) =	2.7073e+1^6 (1.03e+1) =
	5	1000	1.2324e+2^4 (3.06e+1)	1.3481e+2^1 (9.57e+0) =	1.2702e+2^2 (2.39e+1) =	1.2460e+2^3 (2.86e+1) =	1.2064e+2^5 (2.68e+1) =	1.1441e+2^7 (3.47e+1) −	1.1764e+2^6 (3.15e+1) =	1.0810e+2^8 (3.78e+1) −
	8	1250	1.2793e+2^8 (2.08e+1)	1.4877e+2^1 (1.55e+0) +	1.3386e+2^5 (1.59e+1) =	1.3591e+2^4 (1.69e+1) =	1.4111e+2^2 (8.55e+0) +	1.2801e+2^7 (1.95e+1) =	1.3278e+2^6 (1.63e+1) =	1.3668e+2^3 (1.09e+1) =
	10	2000	2.4519e+2^7 (1.98e+1)	2.6263e+2^1 (1.01e+0) +	2.5325e+2^3 (9.67e+0) =	2.5239e+2^4 (1.69e+1) =	2.4687e+2^5 (2.20e+1) =	2.4437e+2^8 (2.18e+1) =	2.5447e+2^2 (1.04e+1) =	2.4581e+2^6 (2.09e+1) =
WFG1	3	400	1.5666e+1^2 (5.74e−1)	1.7062e+1^1 (7.89e−1) +	1.4545e+1^8 (1.09e+0) −	1.4744e+1^3 (9.79e−1) −	1.4670e+1^5 (1.03e+0) −	1.4654e+1^6 (6.99e−1) −	1.4590e+1^7 (8.57e−1) −	1.4711e+1^4 (1.08e+0) −
	5	750	2.8848e+1^2 (5.16e+0)	3.2463e+1^1 (1.12e+0) +	2.5187e+1^6 (3.73e+0) −	2.4044e+1^8 (3.83e+0) −	2.5132e+1^7 (2.78e+0) −	2.6043e+1^5 (3.67e+0) −	2.7122e+1^4 (4.21e+0) =	2.7464e+1^3 (3.74e+0) =
	8	1500	3.6051e+1^5 (5.55e+0)	4.4348e+1^1 (2.46e+0) +	3.6753e+1^4 (5.16e+0) =	3.1467e+1^8 (4.85e+0) −	3.5686e+1^6 (5.47e+0) =	3.1608e+1^7 (3.17e+0) −	4.1186e+1^2 (5.06e+0) +	3.8966e+1^3 (5.50e+0) +
	10	2000	5.7761e+1^1 (4.90e+0)	5.2929e+1^3 (4.76e+0) −	3.9673e+1^5 (8.17e+0) −	3.6273e+1^7 (6.29e+0) −	3.8429e+1^6 (6.93e+0) −	3.5697e+1^8 (8.66e+0) −	5.0886e+1^4 (1.05e+1) −	5.2990e+1^2 (9.34e+0) −
WFG4	3	400	3.2192e+1^6 (2.48e−1)	3.1920e+1^8 (2.59e−1) −	3.2228e+1^3 (2.98e−1) =	3.2249e+1^2 (2.23e−1) =	3.2211e+1^4 (4.17e−1) =	3.2253e+1^1 (2.50e−1) =	3.2168e+1^7 (4.14e−1) =	3.2198e+1^5 (2.85e−1) =
	5	750	1.3589e+2^4 (2.95e+0)	1.3401e+2^8 (6.26e−1) −	1.3587e+2^5 (4.33e+0) =	1.3673e+2^2 (7.37e−1) =	1.3575e+2^7 (4.39e+0) =	1.3649e+2^3 (9.88e−1) =	1.3583e+2^6 (4.18e+0) =	1.3680e+2^1 (4.73e−1) =
	8	1500	1.4615e+2^6 (1.97e+0)	1.4940e+2^1 (2.78e−1) +	1.4618e+2^5 (2.10e+0) =	1.4595e+2^8 (2.92e+0) =	1.4606e+2^7 (2.20e+0) =	1.4637e+2^3 (1.63e+0) =	1.4661e+2^2 (6.82e−1) =	1.4636e+2^4 (1.85e+0) =
	10	2000	2.5832e+2^5 (9.58e−1)	2.6402e+2^1 (6.88e−1) +	2.5773e+2^7 (3.71e+0) =	2.5784e+2^6 (3.92e+0) =	2.5849e+2^3 (4.17e−1) =	2.5743e+2^8 (4.81e+0) =	2.5855e+2^2 (2.17e−1) =	2.5836e+2^4 (1.63e+0) +
WFG5	3	400	3.1709e+1^3 (9.26e−1)	3.1279e+1^8 (4.17e−1) −	3.1292e+1^7 (1.03e+0) −	3.1548e+1^5 (9.49e−1) =	3.1794e+1^1 (9.60e−1) =	3.1309e+1^6 (1.05e+0) =	3.1758e+1^2 (9.69e−1) =	3.1575e+1^4 (9.18e−1) =
	5	750	1.3758e+2^5 (4.05e+0)	1.3189e+2^8 (9.77e−1) −	1.3773e+2^3 (4.13e+0) =	1.3806e+2^2 (1.21e+0) =	1.3816e+2^1 (8.10e−1) =	1.3746e+2^7 (4.08e+0) =	1.3764e+2^4 (3.81e+0) =	1.3754e+2^6 (4.02e+0) =
	8	1500	1.4237e+2^7 (7.57e+0)	1.4883e+2^1 (2.23e−1) +	1.4399e+2^3 (4.14e+0) =	1.4432e+2^2 (4.18e+0) =	1.4243e+2^6 (6.21e+0) =	1.4350e+2^5 (5.40e+0) =	1.4356e+2^4 (4.75e+0) =	1.4165e+2^8 (5.65e+0) =
	10	2000	2.5375e+2^6 (5.82e+0)	2.6308e+2^1 (3.93e−1) +	2.5450e+2^3 (4.87e+0) =	2.5351e+2^7 (7.19e+0) =	2.5399e+2^5 (5.38e+0) =	2.5402e+2^4 (6.54e+0) =	2.5472e+2^2 (5.06e+0) =	2.5337e+2^8 (6.31e+0) =
WFG6	3	400	3.2200e+1^6 (4.19e−1)	3.1981e+1^8 (2.06e−1) −	3.2249e+1^5 (3.28e−1) =	3.2328e+1^2 (3.31e−1) +	3.2199e+1^7 (3.68e−1) =	3.2345e+1^1 (2.06e−1) +	3.2251e+1^4 (5.37e−1) +	3.2280e+1^3 (2.99e−1) =
	5	750	1.3859e+2^2 (2.82e−1)	1.3360e+2^8 (6.92e−1) −	1.3845e+2^4 (5.11e−1) =	1.3845e+2^3 (5.82e−1) =	1.3824e+2^6 (1.52e+0) =	1.3868e+2^1 (2.92e−1) =	1.3834e+2^5 (8.37e−1) =	1.3801e+2^7 (2.28e+0) =
	8	1500	1.4719e+2^2 (8.80e−2)	1.4947e+2^1 (1.74e−1) +	1.4561e+2^8 (8.53e+0) =	1.4678e+2^6 (2.01e+0) =	1.4715e+2^3 (1.88e−1) =	1.4664e+2^7 (2.83e+0) =	1.4705e+2^5 (7.57e−1) =	1.4715e+2^4 (1.41e−1) =
	10	2000	2.5827e+2^6 (4.57e+0)	2.6421e+2^1 (3.66e−1) +	2.5693e+2^7 (6.93e+0) =	2.5662e+2^8 (9.12e+0) =	2.5858e+2^5 (2.88e+0) =	2.5911e+2^2 (6.79e−2) =	2.5908e+2^3 (1.61e−1) =	2.5899e+2^4 (3.72e−1) =
WFG7	3	400	3.2639e+1^3 (4.99e−2)	3.2086e+1^8 (2.77e−1) −	3.2638e+1^4 (3.43e−2) =	3.2643e+1^1 (3.10e−2) =	3.2631e+1^5 (4.84e−2) =	3.2639e+1^2 (4.85e−2) =	3.2629e+1^6 (6.10e−2) =	3.2625e+1^7 (6.03e−2) =
	5	750	1.3734e+2^1 (5.90e−1)	1.3353e+2^8 (7.70e−1) −	1.3730e+2^3 (7.52e−1) =	1.3671e+2^6 (3.42e+0) =	1.3623e+2^7 (4.58e+0) =	1.3696e+2^5 (1.22e+0) =	1.3731e+2^2 (6.24e−1) =	1.3715e+2^4 (7.87e−1) =
	8	1500	1.4707e+2^7 (1.54e−1)	1.4953e+2^1 (3.29e−1) +	1.4713e+2^5 (8.61e−2) =	1.4714e+2^2 (9.91e−2) +	1.4703e+2^8 (6.73e−1) =	1.4713e+2^4 (1.70e−1) +	1.4714e+2^3 (7.65e−2) +	1.4709e+2^6 (1.50e−1) =
	10	2000	2.5859e+2^2 (1.74e−1)	2.6491e+2^1 (5.46e−1) +	2.5830e+2^6 (1.79e+0) =	2.5804e+2^7 (2.40e+0) =	2.5802e+2^8 (3.13e+0) =	2.5856e+2^4 (3.53e−1) =	2.5856e+2^5 (3.69e−1) =	2.5857e+2^3 (2.14e−1) =
WFG8	3	400	2.6718e+1^8 (2.82e−1)	3.1686e+1^1 (2.38e−1) +	2.6977e+1^4 (3.65e−1) +	2.6801e+1^6 (3.51e−1) =	2.6738e+1^7 (3.41e−1) =	2.6967e+1^5 (4.06e−1) +	2.7009e+1^3 (3.05e−1) +	2.7029e+1^2 (4.39e−1) +
	5	750	3.7958e+1^8 (4.58e+0)	1.3339e+2^1 (8.16e−1) +	5.3602e+1^4 (5.05e+0) +	5.4548e+1^3 (6.84e+0) +	5.4947e+1^2 (5.12e+0) +	4.5077e+1^6 (5.24e+0) +	4.4782e+1^7 (6.22e+0) +	4.6851e+1^5 (6.00e+0) +
	8	1500	6.7194e+1^8 (5.37e+0)	1.4982e+2^1 (2.26e−1) +	7.8424e+1^2 (9.19e+0) +	7.7074e+1^3 (9.89e+0) +	7.6460e+1^4 (9.71e+0) +	7.1594e+1^6 (4.82e+0) +	7.2616e+1^5 (4.56e+0) +	6.9144e+1^7 (4.19e+0) =
	10	2000	9.8031e+1^8 (1.07e+1)	2.6508e+2^1 (4.61e−1) +	1.4166e+2^4 (1.91e+1) +	1.5388e+2^2 (1.89e+1) +	1.4410e+2^3 (2.07e+1) +	1.2603e+2^5 (1.54e+1) +	1.1724e+2^6 (8.35e+0) +	1.1517e+2^7 (1.16e+1) +
WFG9	3	400	2.8712e+1^7 (5.29e−1)	3.0656e+1^1 (2.62e−1) +	2.8906e+1^3 (5.36e−1) =	2.8706e+1^8 (5.73e−1) =	2.8955e+1^2 (4.98e−1) =	2.8858e+1^4 (5.32e−1) =	2.8856e+1^5 (4.92e−1) =	2.8769e+1^6 (5.27e−1) =
	5	750	7.5831e+1^8 (1.34e+1)	1.2744e+2^1 (1.33e+0) +	8.0588e+1^7 (1.27e+1) =	8.3065e+1^3 (1.31e+1) +	8.1044e+1^5 (1.30e+1) =	8.5208e+1^2 (1.37e+1) +	8.1865e+1^4 (1.26e+1) +	8.0590e+1^6 (1.29e+1) =
	8	1500	6.0203e+1^3 (6.42e+0)	1.4680e+2^1 (6.61e−1) +	5.8478e+1^7 (6.31e+0) =	5.8709e+1^6 (6.51e+0) =	5.9445e+1^4 (8.27e+0) =	6.0287e+1^2 (6.73e+0) =	5.8086e+1^8 (4.06e+0) =	5.9098e+1^5 (5.26e+0) =
	10	2000	9.7824e+1^3 (1.72e+1)	2.5943e+2^1 (6.62e−1) +	9.7031e+1^4 (1.60e+1) =	9.6907e+1^5 (1.04e+1) =	1.0239e+2^2 (2.39e+1) =	9.3121e+1^8 (8.32e+0) =	9.5826e+1^6 (1.05e+1) =	9.3991e+1^7 (1.11e+1) =
+/−/=				23/19/2	5/6/33	7/5/32	5/5/34	9/7/28	11/3/30	10/4/30
% of satisfaction				56.82%	86.36%	88.64%	88.64%	84.09%	93.18%	90.91%

evolution because RVEA* adapts the WVRS at each generation. However, most versions of RVEA-Ada$\mathcal{K}$ obtain better HV and SPD values than RVEA* at the end of the evolution. Additionally, the convergence and diversity of AdaW and MOEAs with our adaptation method are improved at each $0.05 \cdot g_{\max}$ generations due to the adaptation frequency. However, the performance of all versions of RVEA-Ada$\mathcal{K}$ begins to be improved until the generation $0.1 \cdot g_{\max}$ on DTLZ1^{-1} with 8 and 10 objective functions and all instances of WFG4^{-1}. This behavior occurs because, following the RVEA framework, the information of the ranges of objective functions is included in the WVRS at each $0.1 \cdot g_{\max}$ generations. Finally, it is worth noting that the performance of MOEAs with our adaptation method is slightly degraded at each adaptation step due to the inclusion of new weight vectors, which have no associated solutions. However, the performance increases rapidly as good solutions are found for new weight vectors. Since AdaW includes additional solutions from the archive into the main population at each adaptation step, its diversity is improved. However, it decreases during the next generations. In addition, it can be seen that all versions of NSGA-III-Ada$\mathcal{K}$ have smoother convergence and diversity graphs than all versions of RVEA-Ada$\mathcal{K}$ and MOEA/D-Ada$\mathcal{K}$. The selection mechanism and the normalization procedure of the NSGA-III framework may produce this result. When empty sub-populations are generated, a second solution is selected randomly from sub-populations with multiple solutions preventing the diversity loss at each adaptation step. In addition, the normalization procedure includes information of the ranges of objective functions at each generation instead of including it with a specific frequency promoting a smoother evolution. The presented convergence and diversity graphs indicate that our adaptation method enhances the performance of MOEAs using predefined WVRSs on MOPs with irregular PF shapes.

Table 7: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the NSGA-III framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to NSGA-III based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than NSGA-III. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	NSGA-III	A-NSGA-III	NSGA-III-AdaRSE	NSGA-III-AdaGAE	NSGA-III-AdaMPT	NSGA-III-AdaCOU	NSGA-III-AdaPT	NSGA-III-AdaKRA
DTLZ5	3	400	5.4810e+0^{8} (5.67e−3)	5.4900e+0^{7} (3.43e−3) +	5.5074e+0^{3} (8.57e−3) +	5.5044e+0^{5} (1.12e−2) +	5.5076e+0^{2} (1.21e−3) +	5.5060e+0^{4} (1.66e−2) +	5.5077e+0^{1} (6.22e−3) +	5.5001e+0^{6} (4.21e−2) +
	5	600	3.1188e+1^{1} (4.91e−2)	3.1082e+1^{3} (9.72e−2) −	3.0881e+1^{7} (1.76e−1) −	3.0812e+1^{8} (2.42e−1) −	3.0937e+1^{6} (1.52e−1) −	3.1143e+1^{2} (8.07e−2) −	3.1009e+1^{4} (1.21e−1) −	3.0988e+1^{5} (1.25e−1) −
	8	750	2.4790e+2^{1} (3.76e−1)	2.4781e+2^{3} (4.24e−1) =	2.4499e+2^{6} (2.03e+0) −	2.4617e+2^{4} (1.63e+0) −	2.4611e+2^{5} (1.62e+0) −	2.4789e+2^{2} (8.97e−1) =	2.4276e+2^{7} (1.63e+0) −	2.4252e+2^{8} (1.34e+0) −
	10	1000	9.9280e+2^{2} (1.22e+0)	9.9225e+2^{3} (1.84e+0) =	9.8255e+2^{6} (7.33e+0) −	9.8326e+2^{5} (5.29e+0) −	9.8448e+2^{4} (6.99e+0) −	9.9683e+2^{1} (2.82e+0) +	9.7152e+2^{7} (7.06e+0) −	9.6961e+2^{8} (5.16e+0) −
DTLZ6	3	400	5.4793e+0^{8} (6.74e−3)	5.4893e+0^{7} (3.20e−3) +	5.5116e+0^{3} (3.62e−3) +	5.5067e+0^{6} (9.96e−4) +	5.5085e+0^{5} (8.24e−4) +	5.5110e+0^{4} (4.65e−3) +	5.5117e+0^{2} (3.46e−3) +	5.5119e+0^{1} (2.69e−3) +
	5	600	3.1882e+1^{1} (1.73e−2)	3.1870e+1^{3} (1.96e−2) −	3.1820e+1^{8} (4.03e−2) −	3.1828e+1^{7} (3.43e−2) −	3.1829e+1^{6} (4.08e−2) −	3.1873e+1^{2} (3.50e−2) =	3.1829e+1^{5} (4.23e−2) −	3.1848e+1^{4} (3.66e−2) −
	8	750	2.5507e+2^{1} (2.42e−1)	2.5503e+2^{2} (1.48e−1) −	2.5455e+2^{7} (2.89e−1) −	2.5444e+2^{8} (4.04e−1) −	2.5457e+2^{6} (3.06e−1) −	2.5485e+2^{3} (2.58e−1) −	2.5460e+2^{4} (3.71e−1) −	2.5459e+2^{5} (3.06e−1) −
	10	1000	1.0207e+3^{1} (2.42e−1)	1.0177e+3^{8} (7.27e+0) −	1.0179e+3^{7} (1.73e+0) −	1.0182e+3^{4} (1.47e+0) −	1.0180e+3^{6} (1.83e+0) −	1.0197e+3^{2} (8.59e−1) −	1.0182e+3^{3} (1.25e+0) −	1.0182e+3^{5} (1.47e+0) −
DTLZ7	3	1000	6.5205e+0^{6} (2.06e−1)	6.5140e+0^{8} (2.54e−1) =	6.5455e+0^{4} (2.11e−1) +	6.5708e+0^{3} (1.52e−1) +	6.5716e+0^{2} (1.50e−1) +	6.5438e+0^{5} (2.11e−1) +	6.5730e+0^{1} (1.51e−1) +	6.5181e+0^{7} (2.54e−1) =
	5	1000	2.5042e+1^{7} (7.65e−2)	2.4889e+1^{8} (6.34e−2) −	2.5224e+1^{3} (7.79e−2) +	2.5126e+1^{5} (9.93e−2) +	2.5097e+1^{6} (1.21e−1) +	2.5210e+1^{4} (1.11e−1) +	2.5259e+1^{1} (6.88e−2) +	2.5231e+1^{2} (6.92e−2) +
	8	1000	1.8183e+2^{7} (6.41e−1)	1.7840e+2^{8} (5.15e−1) −	1.8639e+2^{4} (4.94e−1) +	1.8574e+2^{6} (4.84e−1) +	1.8665e+2^{1} (5.01e−1) +	1.8578e+2^{5} (2.70e−1) +	1.8656e+2^{2} (4.41e−1) +	1.8644e+2^{3} (5.55e−1) +
	10	1500	7.0037e+2^{7} (2.64e+0)	6.8765e+2^{8} (3.25e+0) −	7.1469e+2^{3} (3.45e+0) +	7.1431e+2^{4} (2.44e+0) +	7.1544e+2^{2} (1.80e+0) +	7.1991e+2^{1} (1.29e+0) +	7.0767e+2^{6} (3.77e+0) +	7.0839e+2^{5} (4.28e+0) +
WFG2	3	400	7.8650e+0^{2} (1.08e−2)	7.8551e+0^{8} (1.34e−2) −	7.8653e+0^{1} (8.79e−3) =	7.8574e+0^{7} (1.70e−2) −	7.8601e+0^{4} (1.34e−2) =	7.8596e+0^{5} (1.48e−2) =	7.8595e+0^{6} (1.67e−2) =	7.8644e+0^{3} (1.24e−2) =
	5	750	3.1900e+1^{6} (1.96e−2)	3.1893e+1^{8} (1.76e−2) =	3.1901e+1^{4} (1.74e−2) =	3.1900e+1^{7} (1.71e−2) =	3.1905e+1^{2} (1.59e−2) =	3.1906e+1^{1} (1.41e−2) =	3.1903e+1^{3} (1.74e−2) =	3.1901e+1^{5} (1.89e−2) =
	8	1500	2.5560e+2^{6} (1.14e−1)	2.5553e+2^{8} (1.56e−1) −	2.5561e+2^{5} (9.20e−2) =	2.5564e+2^{1} (9.19e−2) +	2.5560e+2^{7} (1.29e−1) =	2.5561e+2^{4} (9.63e−2) =	2.5562e+2^{3} (1.02e−1) =	2.5564e+2^{2} (9.58e−2) =
	10	2000	1.0232e+3^{7} (2.58e−1)	1.0229e+3^{8} (4.06e−1) −	1.0232e+3^{6} (2.93e−1) =	1.0233e+3^{5} (2.64e−1) =	1.0233e+3^{2} (2.31e−1) =	1.0233e+3^{4} (2.54e−1) =	1.0233e+3^{3} (2.88e−1) +	1.0233e+3^{1} (2.37e−1) +
WFG3	3	400	7.0237e+0^{1} (2.22e−2)	7.0148e+0^{3} (2.10e−2) −	7.0054e+0^{6} (2.31e−2) −	6.9911e+0^{8} (2.47e−2) −	7.0007e+0^{7} (1.72e−2) −	7.0154e+0^{2} (1.98e−2) −	7.0066e+0^{5} (2.56e−2) −	7.0087e+0^{4} (1.80e−2) −
	5	750	2.8861e+1^{1} (7.68e−2)	2.8504e+1^{4} (1.06e−1) −	2.8490e+1^{6} (1.01e−1) −	2.8370e+1^{8} (1.21e−1) −	2.8435e+1^{7} (1.01e−1) −	2.8500e+1^{5} (1.46e−1) −	2.8588e+1^{3} (1.29e−1) −	2.8603e+1^{2} (1.23e−1) −
	8	1500	2.2820e+2^{4} (9.69e−1)	2.2558e+2^{5} (1.55e+0) −	2.2526e+2^{8} (1.66e+0) −	2.2556e+2^{7} (1.72e+0) −	2.2556e+2^{6} (1.80e+0) −	2.3236e+2^{1} (1.04e+0) +	2.3011e+2^{2} (1.39e+0) +	2.3005e+2^{3} (1.59e+0) +
	10	2000	9.1788e+2^{4} (2.87e+0)	9.0989e+2^{6} (5.45e+0) −	9.1245e+2^{5} (6.46e+0) −	9.0867e+2^{8} (6.13e+0) −	9.0928e+2^{7} (4.91e+0) −	9.4403e+2^{1} (2.74e+0) +	9.3276e+2^{3} (5.04e+0) +	9.3371e+2^{2} (4.11e+0) +
DTLZ1^{-1}	3	400	5.4225e+0^{8} (1.07e−2)	5.4937e+0^{7} (6.38e−3) +	5.5049e+0^{1} (3.21e−3) +	5.4959e+0^{6} (3.26e−3) +	5.4966e+0^{5} (2.87e−3) +	5.5004e+0^{4} (2.46e−3) +	5.5039e+0^{3} (3.59e−3) +	5.5042e+0^{2} (3.81e−3) +
	5	600	9.3294e+0^{7} (1.41e−1)	9.1697e+0^{8} (2.43e−1) −	1.0960e+1^{4} (4.90e−2) +	1.0469e+1^{6} (7.88e−2) +	1.0636e+1^{5} (7.95e−2) +	1.1274e+1^{1} (1.87e−2) +	1.1259e+1^{3} (2.22e−2) +	1.1269e+1^{2} (2.04e−2) +
	8	750	7.4554e+0^{8} (4.15e−1)	7.5658e+0^{7} (3.43e−1) =	2.0239e+1^{4} (2.19e−1) +	1.8693e+1^{6} (3.15e−1) +	1.9724e+1^{5} (2.43e−1) +	2.0364e+1^{3} (4.94e−2) +	2.0396e+1^{1} (4.95e−2) +	2.0386e+1^{2} (4.80e−2) +
	10	1000	8.4726e+0^{8} (5.56e−1)	8.5490e+0^{7} (5.54e−1) =	2.9734e+1^{4} (2.05e−1) +	2.7414e+1^{6} (4.31e−1) +	2.9259e+1^{5} (2.93e−1) +	2.9754e+1^{2} (6.14e−2) +	2.9763e+1^{1} (8.28e−2) +	2.9749e+1^{3} (7.36e−2) +
DTLZ2^{-1}	3	250	6.6630e+0^{8} (4.99e−3)	6.6801e+0^{7} (6.12e−3) +	6.7162e+0^{1} (2.09e−3) +	6.7128e+0^{5} (2.76e−3) +	6.7141e+0^{4} (3.23e−3) +	6.7128e+0^{6} (3.33e−3) +	6.7150e+0^{3} (2.57e−3) +	6.7159e+0^{2} (2.47e−3) +
	5	350	1.6429e+1^{7} (9.19e−2)	1.6008e+1^{8} (9.68e−2) −	1.7409e+1^{4} (5.46e−2) +	1.7142e+1^{6} (7.55e−2) +	1.7214e+1^{5} (8.36e−2) +	1.7476e+1^{1} (3.92e−2) +	1.7424e+1^{2} (4.36e−2) +	1.7421e+1^{3} (5.63e−2) +
	8	500	2.7872e+1^{7} (1.05e+0)	2.1528e+1^{8} (9.66e−1) −	4.1104e+1^{3} (7.17e−1) +	4.1928e+1^{2} (5.90e−1) +	4.2007e+1^{1} (6.39e−1) +	3.9060e+1^{4} (4.18e−1) +	3.7589e+1^{6} (3.36e−1) +	3.7890e+1^{5} (5.03e−1) +
	10	750	4.5254e+1^{7} (1.30e+0)	4.5131e+1^{8} (1.89e+0) =	7.2094e+1^{3} (1.13e+0) +	7.4089e+1^{2} (1.65e+0) +	7.4959e+1^{1} (1.65e+0) +	6.4514e+1^{4} (5.20e−1) +	6.1845e+1^{5} (5.67e−1) +	6.1582e+1^{6} (5.13e−1) +
DTLZ3^{-1}	3	1000	6.6636e+0^{8} (5.25e−3)	6.6814e+0^{7} (4.70e−3) +	6.7183e+0^{6} (1.76e−3) +	6.7185e+0^{5} (1.77e−3) +	6.7189e+0^{2} (1.53e−3) +	6.7195e+0^{1} (1.51e−3) +	6.7188e+0^{3} (1.85e−3) +	6.7185e+0^{4} (1.95e−3) +
	5	1000	1.6208e+1^{7} (1.56e−1)	1.5908e+1^{8} (1.27e−1) −	1.7518e+1^{4} (5.99e−2) +	1.7226e+1^{6} (8.85e−2) +	1.7300e+1^{5} (1.21e−1) +	1.7552e+1^{1} (3.75e−2) +	1.7538e+1^{2} (3.51e−2) +	1.7534e+1^{3} (5.01e−2) +
	8	1000	2.6243e+1^{7} (6.58e−1)	2.0862e+1^{8} (1.08e+0) −	3.9950e+1^{2} (8.04e−1) +	3.8758e+1^{3} (1.19e+0) +	4.0172e+1^{1} (1.44e+0) +	3.8510e+1^{4} (3.56e−1) +	3.7270e+1^{5} (5.88e−1) +	3.7151e+1^{6} (5.46e−1) +
	10	1500	4.2963e+1^{7} (1.89e+0)	4.2629e+1^{8} (1.63e+0) =	7.1389e+1^{2} (1.96e+0) +	7.0979e+1^{3} (2.56e+0) +	7.1928e+1^{1} (1.68e+0) +	6.4103e+1^{4} (3.94e−1) +	6.1396e+1^{6} (6.07e−1) +	6.1435e+1^{5} (7.06e−1) +
DTLZ4^{-1}	3	600	6.6669e+0^{8} (4.87e−3)	6.6844e+0^{7} (4.78e−3) +	6.7185e+0^{2} (1.76e−3) +	6.7179e+0^{6} (2.64e−3) +	6.7180e+0^{4} (2.33e−3) +	6.7180e+0^{5} (1.89e−3) +	6.7184e+0^{3} (2.54e−3) +	6.7186e+0^{1} (1.95e−3) +
	5	1000	1.6739e+1^{7} (1.03e−1)	1.6460e+1^{8} (1.24e−1) −	1.7609e+1^{1} (3.45e−2) +	1.7449e+1^{6} (4.10e−2) +	1.7461e+1^{5} (4.22e−2) +	1.7586e+1^{2} (2.30e−2) +	1.7560e+1^{4} (3.25e−2) +	1.7575e+1^{3} (3.00e−2) +
	8	1250	3.7093e+1^{6} (7.97e−1)	3.7076e+1^{7} (6.27e−1) =	3.9412e+1^{3} (3.61e−1) +	3.9728e+1^{2} (5.01e−1) +	3.9942e+1^{1} (5.30e−1) +	3.8194e+1^{4} (2.17e−1) +	3.7045e+1^{8} (2.92e−1) =	3.7095e+1^{5} (2.77e−1) =
	10	2000	6.6342e+1^{5} (1.46e+0)	6.6515e+1^{4} (1.26e+0) =	6.7487e+1^{2} (6.31e−1) +	6.7194e+1^{3} (9.06e−1) +	6.8622e+1^{1} (9.18e−1) +	6.3449e+1^{6} (2.62e−1) −	6.1518e+1^{7} (4.65e−1) −	6.1492e+1^{8} (4.05e−1) −
DTLZ5^{-1}	3	400	6.7053e+0^{8} (9.11e−3)	6.7203e+0^{7} (4.43e−3) +	6.7919e+0^{3} (4.51e−3) +	6.7629e+0^{6} (6.77e−3) +	6.7684e+0^{5} (9.55e−3) +	6.7703e+0^{4} (7.66e−3) +	6.7922e+0^{2} (5.52e−3) +	6.7947e+0^{1} (3.71e−3) +
	5	600	1.7756e+1^{7} (1.27e−1)	1.6948e+1^{8} (1.79e−1) −	1.8526e+1^{4} (7.03e−2) +	1.8094e+1^{6} (1.02e−1) +	1.8204e+1^{5} (1.26e−1) +	1.8807e+1^{3} (3.56e−2) +	1.8826e+1^{1} (3.14e−2) +	1.8823e+1^{2} (4.75e−2) +
	8	750	3.2742e+1^{7} (1.17e+0)	3.2172e+1^{8} (1.20e+0) −	5.3639e+1^{2} (5.85e−1) +	5.0021e+1^{6} (8.86e−1) +	5.1861e+1^{5} (7.38e−1) +	5.4995e+1^{1} (2.95e−1) +	5.2597e+1^{4} (3.02e−1) +	5.2701e+1^{3} (2.87e−1) +
	10	1000	5.6190e+1^{8} (1.95e+0)	5.7002e+1^{7} (2.40e+0) =	1.0745e+2^{2} (1.37e+0) +	9.5947e+1^{6} (1.98e+0) +	1.0216e+2^{5} (1.72e+0) +	1.1084e+2^{1} (4.83e−1) +	1.0359e+2^{3} (5.51e−1) +	1.0353e+2^{4} (6.75e−1) +
DTLZ6^{-1}	3	400	6.6819e+0^{8} (5.23e−3)	6.6945e+0^{7} (3.86e−3) +	6.7320e+0^{1} (1.48e−3) +	6.7230e+0^{6} (1.85e−3) +	6.7244e+0^{4} (2.52e−3) +	6.7235e+0^{5} (2.27e−3) +	6.7316e+0^{3} (1.99e−3) +	6.7318e+0^{2} (1.85e−3) +
	5	600	1.6927e+1^{7} (1.06e−1)	1.6320e+1^{8} (1.43e−1) −	1.7801e+1^{4} (3.66e−2) +	1.7656e+1^{6} (4.62e−2) +	1.7693e+1^{5} (3.34e−2) +	1.7812e+1^{3} (2.69e−2) +	1.7834e+1^{2} (2.29e−2) +	1.7837e+1^{1} (2.85e−2) +
	8	750	2.9360e+1^{7} (1.16e+0)	2.9092e+1^{8} (1.08e+0) =	4.3522e+1^{3} (3.56e−1) +	4.4685e+1^{1} (4.52e−1) +	4.4646e+1^{2} (5.32e−1) +	4.2539e+1^{4} (2.10e−1) +	4.0862e+1^{5} (3.21e−1) +	4.0839e+1^{6} (3.10e−1) +
	10	1000	4.8593e+1^{7} (1.99e+0)	4.7927e+1^{8} (1.70e+0) =	7.9739e+1^{3} (8.58e−1) +	8.2808e+1^{2} (1.19e+0) +	8.2996e+1^{1} (9.28e−1) +	7.5683e+1^{4} (4.22e−1) +	7.1245e+1^{6} (4.64e−1) +	7.1362e+1^{5} (5.81e−1) +
DTLZ7^{-1}	3	1000	7.2371e+0^{8} (2.31e−3)	7.2438e+0^{5} (1.82e−3) +	7.2504e+0^{1} (1.42e−3) +	7.2485e+0^{4} (1.51e−3) +	7.2435e+0^{6} (3.16e−2) +	7.2415e+0^{7} (3.71e−2) +	7.2504e+0^{2} (1.51e−3) +	7.2503e+0^{3} (1.19e−3) +
	5	1000	2.8129e+1^{7} (2.04e−1)	2.8081e+1^{8} (1.51e−1) −	2.8281e+1^{4} (1.18e−1) +	2.8182e+1^{6} (1.89e−1) =	2.8249e+1^{5} (1.79e−1) +	2.8348e+1^{2} (1.66e−1) +	2.8402e+1^{1} (9.10e−2) +	2.8328e+1^{3} (1.61e−1) +
	8	1000	1.9160e+2^{7} (4.16e+0)	1.8980e+2^{8} (2.34e+0) =	1.9343e+2^{4} (2.52e+0) +	1.9819e+2^{2} (5.55e+0) +	1.9613e+2^{3} (4.98e+0) +	1.9939e+2^{1} (3.36e+0) +	1.9313e+2^{6} (9.13e−1) +	1.9336e+2^{5} (1.30e+0) +
	10	1500	7.2717e+2^{7} (3.28e+0)	7.1618e+2^{8} (3.36e+0) −	7.3903e+2^{2} (3.57e+0) +	7.3796e+2^{3} (7.06e+0) +	7.3630e+2^{4} (4.43e+0) +	7.7124e+2^{1} (1.43e+1) +	7.3324e+2^{6} (2.24e+0) +	7.3355e+2^{5} (2.53e+0) +
WFG1^{-1}	3	400	4.7325e+0^{8} (3.17e−2)	4.7994e+0^{1} (3.09e−2) +	4.7559e+0^{3} (2.23e−2) +	4.7415e+0^{7} (2.57e−2) +	4.7470e+0^{6} (1.67e−2) +	4.7500e+0^{4} (1.23e−2) +	4.7579e+0^{2} (2.18e−2) +	4.7493e+0^{5} (1.73e−2) +
	5	750	7.0145e+0^{5} (4.64e−2)	6.5176e+0^{8} (1.33e−1) −	7.0993e+0^{4} (3.42e−1) =	6.7189e+0^{7} (3.34e−1) −	6.8547e+0^{6} (2.84e−1) −	7.5908e+0^{1} (2.85e−1) +	7.5082e+0^{2} (2.91e−1) +	7.4971e+0^{3} (2.52e−1) +
	8	1500	8.0600e+0^{8} (5.63e−1)	8.1743e+0^{7} (4.97e−1) =	1.2260e+1^{5} (7.75e−1) +	1.1905e+1^{6} (7.61e−1) +	1.2456e+1^{4} (5.52e−1) +	1.2934e+1^{1} (8.30e−1) +	1.2774e+1^{3} (9.24e−1) +	1.2874e+1^{2} (8.84e−1) +
	10	2000	8.3852e+0^{8} (4.68e−1)	8.5158e+0^{7} (5.43e−1) =	1.6031e+1^{5} (1.05e+0) +	1.5666e+1^{6} (1.03e+0) +	1.6413e+1^{4} (1.15e+0) +	1.8109e+1^{1} (1.11e+0) +	1.7516e+1^{3} (1.46e+0) +	1.7965e+1^{2} (1.19e+0) +
WFG2^{-1}	3	400	6.1488e+0^{8} (2.85e−3)	6.1502e+0^{7} (3.92e−3) =	6.1541e+0^{4} (6.07e−3) +	6.1514e+0^{6} (5.43e−3) +	6.1525e+0^{5} (5.42e−3) +	6.1592e+0^{1} (6.08e−3) +	6.1563e+0^{3} (5.22e−3) +	6.1576e+0^{2} (5.90e−3) +
	5	750	1.0777e+1^{7} (5.35e−2)	1.0646e+1^{8} (1.05e−1) −	1.1169e+1^{4} (5.68e−2) +	1.1053e+1^{6} (7.44e−2) +	1.1091e+1^{5} (6.83e−2) +	1.1291e+1^{1} (2.64e−2) +	1.1280e+1^{2} (2.83e−2) +	1.1279e+1^{3} (2.41e−2) +
	8	1500	8.6812e+0^{7} (8.29e−1)	8.5225e+0^{8} (7.91e−1) =	1.8511e+1^{3} (1.50e+0) +	1.7004e+1^{6} (3.24e+0) +	1.8154e+1^{5} (2.16e+0) +	1.8729e+1^{1} (1.44e−1) +	1.8341e+1^{4} (1.23e+0) +	1.8667e+1^{2} (1.61e−1) +
	10	2000	8.6576e+0^{8} (7.49e−1)	8.7122e+0^{7} (9.92e−1) =	2.5090e+1^{3} (2.60e+0) +	2.4516e+1^{5} (3.01e+0) +	2.4196e+1^{6} (4.02e+0) +	2.5332e+1^{1} (8.81e−1) +	2.4964e+1^{4} (2.13e+0) +	2.5228e+1^{2} (1.04e+0) +
WFG3^{-1}	3	400	5.3510e+0^{8} (2.10e−2)	5.3568e+0^{7} (2.37e−2) =	5.4437e+0^{3} (2.01e−2) +	5.3602e+0^{6} (1.94e−2) =	5.3790e+0^{5} (2.46e−2) +	5.4195e+0^{4} (2.78e−2) +	5.4457e+0^{2} (3.06e−2) +	5.4496e+0^{1} (2.27e−2) +
	5	750	9.3565e+0^{8} (1.64e−1)	9.4748e+0^{7} (1.29e−1) +	1.0787e+1^{4} (8.87e−2) +	1.0243e+1^{6} (1.76e−1) +	1.0515e+1^{5} (1.03e−1) +	1.1090e+1^{3} (1.20e−1) +	1.1119e+1^{1} (4.29e−2) +	1.1103e+1^{2} (7.39e−2) +
	8	1500	7.2678e+0^{8} (6.21e−1)	7.3581e+0^{7} (5.20e−1) =	2.0138e+1^{4} (1.66e−1) +	1.8451e+1^{6} (2.98e−1) +	1.9627e+1^{5} (1.78e−1) +	2.0318e+1^{1} (1.17e−1) +	2.0234e+1^{3} (9.45e−2) +	2.0266e+1^{2} (1.04e−1) +
	10	2000	7.9454e+0^{7} (6.08e−1)	7.7628e+0^{8} (4.09e−1) =	2.9365e+1^{4} (2.60e−1) +	2.7199e+1^{6} (6.04e−1) +	2.8902e+1^{5} (3.88e−1) +	2.9843e+1^{1} (2.39e−1) +	2.9582e+1^{3} (3.78e−1) +	2.9639e+1^{2} (2.65e−1) +
WFG4^{-1}	3	400	6.6505e+0^{8} (8.29e−3)	6.6632e+0^{7} (8.92e−3) +	6.7095e+0^{3} (6.64e−3) +	6.6996e+0^{6} (5.28e−3) +	6.7023e+0^{4} (5.94e−3) +	6.7020e+0^{5} (6.62e−3) +	6.7102e+0^{2} (4.65e−3) +	6.7105e+0^{1} (4.67e−3) +
	5	750	1.6877e+1^{7} (1.20e−1)	1.6384e+1^{8} (1.31e−1) −	1.7365e+1^{3} (1.47e−1) +	1.7153e+1^{6} (1.41e−1) +	1.7205e+1^{5} (1.58e−1) +	1.7400e+1^{2} (9.80e−2) +	1.7402e+1^{1} (8.91e−2) +	1.7357e+1^{4} (1.09e−1) +
	8	1500	3.3085e+1^{7} (1.14e+0)	3.2868e+1^{8} (1.40e+0) =	4.0978e+1^{3} (4.46e−1) +	4.2054e+1^{1} (7.05e−1) +	4.1756e+1^{2} (5.12e−1) +	3.9200e+1^{4} (3.27e−1) +	3.8333e+1^{6} (3.55e−1) +	3.8352e+1^{5} (6.89e−1) +
	10	2000	5.8046e+1^{8} (1.89e+0)	5.8066e+1^{7} (2.04e+0) =	7.0901e+1^{3} (8.81e−1) +	7.3648e+1^{1} (9.64e−1) +	7.3314e+1^{2} (9.68e−1) +	6.5268e+1^{4} (5.59e−1) +	6.3090e+1^{5} (9.37e−1) +	6.3038e+1^{6} (7.79e−1) +
WFG5^{-1}	3	400	6.6342e+0^{8} (8.98e−3)	6.6522e+0^{7} (7.40e−3) +	6.6943e+0^{3} (4.49e−3) +	6.6841e+0^{6} (5.34e−3) +	6.6868e+0^{4} (4.64e−3) +	6.6861e+0^{5} (4.26e−3) +	6.6945e+0^{2} (4.20e−3) +	6.6948e+0^{1} (4.51e−3) +
	5	750	1.6726e+1^{7} (1.11e−1)	1.6211e+1^{8} (1.41e−1) −	1.7444e+1^{4} (7.30e−2) +	1.7306e+1^{6} (9.02e−2) +	1.7341e+1^{5} (9.02e−2) +	1.7460e+1^{2} (4.56e−2) +	1.7452e+1^{3} (7.63e−2) +	1.7471e+1^{1} (5.08e−2) +
	8	1500	3.1248e+1^{7} (1.06e+0)	3.1042e+1^{8} (1.35e+0) =	4.2005e+1^{3} (2.77e−1) +	4.3307e+1^{1} (4.01e−1) +	4.2974e+1^{2} (3.15e−1) +	4.0206e+1^{4} (3.68e−1) +	3.9103e+1^{6} (3.05e−1) +	3.9103e+1^{5} (3.06e−1) +
	10	2000	5.3208e+1^{8} (1.73e+0)	5.3865e+1^{7} (1.99e+0) =	7.4854e+1^{3} (7.07e−1) +	7.9218e+1^{1} (8.67e−1) +	7.8459e+1^{2} (7.52e−1) +	6.8164e+1^{4} (7.04e−1) +	6.6044e+1^{5} (7.27e−1) +	6.5681e+1^{6} (6.23e−1) +
WFG6^{-1}	3	400	6.6466e+0^{8} (7.60e−3)	6.6637e+0^{7} (7.78e−3) +	6.7062e+0^{1} (4.41e−3) +	6.6962e+0^{6} (5.60e−3) +	6.7002e+0^{4} (5.15e−3) +	6.6971e+0^{5} (4.49e−3) +	6.7046e+0^{3} (5.41e−3) +	6.7050e+0^{2} (4.14e−3) +
	5	750	1.6600e+1^{7} (1.02e−1)	1.6265e+1^{8} (1.25e−1) −	1.7510e+1^{1} (6.79e−2) +	1.7363e+1^{6} (6.87e−2) +	1.7389e+1^{5} (8.03e−2) +	1.7503e+1^{3} (5.21e−2) +	1.7493e+1^{4} (3.89e−2) +	1.7509e+1^{2} (6.68e−2) +
	8	1500	2.7869e+1^{7} (8.03e−1)	2.7721e+1^{8} (9.65e−1) =	4.1285e+1^{3} (3.97e−1) +	4.3301e+1^{1} (4.57e−1) +	4.2779e+1^{2} (3.64e−1) +	3.9033e+1^{4} (2.59e−1) +	3.7651e+1^{6} (3.72e−1) +	3.7789e+1^{5} (3.35e−1) +
	10	2000	4.4852e+1^{8} (1.64e+0)	4.5363e+1^{7} (1.58e+0) =	7.3300e+1^{3} (8.07e−1) +	7.8414e+1^{1} (7.74e−1) +	7.8160e+1^{2} (8.32e−1) +	6.5311e+1^{4} (6.19e−1) +	6.3023e+1^{6} (7.43e−1) +	6.3051e+1^{5} (6.61e−1) +
WFG7^{-1}	3	400	6.6245e+0^{7} (1.11e−2)	6.6217e+0^{8} (1.55e−2) =	6.6675e+0^{2} (1.14e−2) +	6.6564e+0^{6} (1.43e−2) +	6.6585e+0^{5} (1.29e−2) +	6.6634e+0^{4} (1.04e−2) +	6.6677e+0^{1} (9.73e−3) +	6.6665e+0^{3} (1.05e−2) +
	5	750	1.6774e+1^{7} (1.15e−1)	1.6339e+1^{8} (1.32e−1) −	1.7122e+1^{2} (8.40e−2) +	1.7018e+1^{5} (1.12e−1) +	1.6997e+1^{6} (9.39e−2) +	1.7196e+1^{1} (8.95e−2) +	1.7022e+1^{4} (8.77e−2) +	1.7027e+1^{3} (7.46e−2) +
	8	1500	2.7079e+1^{8} (1.42e+0)	2.7283e+1^{7} (1.13e+0) =	3.7678e+1^{3} (6.38e−1) +	3.9055e+1^{1} (9.07e−1) +	3.8734e+1^{2} (7.32e−1) +	3.7023e+1^{4} (4.02e−1) +	3.5007e+1^{5} (4.83e−1) +	3.4888e+1^{6} (5.05e−1) +
	10	2000	4.1620e+1^{8} (1.37e+0)	4.1939e+1^{7} (2.22e+0) =	6.3266e+1^{3} (1.90e+0) +	6.8831e+1^{1} (1.68e+0) +	6.7676e+1^{2} (1.99e+0) +	6.1309e+1^{4} (1.63e+0) +	5.2399e+1^{6} (1.86e+0) +	5.2670e+1^{5} (2.49e+0) +
WFG8^{-1}	3	400	6.6535e+0^{8} (9.22e−3)	6.6740e+0^{7} (7.66e−3) +	6.7182e+0^{1} (2.97e−3) +	6.7105e+0^{5} (3.46e−3) +	6.7124e+0^{4} (1.98e−3) +	6.7097e+0^{6} (3.57e−3) +	6.7175e+0^{3} (3.76e−3) +	6.7181e+0^{2} (2.83e−3) +
	5	750	1.6613e+1^{7} (1.20e−1)	1.6338e+1^{8} (1.04e−1) −	1.7592e+1^{1} (3.97e−2) +	1.7477e+1^{6} (6.17e−2) +	1.7503e+1^{5} (4.89e−2) +	1.7563e+1^{4} (3.77e−2) +	1.7583e+1^{2} (3.57e−2) +	1.7573e+1^{3} (3.68e−2) +
	8	1500	2.7482e+1^{8} (1.06e+0)	2.7554e+1^{7} (8.20e−1) =	4.2069e+1^{3} (6.21e−1) +	4.3434e+1^{1} (7.05e−1) +	4.3122e+1^{2} (5.05e−1) +	4.0497e+1^{4} (6.04e−1) +	3.9507e+1^{6} (8.06e−1) +	3.9625e+1^{5} (6.88e−1) +
	10	2000	4.5053e+1^{8} (1.99e+0)	4.5862e+1^{7} (1.66e+0) =	7.5029e+1^{3} (1.15e+0) +	8.0224e+1^{1} (1.03e+0) +	7.9359e+1^{2} (9.01e−1) +	6.7878e+1^{4} (1.16e+0) +	6.4705e+1^{6} (1.01e+0) +	6.5000e+1^{5} (1.06e+0) +
WFG9^{-1}	3	400	6.5719e+0^{7} (1.81e−2)	6.5566e+0^{8} (2.61e−2) −	6.6250e+0^{3} (1.97e−2) +	6.6055e+0^{6} (2.66e−2) +	6.6091e+0^{4} (2.52e−2) +	6.6058e+0^{5} (2.38e−2) +	6.6251e+0^{2} (2.37e−2) +	6.6280e+0^{1} (2.64e−2) +
	5	750	1.6681e+1^{7} (1.46e−1)	1.6102e+1^{8} (1.44e−1) −	1.7075e+1^{4} (1.41e−1) +	1.6717e+1^{6} (1.27e−1) =	1.6852e+1^{5} (1.60e−1) +	1.7140e+1^{3} (9.15e−2) +	1.7177e+1^{2} (1.02e−1) +	1.7184e+1^{1} (1.00e−1) +
	8	1500	3.0428e+1^{8} (1.34e+0)	3.0949e+1^{7} (1.09e+0) +	4.0283e+1^{3} (6.21e−1) +	4.1633e+1^{1} (8.31e−1) +	4.1328e+1^{2} (9.17e−1) +	3.9659e+1^{4} (7.39e−1) +	3.7970e+1^{6} (7.64e−1) +	3.8068e+1^{5} (5.55e−1) +
	10	2000	5.0649e+1^{7} (2.44e+0)	5.0396e+1^{8} (2.35e+0) =	7.2292e+1^{3} (1.62e+0) +	7.6582e+1^{1} (1.16e+0) +	7.5526e+1^{2} (1.56e+0) +	6.8127e+1^{4} (9.73e−1) +	6.3015e+1^{6} (1.69e+0) +	6.3189e+1^{5} (1.24e+0) +
+/−/=				16/34/34	69/10/5	67/12/5	69/11/4	72/6/6	71/9/4	70/9/5
% of satisfaction				19.05%	82.14%	79.76%	82.14%	85.71%	84.52%	83.33%

Table 8: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the NSGA-III framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to NSGA-III based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than NSGA-III. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	NSGA-III	A-NSGA-III	NSGA-III-AdaRSE	NSGA-III-AdaGAE	NSGA-III-AdaMPT	NSGA-III-AdaCOU	NSGA-III-AdaPT	NSGA-III-AdaKRA
DTLZ5	3	400	1.0047e+1^{8} (1.18e−1)	1.0248e+1^{7} (6.63e−2) +	1.0427e+1^{4} (1.33e−1) +	1.0414e+1^{5} (7.81e−2) +	1.0437e+1^{3} (1.59e−2) +	1.0439e+1^{2} (1.12e−1) +	1.0449e+1^{1} (3.75e−2) +	1.0375e+1^{6} (3.51e−1) +
	5	600	2.2132e+1^{5} (1.42e+0)	2.0791e+1^{8} (1.72e+0) −	2.2743e+1^{3} (2.00e+0) =	2.1600e+1^{6} (2.25e+0) =	2.1288e+1^{7} (2.36e+0) =	2.2315e+1^{4} (1.32e+0) =	2.5661e+1^{1} (2.07e+0) +	2.5146e+1^{2} (2.43e+0) +
	8	750	3.3044e+1^{8} (4.14e+0)	3.8213e+1^{4} (4.59e+0) +	4.5677e+1^{3} (7.99e+0) +	3.3671e+1^{7} (4.09e+0) =	3.6354e+1^{6} (5.71e+0) +	3.7864e+1^{5} (3.79e+0) +	9.1547e+1^{2} (7.02e+0) +	9.4464e+1^{1} (5.90e+0) +
	10	1000	6.1875e+1^{7} (5.47e+0)	9.4568e+1^{3} (2.24e+1) +	7.3127e+1^{4} (1.29e+1) +	5.2289e+1^{8} (6.84e+0) −	6.2351e+1^{6} (9.07e+0) =	6.5351e+1^{5} (6.10e+0) +	1.7715e+2^{2} (5.42e+0) +	1.7743e+2^{1} (5.98e+0) +
DTLZ6	3	400	9.9043e+0^{8} (1.52e−1)	1.0194e+1^{7} (1.84e−1) +	1.0480e+1^{3} (1.83e−2) +	1.0425e+1^{6} (1.12e−2) +	1.0443e+1^{5} (7.54e−3) +	1.0478e+1^{4} (2.30e−2) +	1.0513e+1^{1} (1.65e−1) +	1.0481e+1^{2} (1.36e−2) +
	5	600	1.3755e+1^{7} (1.20e+0)	1.2791e+1^{8} (1.04e+0) −	1.7708e+1^{3} (2.19e+0) +	1.7001e+1^{4} (1.78e+0) +	1.6929e+1^{5} (2.11e+0) +	1.5402e+1^{6} (1.80e+0) +	1.9259e+1^{1} (1.83e+0) +	1.8738e+1^{2} (1.55e+0) +
	8	750	2.5631e+1^{7} (3.40e+0)	3.4547e+1^{3} (4.53e+0) +	2.9918e+1^{4} (3.16e+0) +	2.8141e+1^{6} (3.37e+0) +	2.8967e+1^{5} (3.99e+0) +	2.4864e+1^{8} (3.60e+0) =	4.1893e+1^{2} (6.04e+0) +	4.3082e+1^{1} (4.69e+0) +
	10	1000	4.0761e+1^{6} (5.03e+0)	9.9001e+1^{1} (1.31e+1) +	4.2746e+1^{4} (5.00e+0) =	3.9190e+1^{7} (4.03e+0) =	4.2121e+1^{5} (3.66e+0) =	3.7647e+1^{8} (4.32e+0) −	7.8144e+1^{2} (7.69e+0) +	7.3480e+1^{3} (9.33e+0) +
DTLZ7	3	1000	2.3038e+1^{7} (2.97e+0)	2.2156e+1^{8} (3.52e+0) −	2.4403e+1^{4} (3.39e+0) +	2.4615e+1^{3} (2.45e+0) +	2.4705e+1^{2} (2.44e+0) +	2.4352e+1^{5} (3.37e+0) +	2.4864e+1^{1} (2.46e+0) +	2.4019e+1^{6} (4.10e+0) +
	5	1000	1.1640e+2^{8} (1.86e+0)	1.2835e+2^{7} (2.55e+0) +	1.5273e+2^{1} (1.77e+0) +	1.5098e+2^{2} (2.27e+0) +	1.5043e+2^{3} (2.10e+0) +	1.4101e+2^{6} (3.12e+0) +	1.4545e+2^{4} (2.06e+0) +	1.4502e+2^{5} (2.53e+0) +
	8	1000	1.3578e+2^{8} (2.17e+0)	1.3999e+2^{7} (1.77e+0) +	1.5445e+2^{2} (5.42e−1) +	1.5421e+2^{5} (5.82e−1) +	1.5437e+2^{3} (4.75e−1) +	1.5286e+2^{6} (8.12e−1) +	1.5434e+2^{4} (4.46e−1) +	1.5447e+2^{1} (4.42e−1) +
	10	1500	2.4481e+2^{8} (2.30e+0)	2.5074e+2^{7} (2.74e+0) +	2.7315e+2^{2} (5.75e−1) +	2.7330e+2^{1} (7.63e−1) +	2.7278e+2^{4} (2.41e+0) +	2.7085e+2^{6} (8.41e−1) +	2.7309e+2^{3} (6.29e−1) +	2.7263e+2^{5} (2.44e+0) +
WFG2	3	400	2.0618e+1^{4} (2.51e−1)	2.0190e+1^{8} (3.62e−1) −	2.0548e+1^{7} (1.78e−1) =	2.0648e+1^{1} (2.64e−1) =	2.0622e+1^{3} (3.58e−1) =	2.0565e+1^{5} (2.72e−1) =	2.0548e+1^{6} (2.95e−1) =	2.0637e+1^{2} (2.13e−1) =
	5	750	4.0023e+1^{1} (6.65e−1)	3.9234e+1^{8} (8.08e−1) −	3.9767e+1^{7} (7.57e−1) =	3.9775e+1^{5} (6.60e−1) =	3.9774e+1^{6} (6.49e−1) =	3.9979e+1^{2} (6.03e−1) =	3.9973e+1^{3} (7.39e−1) =	3.9853e+1^{4} (5.50e−1) =
	8	1500	5.1547e+1^{2} (1.24e+0)	4.9080e+1^{8} (2.48e+0) −	5.1740e+1^{1} (6.43e−1) =	5.1412e+1^{4} (1.26e+0) =	5.1240e+1^{7} (1.28e+0) =	5.1387e+1^{6} (1.35e+0) =	5.1402e+1^{5} (1.12e+0) =	5.1423e+1^{3} (1.24e+0) =
	10	2000	6.9279e+1^{3} (1.25e+0)	5.9667e+1^{8} (8.72e+0) −	6.9726e+1^{1} (1.30e+0) =	6.7954e+1^{7} (3.18e+0) −	6.9314e+1^{2} (1.41e+0) =	6.8740e+1^{6} (2.33e+0) =	6.8896e+1^{5} (1.78e+0) =	6.9190e+1^{4} (1.61e+0) =
WFG3	3	400	1.2655e+1^{5} (5.81e−1)	1.2413e+1^{7} (5.03e−1) =	1.2733e+1^{2} (3.90e−1) =	1.2639e+1^{6} (4.48e−1) =	1.2684e+1^{4} (4.20e−1) =	1.2341e+1^{8} (3.64e−1) −	1.2709e+1^{3} (3.73e−1) =	1.2799e+1^{1} (4.00e−1) =
	5	750	4.4270e+1^{5} (6.26e−1)	4.4337e+1^{3} (6.01e−1) =	4.3641e+1^{6} (7.41e−1) −	3.7344e+1^{8} (7.34e−1) −	3.9658e+1^{7} (1.06e+0) −	4.4278e+1^{4} (7.56e−1) =	4.8558e+1^{1} (6.04e−1) +	4.8529e+1^{2} (5.34e−1) +
	8	1500	6.3767e+1^{8} (1.40e+0)	7.3987e+1^{7} (8.11e−1) +	8.2602e+1^{3} (1.27e+0) +	7.4538e+1^{6} (2.07e+0) +	7.7567e+1^{5} (1.80e+0) +	7.7952e+1^{4} (8.50e+0) +	8.5092e+1^{2} (1.12e+0) +	8.5172e+1^{1} (1.27e+0) +
	10	2000	1.0317e+2^{8} (1.50e+0)	1.1389e+2^{6} (8.40e−1) +	1.2416e+2^{3} (1.98e+0) +	1.0941e+2^{7} (1.20e+1) +	1.1799e+2^{5} (3.26e+0) +	1.2248e+2^{4} (3.77e+0) +	1.2991e+2^{1} (1.47e+0) +	1.2982e+2^{2} (1.51e+0) +
DTLZ1^{-1}	3	400	2.1750e+1^{8} (2.43e−1)	2.3014e+1^{7} (1.00e−1) +	2.3181e+1^{1} (4.77e−2) +	2.3148e+1^{6} (5.76e−2) +	2.3162e+1^{5} (4.54e−2) +	2.3169e+1^{3} (3.80e−2) +	2.3162e+1^{4} (3.18e−2) +	2.3174e+1^{2} (4.59e−2) +
	5	600	4.2213e+1^{8} (1.18e+0)	4.5097e+1^{7} (2.44e+0) +	6.8367e+1^{4} (5.89e−1) +	6.0448e+1^{6} (9.38e−1) +	6.3581e+1^{5} (8.66e−1) +	7.2030e+1^{1} (2.88e−1) +	7.1666e+1^{2} (2.74e−1) +	7.1640e+1^{3} (3.38e−1) +
	8	750	2.4903e+1^{8} (1.94e+0)	2.5673e+1^{7} (1.59e+0) =	1.0593e+2^{1} (1.02e+0) +	9.7300e+1^{6} (1.25e+0) +	1.0279e+2^{2} (1.20e+0) +	9.7898e+1^{3} (1.01e+0) +	9.7627e+1^{4} (9.07e−1) +	9.7617e+1^{5} (9.66e−1) +
	10	1000	2.3717e+1^{8} (2.36e+0)	2.4039e+1^{7} (2.37e+0) =	1.7271e+2^{1} (1.49e+0) +	1.5559e+2^{4} (2.69e+0) +	1.6832e+2^{2} (1.86e+0) +	1.5596e+2^{3} (1.25e+0) +	1.5545e+2^{6} (1.36e+0) +	1.5555e+2^{5} (1.24e+0) +
DTLZ2^{-1}	3	250	2.9548e+1^{8} (3.11e−1)	2.9796e+1^{7} (3.99e−1) +	3.2463e+1^{2} (1.34e−1) +	3.2052e+1^{6} (2.10e−1) +	3.2180e+1^{4} (2.32e−1) +	3.2175e+1^{5} (1.60e−1) +	3.2367e+1^{3} (1.72e−1) +	3.2489e+1^{1} (1.52e−1) +
	5	350	1.0153e+2^{7} (1.75e+0)	1.0080e+2^{8} (1.53e+0) =	1.2848e+2^{2} (1.57e+0) +	1.1705e+2^{6} (3.09e+0) +	1.2130e+2^{5} (3.34e+0) +	1.3120e+2^{1} (1.19e+0) +	1.2465e+2^{4} (1.19e+0) +	1.2491e+2^{3} (1.49e+0) +
	8	500	8.6972e+1^{7} (4.38e+0)	8.6035e+1^{8} (1.53e+0) =	1.3627e+2^{1} (1.39e+0) +	1.2714e+2^{6} (2.20e+0) +	1.3215e+2^{4} (2.05e+0) +	1.3438e+2^{2} (1.51e+0) +	1.3206e+2^{5} (1.51e+0) +	1.3279e+2^{3} (1.85e+0) +
	10	750	1.2427e+2^{7} (6.09e+0)	1.2386e+2^{8} (5.69e+0) =	2.4543e+2^{1} (2.42e+0) +	2.2365e+2^{6} (5.48e+0) +	2.3533e+2^{3} (3.33e+0) +	2.3973e+2^{2} (2.46e+0) +	2.3524e+2^{4} (1.87e+0) +	2.3395e+2^{5} (2.08e+0) +
DTLZ3^{-1}	3	1000	2.9623e+1^{8} (3.09e−1)	2.9700e+1^{7} (3.13e−1) =	3.2700e+1^{3} (9.64e−2) +	3.2464e+1^{6} (1.39e−1) +	3.2510e+1^{5} (1.10e−1) +	3.2510e+1^{4} (5.99e−2) +	3.2772e+1^{1} (5.57e−2) +	3.2704e+1^{2} (8.27e−2) +
	5	1000	1.0425e+2^{7} (1.99e+0)	1.0011e+2^{8} (1.10e+0) −	1.3139e+2^{2} (1.34e+0) +	1.1917e+2^{6} (2.29e+0) +	1.2205e+2^{5} (3.59e+0) +	1.3441e+2^{1} (9.99e−1) +	1.2787e+2^{4} (1.34e+0) +	1.2852e+2^{3} (1.44e+0) +
	8	1000	9.0102e+1^{7} (3.42e+0)	8.6076e+1^{8} (2.06e+0) −	1.3636e+2^{1} (2.41e+0) +	1.1481e+2^{6} (3.28e+0) +	1.2706e+2^{5} (2.63e+0) +	1.3519e+2^{2} (1.82e+0) +	1.3275e+2^{4} (1.75e+0) +	1.3342e+2^{3} (1.59e+0) +
	10	1500	1.2796e+2^{8} (8.32e+0)	1.2796e+2^{7} (6.60e+0) =	2.4638e+2^{1} (2.45e+0) +	2.1153e+2^{6} (4.87e+0) +	2.2967e+2^{5} (3.42e+0) +	2.4227e+2^{2} (1.98e+0) +	2.3737e+2^{4} (2.56e+0) +	2.3784e+2^{3} (2.83e+0) +
DTLZ4^{-1}	3	600	2.9714e+1^{8} (3.39e−1)	2.9745e+1^{7} (2.38e−1) =	3.2726e+1^{1} (9.25e−2) +	3.2430e+1^{6} (1.10e−1) +	3.2481e+1^{4} (1.12e−1) +	3.2466e+1^{5} (8.50e−2) +	3.2723e+1^{2} (1.24e−1) +	3.2710e+1^{3} (1.24e−1) +
	5	1000	1.0579e+2^{7} (2.13e+0)	1.0568e+2^{8} (1.89e+0) =	1.3517e+2^{2} (7.74e−1) +	1.2840e+2^{6} (1.02e+0) +	1.2992e+2^{4} (8.88e−1) +	1.3600e+2^{1} (5.80e−1) +	1.2960e+2^{5} (1.12e+0) +	1.3038e+2^{3} (1.22e+0) +
	8	1250	1.1630e+2^{7} (3.59e+0)	1.1588e+2^{8} (3.66e+0) =	1.4052e+2^{2} (1.69e+0) +	1.3956e+2^{3} (1.54e+0) +	1.4092e+2^{1} (1.47e+0) +	1.3703e+2^{4} (1.41e+0) +	1.3421e+2^{5} (1.82e+0) +	1.3413e+2^{6} (1.21e+0) +
	10	2000	1.8845e+2^{8} (5.70e+0)	1.8929e+2^{7} (6.25e+0) =	2.5305e+2^{1} (2.01e+0) +	2.4970e+2^{3} (2.09e+0) +	2.5154e+2^{2} (1.81e+0) +	2.4423e+2^{4} (2.37e+0) +	2.3918e+2^{6} (2.90e+0) +	2.3991e+2^{5} (1.62e+0) +
DTLZ5^{-1}	3	400	2.4637e+1^{8} (1.86e−1)	2.4801e+1^{7} (2.01e−1) +	2.6980e+1^{3} (1.06e−1) +	2.6311e+1^{6} (1.50e−1) +	2.6420e+1^{5} (1.93e−1) +	2.6581e+1^{4} (1.14e−1) +	2.7024e+1^{2} (1.17e−1) +	2.7039e+1^{1} (1.06e−1) +
	5	600	7.7505e+1^{7} (1.32e+0)	7.5470e+1^{8} (1.15e+0) −	9.7868e+1^{4} (6.92e−1) +	8.5436e+1^{6} (1.81e+0) +	8.9001e+1^{5} (1.64e+0) +	1.0155e+2^{1} (4.70e−1) +	9.9716e+1^{3} (6.75e−1) +	9.9794e+1^{2} (7.45e−1) +
	8	750	5.3928e+1^{8} (2.42e+0)	5.4285e+1^{7} (3.28e+0) =	1.2671e+2^{1} (1.32e+0) +	1.1322e+2^{6} (3.52e+0) +	1.2079e+2^{3} (2.84e+0) +	1.2528e+2^{2} (1.69e+0) +	1.1999e+2^{5} (1.49e+0) +	1.2001e+2^{4} (1.26e+0) +
	10	1000	6.1414e+1^{8} (4.25e+0)	6.1919e+1^{7} (4.13e+0) =	2.2174e+2^{1} (2.65e+0) +	1.9012e+2^{6} (4.14e+0) +	2.0674e+2^{5} (4.98e+0) +	2.1903e+2^{2} (2.25e+0) +	2.0732e+2^{4} (1.99e+0) +	2.0750e+2^{3} (1.76e+0) +
DTLZ6^{-1}	3	400	2.7975e+1^{8} (2.57e−1)	2.8181e+1^{7} (2.65e−1) +	3.0789e+1^{1} (1.28e−1) +	3.0083e+1^{6} (1.46e−1) +	3.0237e+1^{5} (1.78e−1) +	3.0242e+1^{4} (1.19e−1) +	3.0771e+1^{2} (1.17e−1) +	3.0769e+1^{3} (1.03e−1) +
	5	600	9.3157e+1^{7} (1.63e+0)	9.2636e+1^{8} (1.42e+0) =	1.2302e+2^{2} (9.69e−1) +	1.1675e+2^{6} (9.88e−1) +	1.1910e+2^{3} (9.94e−1) +	1.2318e+2^{1} (1.11e+0) +	1.1860e+2^{5} (8.90e−1) +	1.1861e+2^{4} (1.09e+0) +
	8	750	7.4720e+1^{7} (3.83e+0)	7.4250e+1^{8} (4.97e+0) =	1.3499e+2^{2} (1.77e+0) +	1.3294e+2^{3} (1.72e+0) +	1.3500e+2^{1} (1.74e+0) +	1.3219e+2^{4} (1.43e+0) +	1.2917e+2^{5} (1.73e+0) +	1.2849e+2^{6} (1.86e+0) +
	10	1000	1.0087e+2^{7} (5.30e+0)	9.9214e+1^{8} (5.35e+0) =	2.4303e+2^{1} (2.61e+0) +	2.3536e+2^{4} (2.87e+0) +	2.3895e+2^{2} (2.26e+0) +	2.3674e+2^{3} (2.31e+0) +	2.2839e+2^{6} (1.96e+0) +	2.2841e+2^{5} (2.71e+0) +
DTLZ7^{-1}	3	1000	1.4518e+1^{7} (9.51e−1)	1.4114e+1^{8} (1.48e−1) −	1.5117e+1^{1} (8.23e−1) +	1.4744e+1^{6} (1.03e−1) +	1.4868e+1^{5} (3.11e−1) +	1.4981e+1^{3} (6.25e−1) +	1.4913e+1^{4} (8.25e−2) +	1.5002e+1^{2} (6.01e−1) +
	5	1000	9.6481e+1^{7} (1.75e+1)	1.0141e+2^{4} (1.15e+1) =	1.1134e+2^{2} (2.38e+1) +	9.4879e+1^{8} (1.68e+1) =	1.0129e+2^{5} (2.31e+1) =	9.8555e+1^{6} (1.95e+1) =	1.1308e+2^{1} (2.22e+1) +	1.0858e+2^{3} (2.22e+1) +
	8	1000	1.3700e+2^{7} (5.30e+0)	1.3184e+2^{8} (4.52e+0) −	1.5348e+2^{3} (3.09e+0) +	1.5091e+2^{6} (4.51e+0) +	1.5309e+2^{4} (3.70e+0) +	1.5167e+2^{5} (2.29e+0) +	1.5421e+2^{2} (2.92e+0) +	1.5444e+2^{1} (1.11e+0) +
	10	1500	2.4545e+2^{7} (4.44e+0)	2.2687e+2^{8} (6.62e+0) −	2.7011e+2^{5} (1.52e+0) +	2.7016e+2^{4} (1.22e+0) +	2.7033e+2^{3} (1.56e+0) +	2.6549e+2^{6} (3.94e+0) +	2.7093e+2^{2} (1.42e+0) +	2.7097e+2^{1} (1.41e+0) +
WFG1^{-1}	3	400	1.6628e+1^{8} (5.51e−1)	1.8172e+1^{1} (5.81e−1) +	1.7227e+1^{2} (4.91e−1) +	1.6764e+1^{7} (5.96e−1) =	1.7060e+1^{4} (3.59e−1) +	1.7055e+1^{5} (3.22e−1) +	1.7224e+1^{3} (4.36e−1) +	1.7025e+1^{6} (4.65e−1) +
	5	750	2.1282e+1^{7} (6.79e−1)	1.6162e+1^{8} (8.04e−1) −	3.4721e+1^{4} (8.76e−1) +	3.1724e+1^{6} (1.11e+0) +	3.3369e+1^{5} (8.85e−1) +	3.8404e+1^{1} (5.57e−1) +	3.8167e+1^{3} (7.61e−1) +	3.8235e+1^{2} (6.47e−1) +
	8	1500	2.6783e+1^{7} (1.97e+0)	2.6730e+1^{8} (2.06e+0) =	5.1378e+1^{5} (3.68e+0) +	4.8024e+1^{6} (3.19e+0) +	5.1807e+1^{4} (2.87e+0) +	6.0351e+1^{1} (3.48e+0) +	6.0071e+1^{2} (4.00e+0) +	5.9850e+1^{3} (3.87e+0) +
	10	2000	2.7770e+1^{8} (1.82e+0)	2.8689e+1^{7} (2.12e+0) +	6.8639e+1^{5} (4.08e+0) +	6.5101e+1^{6} (3.93e+0) +	7.0689e+1^{4} (4.92e+0) +	8.9087e+1^{1} (5.06e+0) +	8.6362e+1^{3} (6.57e+0) +	8.8664e+1^{2} (5.16e+0) +
WFG2^{-1}	3	400	2.9415e+1^{8} (2.28e−1)	3.0306e+1^{7} (2.74e−1) +	3.1516e+1^{4} (8.89e−2) +	3.1309e+1^{6} (1.34e−1) +	3.1371e+1^{5} (1.33e−1) +	3.1551e+1^{3} (1.41e−1) +	3.1557e+1^{2} (6.93e−2) +	3.1573e+1^{1} (1.08e−1) +
	5	750	5.3939e+1^{7} (1.72e+0)	5.2389e+1^{8} (1.50e+0) −	7.3887e+1^{4} (9.73e−1) +	6.9938e+1^{6} (1.45e+0) +	7.1072e+1^{5} (1.07e+0) +	7.6852e+1^{1} (5.47e−1) +	7.6690e+1^{3} (4.23e−1) +	7.6819e+1^{2} (4.16e−1) +
	8	1500	3.5123e+1^{7} (4.61e+0)	3.3773e+1^{8} (4.07e+0) =	1.0015e+2^{1} (8.85e+0) +	9.1227e+1^{6} (1.42e+1) +	9.7228e+1^{4} (1.01e+1) +	9.7770e+1^{2} (9.76e−1) +	9.5238e+1^{5} (8.19e+0) +	9.7673e+1^{3} (1.25e+0) +
	10	2000	3.8692e+1^{7} (5.11e+0)	3.7805e+1^{8} (5.74e+0) =	1.4939e+2^{1} (1.37e+1) +	1.4201e+2^{6} (1.37e+1) +	1.4335e+2^{5} (1.88e+1) +	1.4704e+2^{2} (8.26e+0) +	1.4586e+2^{4} (9.58e+0) +	1.4643e+2^{3} (8.00e+0) +
WFG3^{-1}	3	400	2.0616e+1^{8} (2.45e−1)	2.1906e+1^{7} (1.64e−1) +	2.2651e+1^{3} (1.57e−1) +	2.2032e+1^{6} (2.26e−1) +	2.2256e+1^{5} (1.75e−1) +	2.2564e+1^{4} (1.50e−1) +	2.2688e+1^{2} (1.96e−1) +	2.2717e+1^{1} (1.80e−1) +
	5	750	4.2419e+1^{8} (1.48e+0)	4.5751e+1^{7} (1.74e+0) +	6.7526e+1^{4} (8.97e−1) +	6.0526e+1^{6} (1.48e+0) +	6.3596e+1^{5} (1.03e+0) +	6.9990e+1^{3} (1.91e+0) +	7.0155e+1^{1} (6.36e−1) +	7.0106e+1^{2} (8.11e−1) +
	8	1500	2.5539e+1^{8} (2.73e+0)	2.5770e+1^{7} (2.74e+0) =	1.0540e+2^{1} (1.13e+0) +	9.6752e+1^{6} (1.25e+0) +	1.0232e+2^{2} (1.15e+0) +	9.8984e+1^{3} (1.23e+0) +	9.7532e+1^{4} (1.22e+0) +	9.7473e+1^{5} (1.09e+0) +
	10	2000	2.5776e+1^{7} (3.06e+0)	2.5416e+1^{8} (2.20e+0) =	1.7033e+2^{1} (1.73e+0) +	1.5363e+2^{6} (2.93e+0) +	1.6555e+2^{2} (2.09e+0) +	1.6036e+2^{3} (1.77e+0) +	1.5746e+2^{4} (2.41e+0) +	1.5730e+2^{5} (2.23e+0) +
WFG4^{-1}	3	400	2.9603e+1^{8} (3.29e−1)	2.9636e+1^{7} (3.17e−1) =	3.2261e+1^{3} (1.94e−1) +	3.1582e+1^{6} (2.54e−1) +	3.1806e+1^{5} (2.63e−1) +	3.1839e+1^{4} (1.89e−1) +	3.2266e+1^{2} (1.85e−1) +	3.2286e+1^{1} (1.96e−1) +
	5	750	1.0892e+2^{7} (3.57e+0)	1.0517e+2^{8} (1.28e+0) −	1.2813e+2^{2} (4.95e+0) +	1.2013e+2^{6} (3.63e+0) +	1.2143e+2^{5} (4.59e+0) +	1.2962e+2^{1} (4.58e+0) +	1.2643e+2^{3} (3.33e+0) +	1.2513e+2^{4} (4.09e+0) +
	8	1500	9.4047e+1^{7} (4.47e+0)	9.3898e+1^{8} (5.43e+0) =	1.4179e+2^{1} (1.37e+0) +	1.3939e+2^{4} (1.41e+0) +	1.4094e+2^{2} (1.23e+0) +	1.3945e+2^{3} (1.53e+0) +	1.3731e+2^{6} (1.71e+0) +	1.3732e+2^{5} (1.45e+0) +
	10	2000	1.3731e+2^{7} (7.33e+0)	1.3583e+2^{8} (7.37e+0) =	2.5505e+2^{1} (1.88e+0) +	2.4902e+2^{4} (1.80e+0) +	2.5201e+2^{2} (1.40e+0) +	2.4908e+2^{3} (1.90e+0) +	2.4480e+2^{6} (1.75e+0) +	2.4524e+2^{5} (1.65e+0) +
WFG5^{-1}	3	400	2.8558e+1^{8} (4.92e−1)	2.8755e+1^{7} (4.54e−1) =	3.1310e+1^{2} (4.00e−1) +	3.0571e+1^{6} (3.84e−1) +	3.0839e+1^{5} (4.05e−1) +	3.0904e+1^{4} (3.79e−1) +	3.1259e+1^{3} (3.45e−1) +	3.1394e+1^{1} (3.61e−1) +
	5	750	1.0350e+2^{7} (2.74e+0)	1.0121e+2^{8} (1.61e+0) −	1.2549e+2^{2} (3.21e+0) +	1.1812e+2^{6} (2.77e+0) +	1.2096e+2^{5} (3.24e+0) +	1.2737e+2^{1} (1.74e+0) +	1.2145e+2^{4} (3.33e+0) +	1.2220e+2^{3} (1.99e+0) +
	8	1500	8.7105e+1^{7} (3.84e+0)	8.6264e+1^{8} (4.57e+0) =	1.3765e+2^{2} (1.58e+0) +	1.3611e+2^{3} (1.52e+0) +	1.3825e+2^{1} (1.16e+0) +	1.3607e+2^{4} (2.00e+0) +	1.3301e+2^{6} (1.46e+0) +	1.3358e+2^{5} (1.39e+0) +
	10	2000	1.2183e+2^{8} (6.08e+0)	1.2342e+2^{7} (6.40e+0) =	2.4863e+2^{1} (1.97e+0) +	2.4221e+2^{4} (2.21e+0) +	2.4522e+2^{2} (2.39e+0) +	2.4376e+2^{3} (1.98e+0) +	2.3776e+2^{5} (2.79e+0) +	2.3648e+2^{6} (2.32e+0) +
WFG6^{-1}	3	400	2.9084e+1^{8} (3.61e−1)	2.9377e+1^{7} (3.98e−1) +	3.2302e+1^{1} (1.95e−1) +	3.1553e+1^{6} (2.82e−1) +	3.1813e+1^{5} (2.23e−1) +	3.1912e+1^{4} (1.46e−1) +	3.2285e+1^{3} (2.22e−1) +	3.2287e+1^{2} (1.67e−1) +
	5	750	1.0087e+2^{8} (2.38e+0)	1.0189e+2^{7} (1.94e+0) +	1.3104e+2^{2} (3.47e+0) +	1.2418e+2^{6} (3.29e+0) +	1.2617e+2^{3} (3.86e+0) +	1.3230e+2^{1} (2.07e+0) +	1.2486e+2^{5} (2.33e+0) +	1.2583e+2^{4} (3.17e+0) +
	8	1500	8.3361e+1^{7} (4.34e+0)	8.1944e+1^{8} (3.74e+0) =	1.3824e+2^{2} (1.74e+0) +	1.3661e+2^{3} (1.64e+0) +	1.3852e+2^{1} (1.84e+0) +	1.3548e+2^{4} (1.43e+0) +	1.3197e+2^{6} (1.75e+0) +	1.3288e+2^{5} (1.92e+0) +
	10	2000	1.1761e+2^{8} (5.64e+0)	1.1982e+2^{7} (5.46e+0) +	2.5011e+2^{1} (2.50e+0) +	2.4549e+2^{3} (1.96e+0) +	2.4653e+2^{2} (2.83e+0) +	2.4199e+2^{4} (1.94e+0) +	2.3638e+2^{6} (2.28e+0) +	2.3646e+2^{5} (1.96e+0) +
WFG7^{-1}	3	400	2.9534e+1^{8} (2.59e−1)	2.9788e+1^{7} (2.99e−1) +	3.2168e+1^{2} (1.39e−1) +	3.1678e+1^{6} (2.31e−1) +	3.1770e+1^{5} (2.15e−1) +	3.1805e+1^{4} (1.80e−1) +	3.2179e+1^{1} (2.35e−1) +	3.2138e+1^{3} (1.79e−1) +
	5	750	1.0241e+2^{8} (2.47e+0)	1.0259e+2^{7} (1.75e+0) =	1.2971e+2^{2} (3.06e+0) +	1.2341e+2^{6} (2.78e+0) +	1.2396e+2^{5} (3.24e+0) +	1.3173e+2^{1} (2.93e+0) +	1.2633e+2^{4} (2.22e+0) +	1.2667e+2^{3} (1.91e+0) +
	8	1500	8.2250e+1^{7} (6.07e+0)	8.1880e+1^{8} (3.52e+0) =	1.4011e+2^{1} (1.44e+0) +	1.3982e+2^{2} (1.62e+0) +	1.3980e+2^{3} (1.34e+0) +	1.3764e+2^{4} (1.61e+0) +	1.3589e+2^{6} (1.58e+0) +	1.3627e+2^{5} (1.48e+0) +
	10	2000	1.0987e+2^{7} (5.34e+0)	1.0980e+2^{8} (7.55e+0) =	2.5367e+2^{1} (2.44e+0) +	2.4977e+2^{3} (1.93e+0) +	2.5151e+2^{2} (1.68e+0) +	2.4452e+2^{4} (2.20e+0) +	2.4295e+2^{6} (2.16e+0) +	2.4326e+2^{5} (2.10e+0) +
WFG8^{-1}	3	400	2.9182e+1^{8} (3.68e−1)	2.9913e+1^{7} (3.95e−1) +	3.2572e+1^{2} (1.86e−1) +	3.1825e+1^{6} (1.77e−1) +	3.2117e+1^{4} (1.89e−1) +	3.2113e+1^{5} (1.74e−1) +	3.2566e+1^{3} (1.98e−1) +	3.2608e+1^{1} (1.51e−1) +
	5	750	9.7803e+1^{8} (2.66e+0)	1.0135e+2^{7} (1.56e+0) +	1.3103e+2^{2} (1.49e+0) +	1.2378e+2^{6} (2.72e+0) +	1.2626e+2^{5} (1.98e+0) +	1.3197e+2^{1} (1.67e+0) +	1.2723e+2^{3} (2.28e+0) +	1.2664e+2^{4} (3.45e+0) +
	8	1500	8.2139e+1^{7} (3.33e+0)	8.2042e+1^{8} (3.66e+0) =	1.3733e+2^{2} (2.03e+0) +	1.3615e+2^{3} (1.62e+0) +	1.3817e+2^{1} (2.05e+0) +	1.3512e+2^{4} (1.70e+0) +	1.3261e+2^{6} (1.25e+0) +	1.3360e+2^{5} (2.19e+0) +
	10	2000	1.1570e+2^{8} (5.87e+0)	1.1780e+2^{7} (6.29e+0) =	2.4932e+2^{1} (2.19e+0) +	2.4519e+2^{3} (2.66e+0) +	2.4630e+2^{2} (3.18e+0) +	2.4155e+2^{4} (2.93e+0) +	2.3904e+2^{5} (2.03e+0) +	2.3882e+2^{6} (1.85e+0) +
WFG9^{-1}	3	400	2.8380e+1^{8} (2.74e−1)	2.8406e+1^{7} (3.12e−1) =	3.0427e+1^{3} (2.28e−1) +	2.9799e+1^{6} (3.25e−1) +	2.9972e+1^{4} (3.88e−1) +	2.9924e+1^{5} (3.39e−1) +	3.0475e+1^{2} (2.71e−1) +	3.0545e+1^{1} (2.83e−1) +
	5	750	9.9004e+1^{7} (3.41e+0)	9.8546e+1^{8} (1.21e+0) −	1.1933e+2^{3} (3.19e+0) +	1.0779e+2^{6} (3.27e+0) +	1.1033e+2^{5} (3.52e+0) +	1.2117e+2^{1} (4.02e+0) +	1.1907e+2^{4} (2.76e+0) +	1.1988e+2^{2} (2.27e+0) +
	8	1500	8.3073e+1^{8} (3.65e+0)	8.5282e+1^{7} (4.46e+0) +	1.3975e+2^{1} (1.36e+0) +	1.3813e+2^{4} (1.05e+0) +	1.3952e+2^{2} (1.32e+0) +	1.3853e+2^{3} (1.44e+0) +	1.3703e+2^{5} (1.35e+0) +	1.3692e+2^{6} (1.17e+0) +
	10	2000	1.1121e+2^{7} (6.18e+0)	1.1015e+2^{8} (5.89e+0) =	2.5188e+2^{1} (1.44e+0) +	2.4501e+2^{5} (2.31e+0) +	2.4833e+2^{2} (1.49e+0) +	2.4817e+2^{3} (1.59e+0) +	2.4493e+2^{6} (1.65e+0) +	2.4517e+2^{4} (1.64e+0) +
+/−/=				28/18/38	76/1/7	72/3/9	74/1/9	74/2/8	79/0/5	79/0/5
% of satisfaction				33.33%	90.48%	85.71%	88.10%	88.10%	94.05%	94.05%

Table 9: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the RVEA framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to RVEA based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than RVEA. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	RVEA	RVEA*	RVEA-AdaRSE	RVEA-AdaGAE	RVEA-AdaMPT	RVEA-AdaCOU	RVEA-AdaPT	RVEA-AdaKRA
DTLZ5	3	400	5.2469e+0^{8} (5.26e−2)	5.5074e+0^{1} (1.27e−3) +	5.4937e+0^{4} (7.79e−3) +	5.4858e+0^{7} (5.68e−3) +	5.4867e+0^{6} (5.82e−3) +	5.4947e+0^{2} (8.73e−3) +	5.4878e+0^{5} (2.89e−2) +	5.4947e+0^{3} (7.30e−3) +
	5	600	3.1213e+1^{5} (1.17e−2)	3.1162e+1^{8} (2.69e−2) −	3.1215e+1^{4} (1.58e−2) =	3.1203e+1^{6} (1.86e−2) −	3.1202e+1^{7} (1.57e−2) −	3.1272e+1^{1} (9.10e−3) +	3.1222e+1^{3} (1.73e−2) +	3.1224e+1^{2} (1.74e−2) +
	8	750	2.4797e+2^{8} (3.68e−1)	2.4824e+2^{7} (4.55e−1) +	2.4877e+2^{4} (2.86e−1) +	2.4861e+2^{6} (2.99e−1) +	2.4864e+2^{5} (2.59e−1) +	2.4980e+2^{1} (1.36e−1) +	2.4886e+2^{2} (2.25e−1) +	2.4886e+2^{3} (2.33e−1) +
	10	1000	9.9364e+2^{8} (7.06e−1)	9.9467e+2^{7} (1.43e+0) +	9.9525e+2^{6} (1.13e+0) +	9.9529e+2^{5} (9.87e−1) +	9.9551e+2^{4} (9.60e−1) +	1.0006e+3^{1} (4.27e−1) +	9.9566e+2^{3} (9.59e−1) +	9.9585e+2^{2} (6.97e−1) +
DTLZ6	3	400	5.2647e+0^{8} (7.03e−2)	5.5070e+0^{4} (1.23e−3) +	5.5075e+0^{2} (8.64e−3) +	5.5032e+0^{6} (9.30e−3) +	5.5009e+0^{7} (1.89e−2) +	5.5072e+0^{3} (6.90e−3) +	5.5076e+0^{1} (7.51e−3) +	5.5065e+0^{5} (1.29e−2) +
	5	600	3.1913e+1^{8} (2.19e−2)	3.1922e+1^{2} (2.58e−3) +	3.1917e+1^{7} (2.77e−3) =	3.1919e+1^{5} (3.36e−3) =	3.1918e+1^{6} (3.13e−3) =	3.1925e+1^{1} (2.65e−3) +	3.1919e+1^{4} (2.78e−3) =	3.1920e+1^{3} (2.71e−3) +
	8	750	2.5498e+2^{8} (7.08e−2)	2.5528e+2^{3} (3.40e−2) +	2.5527e+2^{5} (3.83e−2) +	2.5526e+2^{6} (3.38e−2) +	2.5525e+2^{7} (4.19e−2) +	2.5534e+2^{1} (2.52e−2) +	2.5528e+2^{2} (2.73e−2) +	2.5528e+2^{4} (2.27e−2) +
	10	1000	1.0198e+3^{8} (2.82e−1)	1.0210e+3^{2} (1.28e−1) +	1.0209e+3^{7} (1.24e−1) +	1.0209e+3^{5} (1.35e−1) +	1.0209e+3^{6} (1.40e−1) +	1.0214e+3^{1} (8.29e−2) +	1.0210e+3^{3} (9.63e−2) +	1.0210e+3^{4} (8.40e−2) +
DTLZ7	3	1000	6.5137e+0^{7} (6.20e−3)	6.4793e+0^{8} (2.80e−1) =	6.5617e+0^{2} (8.95e−3) +	6.5551e+0^{6} (1.19e−2) +	6.5586e+0^{4} (1.14e−2) +	6.5575e+0^{5} (1.13e−2) +	6.5596e+0^{3} (1.15e−2) +	6.5628e+0^{1} (1.21e−2) +
	5	1000	2.3430e+1^{8} (6.40e−2)	2.5403e+1^{1} (3.69e−2) +	2.4424e+1^{5} (9.76e−2) +	2.4256e+1^{7} (7.36e−2) +	2.4282e+1^{6} (8.36e−2) +	2.4831e+1^{2} (7.01e−2) +	2.4722e+1^{4} (8.27e−2) +	2.4724e+1^{3} (5.89e−2) +
	8	1000	1.5744e+2^{8} (2.95e+0)	1.7863e+2^{1} (1.88e+0) +	1.7011e+2^{5} (4.33e+0) +	1.6536e+2^{7} (2.66e+0) +	1.6893e+2^{6} (3.30e+0) +	1.7555e+2^{2} (2.90e+0) +	1.7226e+2^{4} (3.13e+0) +	1.7258e+2^{3} (3.02e+0) +
	10	1500	5.8589e+2^{8} (1.35e+1)	6.8911e+2^{1} (2.31e+0) +	6.5590e+2^{3} (1.12e+1) +	6.5436e+2^{5} (9.87e+0) +	6.5483e+2^{4} (9.78e+0) +	6.8857e+2^{2} (6.93e+0) +	6.4067e+2^{6} (1.87e+1) +	6.3766e+2^{7} (1.61e+1) +
WFG2	3	400	7.8154e+0^{2} (3.74e−2)	7.7950e+0^{8} (3.19e−2) −	7.8143e+0^{3} (3.22e−2) =	7.8131e+0^{4} (2.07e−2) =	7.8104e+0^{7} (2.85e−2) =	7.8126e+0^{5} (3.60e−2) =	7.8120e+0^{6} (3.78e−2) =	7.8163e+0^{1} (2.85e−2) =
	5	750	3.1851e+1^{5} (2.80e−2)	3.1651e+1^{8} (4.76e−2) −	3.1849e+1^{7} (3.17e−2) =	3.1861e+1^{2} (3.11e−2) =	3.1857e+1^{3} (3.42e−2) =	3.1865e+1^{1} (3.09e−2) +	3.1849e+1^{6} (2.47e−2) =	3.1855e+1^{4} (3.61e−2) =
	8	1500	2.5434e+2^{3} (4.69e−1)	2.5221e+2^{8} (8.39e−1) −	2.5411e+2^{7} (4.13e−1) −	2.5433e+2^{4} (4.48e−1) =	2.5422e+2^{5} (4.12e−1) =	2.5412e+2^{6} (1.32e+0) =	2.5448e+2^{1} (5.69e−1) =	2.5447e+2^{2} (5.90e−1) =
	10	2000	1.0193e+3^{7} (1.12e+0)	1.0137e+3^{8} (2.58e+0) −	1.0200e+3^{5} (1.23e+0) +	1.0199e+3^{6} (9.59e−1) +	1.0202e+3^{4} (1.19e+0) +	1.0203e+3^{3} (1.31e+0) +	1.0208e+3^{2} (1.21e+0) +	1.0208e+3^{1} (1.25e+0) +
WFG3	3	400	6.9429e+0^{2} (2.14e−2)	6.9547e+0^{1} (6.07e−2) +	6.9331e+0^{3} (2.39e−2) −	6.9089e+0^{7} (2.98e−2) −	6.9071e+0^{8} (3.27e−2) −	6.9328e+0^{4} (2.58e−2) −	6.9303e+0^{5} (3.20e−2) =	6.9217e+0^{6} (3.93e−2) −
	5	750	2.8631e+1^{1} (1.82e−1)	2.7634e+1^{8} (6.27e−1) −	2.8260e+1^{5} (1.85e−1) −	2.8086e+1^{7} (1.43e−1) −	2.8100e+1^{6} (1.28e−1) −	2.8473e+1^{2} (1.30e−1) −	2.8385e+1^{4} (2.44e−1) −	2.8417e+1^{3} (1.63e−1) −
	8	1500	2.0104e+2^{5} (1.43e+1)	2.0269e+2^{4} (1.01e+1) =	1.9811e+2^{7} (1.38e+1) =	1.9933e+2^{6} (1.12e+1) =	1.9665e+2^{8} (1.09e+1) =	2.2784e+2^{1} (2.79e+0) +	2.1762e+2^{2} (5.12e+0) +	2.1623e+2^{3} (4.92e+0) +
	10	2000	7.8449e+2^{5} (5.57e+1)	8.1663e+2^{4} (5.11e+1) +	7.5023e+2^{7} (5.26e+1) −	7.4238e+2^{8} (4.79e+1) −	7.6058e+2^{6} (5.07e+1) −	9.3406e+2^{1} (1.47e+1) +	8.6653e+2^{3} (3.01e+1) +	8.7151e+2^{2} (2.81e+1) +
DTLZ1^{-1}	3	400	5.3421e+0^{8} (7.47e−4)	5.4331e+0^{7} (2.18e−2) +	5.4763e+0^{4} (1.71e−2) +	5.4761e+0^{5} (1.10e−2) +	5.4759e+0^{6} (2.16e−2) +	5.4811e+0^{3} (9.71e−3) +	5.4838e+0^{1} (5.49e−3) +	5.4821e+0^{2} (1.03e−2) +
	5	600	7.1834e+0^{8} (2.24e−1)	8.9725e+0^{7} (4.42e−1) +	1.0916e+1^{4} (5.27e−2) +	1.0307e+1^{6} (1.36e−1) +	1.0507e+1^{5} (7.33e−2) +	1.1229e+1^{1} (4.80e−2) +	1.1213e+1^{3} (1.66e−2) +	1.1218e+1^{2} (9.84e−3) +
	8	750	3.6154e+0^{8} (1.33e+0)	1.5241e+1^{7} (6.65e−1) +	1.7224e+1^{4} (1.44e+0) +	1.5747e+1^{6} (1.45e+0) +	1.6140e+1^{5} (1.86e+0) +	1.9373e+1^{2} (1.12e+0) +	1.9448e+1^{1} (1.15e+0) +	1.8747e+1^{3} (1.67e+0) +
	10	1000	2.7397e+0^{8} (6.89e−1)	2.1858e+1^{6} (8.22e−1) +	2.4340e+1^{4} (2.76e+0) +	2.1509e+1^{7} (2.69e+0) +	2.3206e+1^{5} (2.97e+0) +	2.8243e+1^{1} (2.51e+0) +	2.7662e+1^{3} (2.92e+0) +	2.7837e+1^{2} (2.45e+0) +
DTLZ2^{-1}	3	250	6.6223e+0^{8} (8.64e−3)	6.6613e+0^{7} (2.13e−2) +	6.6881e+0^{2} (8.03e−3) +	6.6691e+0^{6} (1.49e−2) +	6.6777e+0^{4} (1.29e−2) +	6.6753e+0^{5} (1.40e−2) +	6.6910e+0^{1} (9.51e−3) +	6.6868e+0^{3} (9.42e−3) +
	5	350	1.4318e+1^{8} (2.89e−2)	1.5750e+1^{7} (2.77e−1) +	1.7213e+1^{4} (7.62e−2) +	1.6717e+1^{6} (1.31e−1) +	1.6861e+1^{5} (1.19e−1) +	1.7347e+1^{1} (6.60e−2) +	1.7267e+1^{3} (4.72e−2) +	1.7276e+1^{2} (5.38e−2) +
	8	500	1.8325e+1^{8} (8.08e−1)	3.5217e+1^{7} (1.40e+0) +	4.2700e+1^{1} (5.55e−1) +	4.0378e+1^{4} (8.80e−1) +	4.1265e+1^{3} (9.17e−1) +	4.1448e+1^{2} (6.72e−1) +	3.8990e+1^{6} (6.02e−1) +	3.9018e+1^{5} (6.26e−1) +
	10	750	2.4020e+1^{8} (1.04e+0)	6.6312e+1^{5} (1.66e+0) +	7.6947e+1^{1} (1.25e+0) +	7.4214e+1^{3} (1.65e+0) +	7.5594e+1^{2} (1.42e+0) +	6.8701e+1^{4} (9.09e−1) +	6.4298e+1^{6} (1.12e+0) +	6.4068e+1^{7} (1.35e+0) +
DTLZ3^{-1}	3	1000	6.6345e+0^{8} (3.64e−3)	6.6879e+0^{7} (4.66e−3) +	6.7050e+0^{1} (4.86e−3) +	6.6973e+0^{6} (1.11e−2) +	6.6986e+0^{5} (8.42e−3) +	6.7033e+0^{2} (4.24e−3) +	6.7022e+0^{3} (8.97e−3) +	6.7015e+0^{4} (1.16e−2) +
	5	1000	1.4311e+1^{8} (2.14e−2)	1.5962e+1^{7} (1.99e−1) +	1.7294e+1^{4} (8.75e−2) +	1.6696e+1^{6} (1.16e−1) +	1.6884e+1^{5} (7.59e−2) +	1.7481e+1^{1} (3.48e−2) +	1.7406e+1^{3} (5.55e−2) +	1.7425e+1^{2} (4.66e−2) +
	8	1000	1.8201e+1^{8} (8.91e−1)	3.3952e+1^{7} (1.31e+0) +	4.0409e+1^{1} (7.73e−1) +	3.7239e+1^{5} (8.84e−1) +	3.8602e+1^{3} (1.02e+0) +	3.9170e+1^{2} (7.32e−1) +	3.7118e+1^{6} (7.50e−1) +	3.7323e+1^{4} (5.23e−1) +
	10	1500	2.3849e+1^{8} (7.36e−1)	6.4779e+1^{5} (2.70e+0) +	7.4078e+1^{1} (9.33e−1) +	6.9160e+1^{3} (1.68e+0) +	7.1987e+1^{2} (1.50e+0) +	6.4943e+1^{4} (9.45e−1) +	6.0952e+1^{7} (1.07e+0) +	6.1140e+1^{6} (1.11e+0) +
DTLZ4^{-1}	3	600	6.5403e+0^{7} (5.26e−1)	6.6904e+0^{3} (5.46e−3) +	6.6112e+0^{4} (5.38e−1) +	6.7061e+0^{2} (3.26e−3) +	6.6101e+0^{5} (5.37e−1) +	6.6095e+0^{6} (5.36e−1) +	6.5129e+0^{8} (7.46e−1) =	6.7097e+0^{1} (3.51e−3) +
	5	1000	1.4174e+1^{8} (6.67e−1)	1.6425e+1^{7} (1.69e−1) +	1.7243e+1^{4} (1.16e+0) +	1.6477e+1^{6} (1.88e+0) +	1.6995e+1^{5} (1.12e+0) +	1.7508e+1^{1} (2.60e−2) +	1.7463e+1^{2} (3.85e−2) +	1.7258e+1^{3} (1.14e+0) +
	8	1250	1.4476e+1^{8} (1.43e+0)	4.2177e+1^{1} (2.33e+0) +	3.1429e+1^{2} (5.77e+0) +	3.0344e+1^{4} (5.01e+0) +	3.0931e+1^{3} (6.48e+0) +	3.0275e+1^{5} (5.64e+0) +	2.8354e+1^{7} (6.18e+0) +	2.9636e+1^{6} (6.02e+0) +
	10	2000	2.0189e+1^{8} (1.89e+0)	8.0504e+1^{1} (1.41e+0) +	5.3427e+1^{3} (9.75e+0) +	5.1826e+1^{5} (1.06e+1) +	5.3573e+1^{2} (1.02e+1) +	5.1963e+1^{4} (7.87e+0) +	4.9830e+1^{7} (8.44e+0) +	5.1617e+1^{6} (7.26e+0) +
DTLZ5^{-1}	3	400	6.6538e+0^{8} (1.38e−2)	6.7138e+0^{7} (1.13e−2) +	6.7747e+0^{2} (8.66e−3) +	6.7275e+0^{6} (1.29e−2) +	6.7367e+0^{5} (1.58e−2) +	6.7544e+0^{4} (1.01e−2) +	6.7759e+0^{1} (6.67e−3) +	6.7728e+0^{3} (7.57e−3) +
	5	600	1.5476e+1^{8} (5.43e−2)	1.6411e+1^{7} (2.62e−1) +	1.8401e+1^{4} (4.89e−2) +	1.7666e+1^{6} (1.40e−1) +	1.7897e+1^{5} (9.59e−2) +	1.8724e+1^{3} (3.48e−2) +	1.8739e+1^{2} (3.02e−2) +	1.8745e+1^{1} (4.13e−2) +
	8	750	2.2063e+1^{8} (3.19e−1)	4.0749e+1^{7} (1.96e+0) +	5.1885e+1^{4} (1.11e+0) +	4.5664e+1^{6} (1.52e+0) +	4.8501e+1^{5} (1.07e+0) +	5.4397e+1^{1} (3.54e−1) +	5.2313e+1^{3} (3.19e−1) +	5.2380e+1^{2} (3.33e−1) +
	10	1000	3.0194e+1^{8} (1.37e+0)	8.4602e+1^{7} (4.22e+0) +	1.0325e+2^{4} (2.64e+0) +	8.8339e+1^{6} (3.66e+0) +	9.5656e+1^{5} (3.38e+0) +	1.0983e+2^{1} (5.98e−1) +	1.0350e+2^{3} (8.37e−1) +	1.0370e+2^{2} (7.46e−1) +
DTLZ6^{-1}	3	400	6.6532e+0^{8} (2.85e−3)	6.6870e+0^{7} (1.17e−2) +	6.7250e+0^{3} (3.33e−3) +	6.7154e+0^{6} (4.30e−3) +	6.7188e+0^{5} (3.40e−3) +	6.7193e+0^{4} (3.09e−3) +	6.7262e+0^{1} (2.07e−3) +	6.7255e+0^{2} (3.29e−3) +
	5	600	1.4468e+1^{8} (3.89e−2)	1.5993e+1^{7} (2.12e−1) +	1.7701e+1^{2} (3.41e−2) +	1.7506e+1^{6} (6.59e−2) +	1.7591e+1^{5} (5.90e−2) +	1.7715e+1^{1} (3.19e−2) +	1.7700e+1^{3} (2.50e−2) +	1.7692e+1^{4} (3.22e−2) +
	8	750	1.7976e+1^{8} (4.80e−1)	3.6376e+1^{7} (1.29e+0) +	4.5369e+1^{1} (3.70e−1) +	4.4554e+1^{3} (5.50e−1) +	4.5325e+1^{2} (4.74e−1) +	4.3002e+1^{4} (3.55e−1) +	4.1186e+1^{6} (3.34e−1) +	4.1388e+1^{5} (2.67e−1) +
	10	1000	2.7049e+1^{8} (8.67e−1)	7.0771e+1^{7} (2.03e+0) +	8.4975e+1^{1} (6.89e−1) +	8.2213e+1^{3} (2.05e+0) +	8.4278e+1^{2} (1.22e+0) +	7.6464e+1^{4} (8.70e−1) +	7.2036e+1^{6} (6.91e−1) +	7.2275e+1^{5} (8.72e−1) +
DTLZ7^{-1}	3	1000	7.2019e+0^{8} (1.63e−2)	7.2395e+0^{1} (3.71e−3) +	7.2088e+0^{6} (8.13e−3) =	7.2102e+0^{3} (7.09e−3) =	7.2113e+0^{2} (9.41e−3) =	7.2074e+0^{7} (9.75e−3) =	7.2101e+0^{4} (8.77e−3) =	7.2097e+0^{5} (1.04e−2) =
	5	1000	2.7827e+1^{8} (1.36e−1)	2.8452e+1^{1} (9.89e−2) +	2.7964e+1^{5} (2.17e−1) +	2.7922e+1^{6} (1.63e−1) +	2.7886e+1^{7} (2.35e−1) =	2.8281e+1^{2} (2.08e−1) +	2.8076e+1^{4} (1.88e−1) +	2.8129e+1^{3} (1.85e−1) +
	8	1000	1.8563e+2^{8} (4.50e+0)	2.0768e+2^{2} (3.78e+0) +	2.0598e+2^{3} (4.21e+0) +	1.9986e+2^{6} (4.37e+0) +	2.0824e+2^{1} (4.56e+0) +	2.0489e+2^{4} (3.16e+0) +	2.0164e+2^{5} (5.72e+0) +	1.9607e+2^{7} (2.74e+1) +
	10	1500	7.0174e+2^{8} (1.49e+1)	8.0862e+2^{2} (5.99e+0) +	8.0178e+2^{3} (1.79e+1) +	7.9506e+2^{4} (1.86e+1) +	8.0903e+2^{1} (1.77e+1) +	7.6722e+2^{5} (1.44e+1) +	7.5349e+2^{7} (3.00e+1) +	7.5930e+2^{6} (3.60e+1) +
WFG1^{-1}	3	400	3.8492e+0^{8} (6.80e−1)	4.2417e+0^{2} (6.80e−1) =	4.2236e+0^{3} (7.44e−1) +	4.1104e+0^{6} (7.41e−1) +	4.0150e+0^{7} (7.51e−1) =	4.1215e+0^{5} (7.55e−1) +	4.3219e+0^{1} (7.19e−1) +	4.1657e+0^{4} (7.50e−1) +
	5	750	5.2494e+0^{8} (6.05e−1)	5.7333e+0^{3} (1.04e+0) +	5.5290e+0^{7} (1.31e+0) +	5.5329e+0^{6} (1.22e+0) =	5.6822e+0^{5} (1.28e+0) +	5.9501e+0^{2} (1.22e+0) +	6.0536e+0^{1} (1.47e+0) +	5.6826e+0^{4} (1.55e+0) +
	8	1500	4.9963e+0^{8} (3.52e−1)	7.3156e+0^{4} (1.50e+0) +	7.3108e+0^{5} (1.65e+0) +	7.5284e+0^{2} (1.46e+0) +	7.0378e+0^{7} (1.92e+0) +	7.2117e+0^{6} (2.26e+0) +	7.6251e+0^{1} (2.20e+0) +	7.4532e+0^{3} (1.67e+0) +
	10	2000	4.2445e+0^{8} (1.09e+0)	1.0083e+1^{5} (1.29e+0) +	9.9903e+0^{6} (2.06e+0) +	9.8894e+0^{7} (2.11e+0) +	1.0121e+1^{4} (1.92e+0) +	1.1467e+1^{1} (2.15e+0) +	1.0565e+1^{3} (2.09e+0) +	1.1461e+1^{2} (2.63e+0) +
WFG2^{-1}	3	400	6.1299e+0^{2} (5.70e−3)	6.1271e+0^{3} (2.29e−2) =	6.1255e+0^{5} (8.46e−3) −	6.1140e+0^{8} (1.44e−2) −	6.1195e+0^{7} (1.65e−2) −	6.1301e+0^{1} (1.22e−2) =	6.1219e+0^{6} (1.85e−2) −	6.1263e+0^{4} (9.91e−3) =
	5	750	1.0102e+1^{6} (9.11e−2)	1.0610e+1^{3} (6.46e−1) +	9.8267e+0^{8} (1.36e+0) =	1.0172e+1^{5} (1.18e+0) +	9.9049e+0^{7} (1.35e+0) =	1.0187e+1^{4} (1.51e+0) +	1.0701e+1^{2} (8.83e−1) +	1.0730e+1^{1} (1.07e+0) +
	8	1500	9.2435e+0^{8} (3.86e−1)	1.2434e+1^{2} (2.15e+0) +	1.0332e+1^{7} (2.39e+0) =	1.0409e+1^{6} (2.18e+0) +	1.0910e+1^{5} (2.11e+0) +	1.1357e+1^{4} (2.02e+0) +	1.2715e+1^{1} (3.09e+0) +	1.1589e+1^{3} (2.93e+0) +
	10	2000	9.1732e+0^{8} (1.16e−1)	1.6489e+1^{4} (2.62e+0) +	1.6041e+1^{5} (4.49e+0) +	1.5006e+1^{6} (3.76e+0) +	1.4615e+1^{7} (3.14e+0) +	1.9353e+1^{1} (3.14e+0) +	1.9043e+1^{2} (4.13e+0) +	1.8501e+1^{3} (3.76e+0) +
WFG3^{-1}	3	400	5.3407e+0^{8} (7.97e−4)	5.4267e+0^{7} (9.90e−3) +	5.4698e+0^{1} (8.98e−3) +	5.4550e+0^{6} (1.11e−2) +	5.4582e+0^{5} (8.68e−3) +	5.4663e+0^{4} (8.31e−3) +	5.4683e+0^{3} (9.13e−3) +	5.4693e+0^{2} (1.05e−2) +
	5	750	7.6067e+0^{8} (6.21e−2)	8.7700e+0^{7} (6.70e−1) +	1.0417e+1^{4} (5.47e−1) +	9.8052e+0^{5} (5.32e−1) +	9.7981e+0^{6} (6.82e−1) +	1.0796e+1^{1} (4.18e−1) +	1.0773e+1^{3} (4.90e−1) +	1.0791e+1^{2} (5.28e−1) +
	8	1500	5.2105e+0^{8} (1.24e+0)	1.2060e+1^{7} (1.05e+0) +	1.4865e+1^{4} (1.02e+0) +	1.3706e+1^{6} (1.32e+0) +	1.4087e+1^{5} (1.42e+0) +	1.6860e+1^{1} (1.39e+0) +	1.5977e+1^{3} (1.72e+0) +	1.6227e+1^{2} (1.65e+0) +
	10	2000	1.9687e+0^{8} (1.71e+0)	1.7653e+1^{7} (1.36e+0) +	2.1079e+1^{4} (1.30e+0) +	1.9539e+1^{6} (1.55e+0) +	2.0481e+1^{5} (1.74e+0) +	2.4654e+1^{2} (1.94e+0) +	2.4113e+1^{3} (1.79e+0) +	2.4835e+1^{1} (1.87e+0) +
WFG4^{-1}	3	400	6.6197e+0^{8} (5.63e−3)	6.6622e+0^{7} (1.00e−2) +	6.6719e+0^{3} (1.07e−2) +	6.6670e+0^{6} (1.64e−2) +	6.6735e+0^{1} (9.07e−3) +	6.6687e+0^{4} (1.34e−2) +	6.6687e+0^{5} (1.23e−2) +	6.6725e+0^{2} (1.11e−2) +
	5	750	1.4329e+1^{8} (5.07e−2)	1.6025e+1^{7} (1.63e−1) +	1.7017e+1^{4} (8.61e−2) +	1.6828e+1^{6} (9.98e−2) +	1.6862e+1^{5} (1.02e−1) +	1.7139e+1^{1} (6.61e−2) +	1.7033e+1^{3} (7.56e−2) +	1.7040e+1^{2} (6.49e−2) +
	8	1500	1.6968e+1^{8} (4.40e−1)	3.5968e+1^{5} (1.19e+0) +	4.0048e+1^{3} (1.59e+0) +	4.0517e+1^{2} (1.77e+0) +	4.0692e+1^{1} (1.46e+0) +	3.7360e+1^{4} (9.27e−1) +	3.5052e+1^{6} (6.39e−1) +	3.4866e+1^{7} (6.89e−1) +
	10	2000	1.9477e+1^{8} (1.59e+0)	6.2545e+1^{4} (2.20e+0) +	7.0097e+1^{3} (2.92e+0) +	7.2801e+1^{2} (2.93e+0) +	7.3593e+1^{1} (1.92e+0) +	6.0717e+1^{5} (8.35e−1) +	5.7114e+1^{6} (9.86e−1) +	5.6758e+1^{7} (9.73e−1) +
WFG5^{-1}	3	400	6.6082e+0^{8} (5.13e−3)	6.6401e+0^{6} (7.69e−3) +	6.6478e+0^{1} (1.12e−2) +	6.6374e+0^{7} (1.40e−2) +	6.6417e+0^{5} (1.59e−2) +	6.6421e+0^{4} (1.28e−2) +	6.6438e+0^{3} (9.48e−3) +	6.6470e+0^{2} (1.03e−2) +
	5	750	1.4304e+1^{8} (4.39e−2)	1.5952e+1^{7} (1.94e−1) +	1.6950e+1^{4} (7.33e−2) +	1.6761e+1^{6} (7.34e−2) +	1.6792e+1^{5} (7.63e−2) +	1.7032e+1^{1} (5.50e−2) +	1.6994e+1^{2} (5.67e−2) +	1.6965e+1^{3} (6.14e−2) +
	8	1500	1.7148e+1^{8} (2.45e−1)	3.4038e+1^{7} (1.79e+0) +	4.1390e+1^{3} (8.02e−1) +	4.1960e+1^{2} (8.60e−1) +	4.2286e+1^{1} (7.73e−1) +	3.8650e+1^{4} (5.99e−1) +	3.6690e+1^{5} (9.26e−1) +	3.6494e+1^{6} (7.67e−1) +
	10	2000	1.9850e+1^{8} (9.58e−1)	6.0615e+1^{5} (1.73e+0) +	7.5536e+1^{3} (1.33e+0) +	7.6021e+1^{2} (2.46e+0) +	7.6850e+1^{1} (1.46e+0) +	6.5398e+1^{4} (1.27e+0) +	6.0292e+1^{7} (1.25e+0) +	6.0479e+1^{6} (1.33e+0) +
WFG6^{-1}	3	400	6.6245e+0^{8} (3.50e−3)	6.6533e+0^{7} (1.08e−2) +	6.6908e+0^{1} (8.71e−3) +	6.6849e+0^{6} (1.05e−2) +	6.6884e+0^{5} (9.71e−3) +	6.6890e+0^{4} (9.18e−3) +	6.6899e+0^{2} (6.32e−3) +	6.6891e+0^{3} (7.65e−3) +
	5	750	1.4152e+1^{8} (8.61e−2)	1.5916e+1^{7} (1.99e−1) +	1.7289e+1^{1} (5.82e−2) +	1.7142e+1^{6} (6.62e−2) +	1.7179e+1^{5} (6.40e−2) +	1.7272e+1^{2} (4.92e−2) +	1.7242e+1^{3} (4.29e−2) +	1.7239e+1^{4} (5.17e−2) +
	8	1500	1.7391e+1^{8} (1.61e−1)	3.2193e+1^{7} (1.82e+0) +	4.1086e+1^{1} (1.55e+0) +	3.9018e+1^{4} (2.04e+0) +	3.9671e+1^{3} (2.37e+0) +	3.9823e+1^{2} (6.64e−1) +	3.7644e+1^{5} (5.72e−1) +	3.7632e+1^{6} (6.89e−1) +
	10	2000	2.0512e+1^{8} (1.20e+0)	5.6328e+1^{7} (2.72e+0) +	7.0308e+1^{1} (3.46e+0) +	6.8394e+1^{2} (4.10e+0) +	6.7884e+1^{4} (3.53e+0) +	6.7910e+1^{3} (1.19e+0) +	6.2541e+1^{6} (1.45e+0) +	6.3052e+1^{5} (1.21e+0) +
WFG7^{-1}	3	400	6.6072e+0^{8} (8.61e−3)	6.6101e+0^{7} (2.48e−2) =	6.6387e+0^{3} (1.36e−2) +	6.6316e+0^{5} (1.89e−2) +	6.6394e+0^{2} (1.46e−2) +	6.6309e+0^{6} (2.35e−2) +	6.6359e+0^{4} (1.61e−2) +	6.6453e+0^{1} (1.38e−2) +
	5	750	1.4210e+1^{8} (9.17e−2)	1.5741e+1^{7} (1.60e−1) +	1.7078e+1^{3} (1.37e−1) +	1.6707e+1^{6} (2.35e−1) +	1.6855e+1^{5} (1.90e−1) +	1.7134e+1^{1} (6.38e−2) +	1.7099e+1^{2} (7.33e−2) +	1.7058e+1^{4} (8.09e−2) +
	8	1500	1.6652e+1^{8} (6.99e−1)	3.4439e+1^{7} (2.63e+0) +	3.6863e+1^{2} (2.85e+0) +	3.5332e+1^{5} (2.92e+0) +	3.6458e+1^{3} (3.24e+0) +	3.8536e+1^{1} (1.49e+0) +	3.4620e+1^{6} (2.07e+0) +	3.5933e+1^{4} (2.36e+0) +
	10	2000	1.9543e+1^{8} (5.97e−1)	6.4237e+1^{1} (3.27e+0) +	6.2237e+1^{2} (5.79e+0) +	5.8358e+1^{5} (5.06e+0) +	5.9599e+1^{4} (5.02e+0) +	6.0877e+1^{3} (4.56e+0) +	5.4856e+1^{7} (3.60e+0) +	5.6875e+1^{6} (3.30e+0) +
WFG8^{-1}	3	400	6.6271e+0^{8} (3.17e−3)	6.6777e+0^{7} (2.01e−2) +	6.7031e+0^{2} (5.14e−3) +	6.7009e+0^{6} (5.99e−3) +	6.7042e+0^{1} (5.47e−3) +	6.7011e+0^{5} (6.15e−3) +	6.7029e+0^{3} (6.52e−3) +	6.7021e+0^{4} (4.39e−3) +
	5	750	1.4125e+1^{8} (8.51e−2)	1.6049e+1^{7} (1.88e−1) +	1.7397e+1^{1} (5.11e−2) +	1.7275e+1^{6} (6.76e−2) +	1.7293e+1^{5} (6.17e−2) +	1.7361e+1^{2} (5.07e−2) +	1.7346e+1^{3} (5.85e−2) +	1.7338e+1^{4} (5.92e−2) +
	8	1500	1.7541e+1^{8} (2.07e−1)	3.3255e+1^{7} (1.91e+0) +	4.3175e+1^{2} (8.68e−1) +	4.2615e+1^{3} (1.50e+0) +	4.3356e+1^{1} (1.05e+0) +	4.0378e+1^{4} (7.55e−1) +	3.7883e+1^{6} (1.15e+0) +	3.8582e+1^{5} (7.92e−1) +
	10	2000	2.0829e+1^{8} (1.13e+0)	5.7583e+1^{7} (2.06e+0) +	7.7926e+1^{2} (3.91e+0) +	7.7055e+1^{3} (3.89e+0) +	7.8155e+1^{1} (3.63e+0) +	6.9779e+1^{4} (1.71e+0) +	6.5525e+1^{5} (1.28e+0) +	6.5415e+1^{6} (1.81e+0) +
WFG9^{-1}	3	400	6.5664e+0^{8} (2.45e−2)	6.5959e+0^{7} (2.00e−2) +	6.6057e+0^{6} (3.66e−2) +	6.6120e+0^{3} (1.81e−2) +	6.6085e+0^{5} (3.40e−2) +	6.6102e+0^{4} (3.11e−2) +	6.6132e+0^{2} (2.93e−2) +	6.6159e+0^{1} (2.77e−2) +
	5	750	1.4232e+1^{8} (7.50e−2)	1.5959e+1^{7} (1.79e−1) +	1.7160e+1^{4} (9.13e−2) +	1.6968e+1^{6} (1.35e−1) +	1.7048e+1^{5} (9.37e−2) +	1.7212e+1^{3} (8.83e−2) +	1.7212e+1^{2} (1.61e−1) +	1.7237e+1^{1} (8.80e−2) +
	8	1500	1.7176e+1^{8} (2.73e−1)	3.6688e+1^{7} (2.24e+0) +	4.1603e+1^{1} (1.69e+0) +	4.1554e+1^{2} (1.86e+0) +	4.1343e+1^{3} (2.00e+0) +	3.9990e+1^{4} (1.69e+0) +	3.7511e+1^{6} (2.85e+0) +	3.7956e+1^{5} (2.01e+0) +
	10	2000	2.0285e+1^{8} (1.15e+0)	6.4259e+1^{7} (2.77e+0) +	7.6103e+1^{2} (2.88e+0) +	7.5522e+1^{3} (3.97e+0) +	7.6419e+1^{1} (3.67e+0) +	6.9282e+1^{4} (2.40e+0) +	6.4493e+1^{6} (1.47e+0) +	6.5698e+1^{5} (2.53e+0) +
+/−/=				73/6/5	71/5/8	72/5/7	70/5/9	78/2/4	75/2/7	77/2/5
% of satisfaction				86.90%	84.52%	85.71%	83.33%	92.86%	89.29%	91.67%

Table 10: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the RVEA framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to RVEA based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than RVEA. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	RVEA	RVEA*	RVEA-AdaRSE	RVEA-AdaGAE	RVEA-AdaMPT	RVEA-AdaCOU	RVEA-AdaPT	RVEA-AdaKRA
DTLZ5	3	400	9.9863e+0^8 (1.68e+0)	1.0430e+1^7 (2.08e−2) +	1.0579e+1^2 (1.67e−1) +	1.0545e+1^5 (9.04e−2) +	1.0560e+1^3 (7.83e−2) +	1.0619e+1^1 (2.47e−1) +	1.0453e+1^6 (5.83e−1) +	1.0549e+1^4 (1.09e−1) +
	5	600	2.5690e+1^3 (2.29e+0)	9.4552e+0^8 (1.57e+0) −	2.3509e+1^4 (2.72e+0) −	2.1817e+1^7 (1.72e+0) −	2.1868e+1^6 (2.46e+0) −	2.2010e+1^5 (1.47e+0) −	2.6021e+1^2 (2.48e+0) =	2.6893e+1^1 (2.61e+0) +
	8	750	4.3742e+1^4 (9.61e+0)	1.0077e+1^8 (3.37e+0) −	4.4195e+1^3 (9.61e+0) =	3.5497e+1^7 (6.96e+0) −	3.9339e+1^5 (8.09e+0) =	3.6301e+1^6 (4.02e+0) −	6.2517e+1^2 (1.11e+1) +	6.4966e+1^1 (1.27e+1) +
	10	1000	6.4458e+1^6 (1.56e+1)	1.4688e+1^8 (5.40e+0) −	7.6640e+1^3 (1.75e+1) +	6.2726e+1^7 (1.36e+1) =	7.1055e+1^4 (1.23e+1) +	6.6458e+1^5 (6.69e+0) =	1.3283e+2^1 (1.84e+1) +	1.2952e+2^2 (1.90e+1) +
DTLZ6	3	400	1.0028e+1^8 (1.59e+0)	1.0417e+1^7 (1.85e−2) =	1.0594e+1^3 (2.20e−1) =	1.0434e+1^6 (8.90e−2) =	1.0461e+1^5 (7.80e−2) =	1.0657e+1^1 (2.36e−1) =	1.0554e+1^4 (1.54e−1) =	1.0606e+1^2 (2.47e−1) =
	5	600	1.4365e+1^6 (1.46e+0)	1.0368e+1^8 (1.31e+0) −	1.6436e+1^3 (1.97e+0) +	1.5379e+1^5 (2.07e+0) +	1.6180e+1^4 (1.93e+0) +	1.3031e+1^7 (6.12e−1) −	1.7206e+1^2 (1.79e+0) +	1.7344e+1^1 (1.91e+0) +
	8	750	2.2878e+1^7 (4.29e+0)	1.3991e+1^8 (2.02e+0) −	3.5321e+1^3 (4.01e+0) +	3.1030e+1^5 (3.68e+0) +	3.2405e+1^4 (2.84e+0) +	2.6510e+1^6 (2.11e+0) +	4.2783e+1^1 (5.45e+0) +	4.0760e+1^2 (4.64e+0) +
	10	1000	3.6744e+1^7 (6.55e+0)	2.4455e+1^8 (3.63e+0) −	5.8852e+1^3 (8.12e+0) +	5.0638e+1^5 (8.25e+0) +	5.3421e+1^4 (8.16e+0) +	4.5753e+1^6 (3.12e+0) +	7.5856e+1^1 (1.14e+1) +	7.3618e+1^2 (1.05e+1) +
DTLZ7	3	1000	2.3108e+1^7 (3.53e−1)	2.2052e+1^8 (4.15e+0) =	2.5995e+1^1 (3.28e−1) +	2.5293e+1^6 (3.38e−1) +	2.5552e+1^5 (3.25e−1) +	2.5586e+1^4 (4.66e−1) +	2.5903e+1^3 (3.59e−1) +	2.5916e+1^2 (3.80e−1) +
	5	1000	6.8259e+1^8 (2.64e+0)	1.2519e+2^7 (1.32e+0) +	1.3802e+2^2 (2.59e+0) +	1.3652e+2^5 (2.63e+0) +	1.3672e+2^4 (2.97e+0) +	1.3042e+2^6 (2.50e+0) +	1.3807e+2^1 (2.77e+0) +	1.3710e+2^3 (2.71e+0) +
	8	1000	4.7925e+1^8 (5.92e+0)	1.5053e+2^1 (5.75e+0) +	8.7357e+1^7 (7.13e+0) +	8.7705e+1^6 (5.93e+0) +	8.9278e+1^5 (6.06e+0) +	9.1355e+1^2 (2.48e+0) +	8.9362e+1^4 (3.53e+0) +	9.0977e+1^3 (3.24e+0) +
	10	1500	7.0384e+1^8 (1.12e+1)	2.7214e+2^1 (1.88e+0) +	1.4442e+2^3 (6.64e+0) +	1.4281e+2^6 (9.55e+0) +	1.4614e+2^2 (8.84e+0) +	1.4086e+2^7 (6.66e+0) +	1.4382e+2^5 (1.00e+1) +	1.4392e+2^4 (7.80e+0) +
WFG2	3	400	1.9695e+1^7 (4.94e−1)	1.7700e+1^8 (4.76e−1) −	1.9792e+1^5 (3.71e−1) =	1.9902e+1^3 (4.54e−1) =	1.9913e+1^2 (4.59e−1) =	1.9931e+1^1 (5.78e−1) +	1.9777e+1^6 (5.52e−1) =	1.9824e+1^4 (4.16e−1) =
	5	750	3.0137e+1^2 (9.19e−1)	2.1123e+1^8 (1.26e+0) −	2.9343e+1^7 (1.26e+0) −	2.9858e+1^4 (1.21e+0) =	2.9702e+1^5 (1.33e+0) −	2.9602e+1^6 (1.15e+0) −	2.9913e+1^3 (1.12e+0) =	3.0159e+1^1 (9.84e−1) =
	8	1500	2.0408e+1^4 (1.38e+0)	1.1152e+1^8 (1.13e+0) −	2.0073e+1^6 (1.42e+0) =	2.0407e+1^5 (1.46e+0) =	1.9974e+1^7 (1.62e+0) =	2.0408e+1^3 (1.20e+0) =	2.1276e+1^2 (1.73e+0) +	2.1593e+1^1 (1.85e+0) +
	10	2000	2.0636e+1^7 (1.50e+0)	9.8858e+0^8 (1.06e+0) −	2.2293e+1^6 (1.49e+0) +	2.2836e+1^5 (1.65e+0) +	2.2995e+1^4 (1.81e+0) +	2.3628e+1^3 (1.98e+0) +	2.4639e+1^1 (2.38e+0) +	2.4636e+1^2 (1.89e+0) +
WFG3	3	400	1.1568e+1^7 (4.68e−1)	1.0258e+1^8 (3.67e−1) −	1.1900e+1^5 (4.02e−1) +	1.1989e+1^4 (5.06e−1) +	1.2092e+1^2 (5.74e−1) +	1.1632e+1^6 (5.29e−1) =	1.2004e+1^3 (5.08e−1) +	1.2117e+1^1 (5.77e−1) +
	5	750	2.6363e+1^7 (1.05e+1)	2.0371e+1^8 (1.22e+0) =	4.1319e+1^4 (1.10e+0) +	3.6094e+1^6 (1.06e+0) +	3.8159e+1^5 (1.04e+0) +	4.1777e+1^3 (8.84e−1) +	4.6944e+1^1 (1.04e+0) +	4.6929e+1^2 (7.99e−1) +
	8	1500	7.3213e+1^3 (5.02e+0)	4.9923e+1^8 (4.23e+0) −	7.2323e+1^5 (2.77e+0) =	6.4093e+1^7 (3.95e+0) −	6.7373e+1^6 (3.89e+0) −	7.3207e+1^4 (1.49e+0) =	7.6326e+1^1 (1.21e+0) +	7.6065e+1^2 (1.11e+0) =
	10	2000	1.2129e+2^1 (7.77e+0)	9.1133e+1^8 (8.38e+0) −	1.1649e+2^5 (5.95e+0) −	1.0597e+2^7 (9.59e+0) −	1.0980e+2^6 (8.48e+0) −	1.1721e+2^4 (2.10e+0) −	1.2001e+2^2 (1.74e+0) =	1.1985e+2^3 (1.81e+0) =
DTLZ1^{-1}	3	400	1.8649e+1^8 (5.95e−3)	2.1969e+1^7 (1.91e−1) +	2.3554e+1^1 (2.45e−1) +	2.3384e+1^6 (1.62e−1) +	2.3406e+1^5 (2.27e−1) +	2.3490e+1^3 (1.91e−1) +	2.3507e+1^2 (2.02e−1) +	2.3481e+1^4 (2.09e−1) +
	5	600	2.4558e+1^8 (1.45e+0)	4.4724e+1^7 (3.56e+0) +	6.8803e+1^4 (6.72e−1) +	6.0527e+1^6 (1.49e+0) +	6.3253e+1^5 (7.89e−1) +	7.0950e+1^3 (4.00e−1) +	7.1194e+1^2 (3.98e−1) +	7.1337e+1^1 (3.20e−1) +
	8	750	3.3299e+0^8 (3.16e+0)	6.7949e+1^7 (4.72e+0) +	8.0385e+1^4 (1.18e+1) +	7.0310e+1^6 (1.21e+1) +	7.1885e+1^5 (1.44e+1) +	8.7010e+1^2 (8.08e+0) +	8.7209e+1^1 (7.35e+0) +	8.2096e+1^3 (1.22e+1) +
	10	1000	1.3956e+0^8 (1.09e+0)	9.8027e+1^6 (6.63e+0) +	1.2000e+2^4 (2.61e+1) +	9.6639e+1^7 (2.45e+1) +	1.1102e+2^5 (2.62e+1) +	1.3837e+2^1 (2.05e+1) +	1.3332e+2^3 (2.34e+1) +	1.3459e+2^2 (2.03e+1) +
DTLZ2^{-1}	3	250	2.7581e+1^8 (1.47e−1)	2.8527e+1^7 (9.61e−1) +	3.2031e+1^2 (1.82e−1) +	3.1340e+1^6 (4.80e−1) +	3.1764e+1^4 (4.34e−1) +	3.1569e+1^5 (3.66e−1) +	3.2046e+1^1 (2.75e−1) +	3.2003e+1^3 (3.11e−1) +
	5	350	4.3039e+1^8 (2.83e−1)	7.3369e+1^7 (5.03e+0) +	1.2302e+2^2 (2.30e+0) +	1.0628e+2^6 (4.64e+0) +	1.1222e+2^5 (3.71e+0) +	1.2688e+2^1 (1.94e+0) +	1.1891e+2^4 (1.44e+0) +	1.1921e+2^3 (1.37e+0) +
	8	500	3.1683e+1^8 (2.40e+0)	6.1817e+1^7 (6.36e+0) +	1.1431e+2^4 (1.60e+0) +	1.0140e+2^6 (3.05e+0) +	1.0603e+2^5 (2.88e+0) +	1.1805e+2^1 (1.06e+0) +	1.1517e+2^2 (1.54e+0) +	1.1513e+2^3 (1.34e+0) +
	10	750	4.0778e+1^8 (1.09e+0)	1.0955e+2^7 (9.15e+0) +	2.0356e+2^4 (3.57e+0) +	1.7935e+2^6 (4.23e+0) +	1.8934e+2^5 (3.32e+0) +	2.1551e+2^1 (1.34e+0) +	2.0877e+2^3 (2.31e+0) +	2.0912e+2^2 (2.12e+0) +
DTLZ3^{-1}	3	1000	2.7663e+1^8 (9.36e−2)	3.0080e+1^7 (4.12e−1) +	3.2404e+1^1 (1.98e−1) +	3.2128e+1^6 (1.63e−1) +	3.2160e+1^4 (1.52e−1) +	3.2148e+1^5 (1.65e−1) +	3.2399e+1^2 (2.13e−1) +	3.2363e+1^3 (2.01e−1) +
	5	1000	4.3127e+1^8 (1.66e−1)	7.8883e+1^7 (5.36e+0) +	1.2948e+2^2 (1.12e+0) +	1.1726e+2^6 (2.51e+0) +	1.2128e+2^5 (1.70e+0) +	1.3250e+2^1 (9.37e−1) +	1.2375e+2^4 (1.38e+0) +	1.2400e+2^3 (1.74e+0) +
	8	1000	3.1532e+1^8 (2.58e+0)	5.6711e+1^7 (6.97e+0) +	1.1813e+2^4 (1.46e+0) +	1.0382e+2^6 (2.57e+0) +	1.0912e+2^5 (3.03e+0) +	1.2185e+2^1 (5.26e−1) +	1.1943e+2^2 (9.14e−1) +	1.1937e+2^3 (9.33e−1) +
	10	1500	4.0493e+1^8 (7.58e−1)	1.0552e+2^7 (1.21e+1) +	2.1267e+2^4 (1.91e+0) +	1.8517e+2^6 (4.51e+0) +	1.9857e+2^5 (2.78e+0) +	2.1987e+2^1 (5.45e−1) +	2.1529e+2^3 (1.07e+0) +	2.1539e+2^2 (1.09e+0) +
DTLZ4^{-1}	3	600	2.7026e+1^8 (3.62e+0)	3.0202e+1^7 (2.75e−1) +	3.1773e+1^3 (4.40e+0) +	3.2317e+1^2 (1.18e−1) +	3.1643e+1^4 (4.21e+0) +	3.1512e+1^5 (4.32e+0) +	3.0994e+1^6 (6.08e+0) +	3.2587e+1^1 (1.21e−1) +
	5	1000	4.3371e+1^8 (1.14e+0)	8.7714e+1^7 (2.66e+0) +	1.3123e+2^2 (9.81e+0) +	1.2030e+2^6 (1.56e+1) +	1.2500e+2^4 (9.12e+0) +	1.3392e+2^1 (8.07e−1) +	1.2619e+2^3 (1.50e+0) +	1.2497e+2^5 (8.46e+0) +
	8	1250	2.7482e+1^8 (5.32e+0)	1.0811e+2^7 (1.12e+1) +	1.2408e+2^1 (6.94e+0) +	1.2150e+2^3 (7.72e+0) +	1.2146e+2^4 (6.45e+0) +	1.2151e+2^2 (1.10e+1) +	1.1920e+2^6 (1.20e+1) +	1.1984e+2^5 (7.46e+0) +
	10	2000	3.8324e+1^8 (1.70e+0)	1.8774e+2^7 (9.19e+0) +	2.2101e+2^1 (6.40e+0) +	2.1571e+2^5 (9.50e+0) +	2.2001e+2^2 (7.71e+0) +	2.1920e+2^3 (8.93e+0) +	2.1477e+2^6 (9.74e+0) +	2.1572e+2^4 (7.57e+0) +
DTLZ5^{-1}	3	400	2.2753e+1^8 (2.03e−1)	2.4287e+1^7 (3.50e−1) +	2.6784e+1^2 (1.38e−1) +	2.5857e+1^6 (1.79e−1) +	2.6059e+1^5 (2.25e−1) +	2.6333e+1^4 (1.72e−1) +	2.6784e+1^1 (1.34e−1) +	2.6755e+1^3 (1.47e−1) +
	5	600	4.0393e+1^8 (3.67e−1)	5.6717e+1^7 (3.37e+0) +	9.4389e+1^4 (7.76e−1) +	8.0632e+1^6 (1.63e+0) +	8.4156e+1^5 (1.36e+0) +	9.8104e+1^1 (5.85e−1) +	9.6342e+1^3 (4.41e−1) +	9.6398e+1^2 (4.48e−1) +
	8	750	2.5221e+1^8 (7.40e−1)	5.1946e+1^7 (6.42e+0) +	1.0658e+2^4 (2.26e+0) +	8.7748e+1^6 (3.03e+0) +	9.5734e+1^5 (3.28e+0) +	1.1298e+2^1 (1.36e+0) +	1.0811e+2^2 (1.13e+0) +	1.0791e+2^3 (1.13e+0) +
	10	1000	2.7144e+1^8 (6.15e−1)	8.6947e+1^7 (9.82e+0) +	1.8093e+2^4 (4.64e+0) +	1.4638e+2^6 (7.13e+0) +	1.6212e+2^5 (5.13e+0) +	1.9903e+2^1 (2.09e+0) +	1.8960e+2^2 (2.73e+0) +	1.8938e+2^3 (2.15e+0) +
DTLZ6^{-1}	3	400	2.6410e+1^8 (1.05e−1)	2.7847e+1^7 (5.30e−1) +	3.0563e+1^3 (1.72e−1) +	2.9927e+1^6 (1.86e−1) +	3.0116e+1^5 (1.72e−1) +	3.0120e+1^4 (1.47e−1) +	3.0675e+1^1 (9.77e−2) +	3.0567e+1^2 (1.57e−1) +
	5	600	4.2575e+1^8 (3.47e−1)	7.1381e+1^7 (4.24e+0) +	1.1797e+2^2 (1.21e+0) +	1.0811e+2^6 (2.42e+0) +	1.1241e+2^5 (2.01e+0) +	1.1916e+2^1 (9.81e−1) +	1.1347e+2^4 (9.21e−1) +	1.1351e+2^3 (9.11e−1) +
	8	750	2.7002e+1^8 (5.63e−1)	6.1654e+1^7 (6.51e+0) +	1.1770e+2^2 (8.60e−1) +	1.0604e+2^6 (2.83e+0) +	1.1067e+2^5 (1.91e+0) +	1.2059e+2^1 (4.87e−1) +	1.1739e+2^3 (7.98e−1) +	1.1730e+2^4 (9.21e−1) +
	10	1000	3.7907e+1^8 (1.18e+0)	1.1443e+2^7 (8.68e+0) +	2.0605e+2^4 (2.34e+0) +	1.8165e+2^6 (5.85e+0) +	1.9271e+2^5 (3.04e+0) +	2.1516e+2^1 (1.18e+0) +	2.0741e+2^2 (1.74e+0) +	2.0702e+2^3 (1.78e+0) +
DTLZ7^{-1}	3	1000	1.8479e+1^1 (1.51e+0)	1.4298e+1^8 (2.48e−1) −	1.6278e+1^3 (1.90e+0) −	1.5067e+1^7 (1.51e+0) −	1.6686e+1^2 (2.26e+0) −	1.5910e+1^5 (1.71e+0) −	1.5871e+1^6 (1.71e+0) −	1.6270e+1^4 (2.04e+0) −
	5	1000	8.6864e+1^7 (1.60e+0)	7.7908e+1^8 (1.40e+1) −	1.1612e+2^4 (1.04e+1) +	1.1400e+2^6 (1.62e+1) +	1.1529e+2^5 (1.64e+1) +	1.1615e+2^3 (1.47e+1) +	1.2285e+2^2 (1.33e+1) +	1.2725e+2^1 (1.16e+1) +
	8	1000	5.1593e+1^8 (6.38e+0)	1.2462e+2^1 (3.04e+0) +	8.9402e+1^4 (4.51e+0) +	8.4734e+1^7 (5.82e+0) +	8.5018e+1^6 (4.79e+0) +	1.0086e+2^2 (8.58e+0) +	9.0290e+1^3 (4.32e+0) +	8.7632e+1^5 (1.68e+1) +
	10	1500	1.1645e+2^8 (2.21e+1)	2.3227e+2^1 (4.65e+0) +	1.4205e+2^6 (7.42e+0) +	1.4420e+2^4 (1.20e+1) +	1.3966e+2^7 (1.01e+1) +	1.5778e+2^2 (2.33e+1) +	1.4350e+2^5 (6.92e+0) +	1.4730e+2^3 (1.00e+1) +
WFG1^{-1}	3	400	1.0425e+1^8 (3.60e+0)	1.3041e+1^6 (4.59e+0) +	1.4542e+1^2 (5.50e+0) +	1.3540e+1^5 (5.42e+0) +	1.2864e+1^7 (5.51e+0) +	1.3733e+1^4 (5.60e+0) +	1.5241e+1^1 (5.28e+0) +	1.4072e+1^3 (5.62e+0) +
	5	750	1.0973e+1^8 (1.58e+0)	2.2977e+1^7 (6.45e+0) +	2.4073e+1^5 (9.07e+0) +	2.3762e+1^6 (7.91e+0) +	2.4869e+1^4 (8.74e+0) +	2.7220e+1^2 (8.34e+0) +	2.7686e+1^1 (9.97e+0) +	2.5266e+1^3 (1.09e+1) +
	8	1500	5.6000e+0^8 (1.06e+0)	2.9666e+1^7 (7.75e+0) +	3.3047e+1^4 (8.74e+0) +	3.3634e+1^2 (7.88e+0) +	3.1078e+1^6 (1.05e+1) +	3.2380e+1^5 (1.39e+1) +	3.5260e+1^1 (1.22e+1) +	3.3606e+1^3 (1.02e+1) +
	10	2000	4.2378e+0^8 (1.25e+0)	4.4769e+1^7 (4.94e+0) +	4.7764e+1^4 (1.03e+1) +	4.5844e+1^6 (1.21e+1) +	4.7639e+1^5 (1.11e+1) +	5.8074e+1^1 (1.16e+1) +	5.2866e+1^3 (1.34e+1) +	5.7133e+1^2 (1.52e+1) +
WFG2^{-1}	3	400	2.7293e+1^8 (3.70e−1)	3.0021e+1^6 (3.63e−1) +	3.0700e+1^1 (4.70e−1) +	2.9965e+1^7 (4.51e−1) +	3.0231e+1^5 (5.68e−1) +	3.0584e+1^4 (6.94e−1) +	3.0641e+1^3 (6.08e−1) +	3.0700e+1^2 (3.89e−1) +
	5	750	2.3604e+1^8 (4.23e−1)	6.2306e+1^6 (4.02e+0) +	6.2645e+1^5 (1.14e+1) +	6.3239e+1^4 (8.29e+0) +	6.1904e+1^7 (9.81e+0) +	6.6477e+1^3 (1.22e+1) +	7.0303e+1^2 (7.77e+0) +	7.0755e+1^1 (9.05e+0) +
	8	1500	1.0575e+1^8 (1.15e+0)	6.5576e+1^2 (8.98e+0) +	5.9694e+1^6 (1.06e+1) +	5.8887e+1^7 (1.02e+1) +	6.2627e+1^5 (7.81e+0) +	6.2752e+1^4 (1.14e+1) +	6.9815e+1^1 (1.17e+1) +	6.3817e+1^3 (1.41e+1) +
	10	2000	8.7663e+0^8 (1.56e+0)	9.4219e+1^5 (1.17e+1) +	9.5599e+1^4 (2.41e+1) +	8.9561e+1^7 (1.71e+1) +	9.1682e+1^6 (1.43e+1) +	1.1354e+2^1 (1.66e+1) +	1.1123e+2^2 (2.05e+1) +	1.0851e+2^3 (1.95e+1) +
WFG3^{-1}	3	400	1.8647e+1^8 (1.75e−3)	2.1919e+1^7 (1.61e−1) +	2.3171e+1^3 (5.91e−2) +	2.3076e+1^6 (6.10e−2) +	2.3106e+1^5 (3.92e−2) +	2.3139e+1^4 (4.39e−2) +	2.3183e+1^1 (4.95e−2) +	2.3173e+1^2 (4.78e−2) +
	5	750	2.1366e+1^8 (5.93e−1)	4.4294e+1^7 (5.70e+0) +	6.0632e+1^4 (6.69e+0) +	5.1838e+1^6 (6.07e+0) +	5.3110e+1^5 (7.36e+0) +	6.5027e+1^1 (5.55e+0) +	6.4474e+1^3 (6.14e+0) +	6.4803e+1^2 (6.37e+0) +
	8	1500	6.9626e+0^8 (2.66e+0)	6.0071e+1^7 (6.76e+0) +	7.3047e+1^4 (6.86e+0) +	6.4141e+1^6 (8.16e+0) +	6.8457e+1^5 (8.19e+0) +	7.8172e+1^1 (6.79e+0) +	7.4441e+1^3 (7.92e+0) +	7.5110e+1^2 (8.64e+0) +
	10	2000	1.9962e+0^8 (1.50e+0)	9.3968e+1^7 (7.52e+0) +	1.1581e+2^4 (1.11e+1) +	1.0053e+2^6 (1.40e+1) +	1.0848e+2^5 (1.47e+1) +	1.2638e+2^2 (1.09e+1) +	1.2432e+2^3 (1.12e+1) +	1.2760e+2^1 (1.01e+1) +
WFG4^{-1}	3	400	2.7852e+1^8 (1.73e−1)	2.9643e+1^7 (4.29e−1) +	3.2119e+1^1 (1.93e−1) +	3.1748e+1^6 (3.59e−1) +	3.1918e+1^4 (2.09e−1) +	3.1843e+1^5 (2.51e−1) +	3.1985e+1^2 (2.36e−1) +	3.1975e+1^3 (2.60e−1) +
	5	750	4.6935e+1^8 (7.94e−1)	7.8548e+1^7 (3.34e+0) +	1.2191e+2^4 (1.48e+0) +	1.1119e+2^6 (2.96e+0) +	1.1368e+2^5 (2.46e+0) +	1.2370e+2^1 (1.01e+0) +	1.2215e+2^2 (7.03e−1) +	1.2205e+2^3 (7.29e−1) +
	8	1500	2.3389e+1^8 (8.73e−1)	8.5126e+1^7 (6.52e+0) +	1.2011e+2^4 (2.06e+0) +	1.1144e+2^6 (2.84e+0) +	1.1512e+2^5 (3.14e+0) +	1.2286e+2^1 (5.73e−1) +	1.2177e+2^3 (4.87e−1) +	1.2198e+2^2 (4.00e−1) +
	10	2000	1.7941e+1^8 (2.53e+0)	1.4785e+2^7 (7.39e+0) +	2.1673e+2^4 (3.71e+0) +	1.9482e+2^6 (4.88e+0) +	2.0440e+2^5 (6.09e+0) +	2.2236e+2^1 (1.25e+0) +	2.2002e+2^3 (1.25e+0) +	2.2003e+2^2 (1.52e+0) +
WFG5^{-1}	3	400	2.7172e+1^8 (3.82e−1)	2.8079e+1^7 (5.52e−1) +	3.0739e+1^1 (4.75e−1) +	3.0295e+1^6 (6.20e−1) +	3.0311e+1^5 (3.45e−1) +	3.0406e+1^4 (5.61e−1) +	3.0674e+1^3 (4.43e−1) +	3.0696e+1^2 (5.49e−1) +
	5	750	4.5608e+1^8 (7.72e−1)	7.6232e+1^7 (3.94e+0) +	1.1825e+2^4 (9.95e−1) +	1.0736e+2^6 (2.26e+0) +	1.0968e+2^5 (1.52e+0) +	1.1986e+2^1 (7.88e−1) +	1.1888e+2^2 (6.20e−1) +	1.1877e+2^3 (9.48e−1) +
	8	1500	2.3121e+1^8 (9.31e−1)	7.6616e+1^7 (7.59e+0) +	1.1975e+2^3 (1.17e+0) +	1.1237e+2^6 (2.14e+0) +	1.1529e+2^5 (1.91e+0) +	1.2195e+2^1 (6.85e−1) +	1.1974e+2^4 (1.11e+0) +	1.2004e+2^2 (6.54e−1) +
	10	2000	1.9226e+1^8 (1.50e+0)	1.2891e+2^7 (9.81e+0) +	2.1272e+2^4 (2.31e+0) +	1.9636e+2^6 (4.57e+0) +	2.0369e+2^5 (3.13e+0) +	2.1843e+2^1 (1.02e+0) +	2.1523e+2^2 (1.38e+0) +	2.1508e+2^3 (1.34e+0) +
WFG6^{-1}	3	400	2.7931e+1^8 (1.76e−1)	2.9006e+1^7 (6.70e−1) +	3.2297e+1^2 (1.60e−1) +	3.2009e+1^6 (3.22e−1) +	3.2107e+1^4 (3.08e−1) +	3.2023e+1^5 (3.25e−1) +	3.2341e+1^1 (1.80e−1) +	3.2272e+1^3 (1.99e−1) +
	5	750	4.3852e+1^8 (1.19e+0)	7.6946e+1^7 (4.12e+0) +	1.2236e+2^3 (1.19e+0) +	1.1009e+2^6 (3.12e+0) +	1.1234e+2^5 (2.52e+0) +	1.2382e+2^1 (1.02e+0) +	1.2249e+2^2 (6.42e−1) +	1.2222e+2^4 (7.45e−1) +
	8	1500	2.5108e+1^8 (7.46e−1)	6.7335e+1^7 (9.11e+0) +	1.1763e+2^4 (1.46e+0) +	1.0652e+2^6 (2.22e+0) +	1.1188e+2^5 (2.13e+0) +	1.2113e+2^1 (1.10e+0) +	1.1865e+2^3 (1.39e+0) +	1.1919e+2^2 (9.67e−1) +
	10	2000	2.1251e+1^8 (1.53e+0)	1.1258e+2^7 (9.49e+0) +	2.0686e+2^4 (2.58e+0) +	1.8870e+2^6 (4.17e+0) +	1.9565e+2^5 (3.26e+0) +	2.1592e+2^1 (1.88e+0) +	2.1344e+2^2 (2.50e+0) +	2.1331e+2^3 (1.85e+0) +
WFG7^{-1}	3	400	2.7929e+1^8 (1.76e−1)	2.9017e+1^7 (9.95e−1) +	3.1753e+1^2 (4.89e−1) +	3.1435e+1^6 (5.24e−1) +	3.1625e+1^4 (4.31e−1) +	3.1469e+1^5 (6.37e−1) +	3.1727e+1^3 (2.59e−1) +	3.1923e+1^1 (4.14e−1) +
	5	750	4.5005e+1^8 (1.35e+0)	7.5233e+1^7 (3.17e+0) +	1.1750e+2^4 (3.20e+0) +	1.0033e+2^6 (5.66e+0) +	1.0472e+2^5 (6.00e+0) +	1.2127e+2^1 (2.45e+0) +	1.1909e+2^3 (2.74e+0) +	1.1939e+2^2 (2.63e+0) +
	8	1500	2.3632e+1^8 (1.40e+0)	7.8006e+1^7 (8.64e+0) +	1.1315e+2^4 (3.13e+0) +	1.0292e+2^6 (2.56e+0) +	1.0761e+2^5 (3.16e+0) +	1.1708e+2^1 (2.83e+0) +	1.1450e+2^3 (2.25e+0) +	1.1536e+2^2 (2.32e+0) +
	10	2000	2.0025e+1^8 (1.16e+0)	1.3261e+2^7 (9.76e+0) +	2.0250e+2^4 (3.65e+0) +	1.8295e+2^6 (5.15e+0) +	1.8998e+2^5 (4.95e+0) +	2.0645e+2^1 (4.84e+0) +	2.0456e+2^3 (4.23e+0) +	2.0580e+2^2 (3.39e+0) +
WFG8^{-1}	3	400	2.7955e+1^8 (1.70e−1)	2.9345e+1^7 (9.68e−1) +	3.2350e+1^1 (1.73e−1) +	3.2026e+1^6 (3.58e−1) +	3.2204e+1^4 (2.00e−1) +	3.2059e+1^5 (2.07e−1) +	3.2313e+1^2 (2.14e−1) +	3.2279e+1^3 (1.99e−1) +
	5	750	4.3493e+1^8 (1.22e+0)	7.9844e+1^7 (3.68e+0) +	1.2279e+2^2 (1.32e+0) +	1.1172e+2^6 (2.28e+0) +	1.1307e+2^5 (2.11e+0) +	1.2385e+2^1 (7.66e−1) +	1.2253e+2^4 (7.56e−1) +	1.2273e+2^3 (7.91e−1) +
	8	1500	2.6103e+1^8 (1.43e+0)	7.2219e+1^7 (8.46e+0) +	1.1886e+2^4 (2.19e+0) +	1.0898e+2^6 (2.75e+0) +	1.1263e+2^5 (2.89e+0) +	1.2217e+2^1 (1.57e+0) +	1.2084e+2^2 (1.71e+0) +	1.2033e+2^3 (2.19e+0) +
	10	2000	2.2539e+1^8 (1.75e+0)	1.1258e+2^7 (8.55e+0) +	2.0735e+2^4 (4.60e+0) +	1.8714e+2^6 (4.94e+0) +	1.9785e+2^5 (4.25e+0) +	2.1906e+2^1 (4.21e+0) +	2.1725e+2^3 (3.63e+0) +	2.1808e+2^2 (3.92e+0) +
WFG9^{-1}	3	400	2.6715e+1^8 (3.05e−1)	2.7928e+1^7 (5.34e−1) +	3.0032e+1^3 (4.12e−1) +	2.9741e+1^5 (3.60e−1) +	2.9717e+1^6 (4.69e−1) +	2.9746e+1^4 (4.06e−1) +	3.0112e+1^1 (4.44e−1) +	3.0082e+1^2 (4.37e−1) +
	5	750	4.4709e+1^8 (1.06e+0)	8.1734e+1^7 (3.92e+0) +	1.1403e+2^4 (1.82e+0) +	1.0379e+2^6 (1.82e+0) +	1.0551e+2^5 (1.75e+0) +	1.1697e+2^1 (9.52e−1) +	1.1558e+2^3 (1.45e+0) +	1.1584e+2^2 (8.82e−1) +
	8	1500	2.4359e+1^8 (1.26e+0)	9.4054e+1^7 (7.76e+0) +	1.1721e+2^4 (3.62e+0) +	1.1003e+2^6 (3.34e+0) +	1.1230e+2^5 (4.10e+0) +	1.2010e+2^1 (2.04e+0) +	1.1826e+2^2 (3.07e+0) +	1.1761e+2^3 (3.55e+0) +
	10	2000	2.0129e+1^8 (1.48e+0)	1.5876e+2^7 (9.33e+0) +	2.0906e+2^4 (4.35e+0) +	1.9204e+2^6 (7.03e+0) +	2.0003e+2^5 (5.08e+0) +	2.1475e+2^1 (5.67e+0) +	2.1266e+2^2 (2.27e+0) +	2.1168e+2^3 (3.17e+0) +
+/−/=				66/15/3	75/4/5	74/5/5	75/5/4	73/6/5	78/1/5	78/1/5
% of satisfaction				78.57%	89.29%	88.10%	89.29%	86.90%	92.86%	92.86%

Table 11: Mean and standard deviations (in parenthesis) of the HV indicator obtained by MOEAs using the MOEA/D framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to MOEA/D based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than MOEA/D. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	MOEA/D	AdaW	MOEA/D-AdaRSE	MOEA/D-AdaGAE	MOEA/D-AdaMPT	MOEA/D-AdaCOU	MOEA/D-AdaPT	MOEA/D-AdaKRA
DTLZ5	3	400	5.4617e+0^{8} (5.13e−4)	5.5063e+0^{1} (6.92e−3) +	5.5045e+0^{5} (1.74e−3) +	5.4978e+0^{7} (1.43e−3) +	5.5004e+0^{6} (2.09e−3) +	5.5046e+0^{4} (1.82e−3) +	5.5047e+0^{3} (2.14e−3) +	5.5053e+0^{2} (1.84e−3) +
	5	600	3.1082e+1^{8} (9.07e−3)	3.1277e+1^{7} (1.16e−2) +	3.1296e+1^{5} (1.08e−2) +	3.1293e+1^{6} (1.10e−2) +	3.1298e+1^{4} (8.48e−3) +	3.1310e+1^{1} (6.87e−3) +	3.1302e+1^{2} (5.59e−3) +	3.1302e+1^{3} (7.73e−3) +
	8	750	2.4715e+2^{8} (7.74e−1)	2.4921e+2^{7} (1.61e+0) +	2.5016e+2^{4} (1.61e−1) +	2.5006e+2^{6} (1.87e−1) +	2.5009e+2^{5} (2.38e−1) +	2.5038e+2^{1} (6.94e−2) +	2.5017e+2^{3} (1.06e−1) +	2.5018e+2^{2} (1.37e−1) +
	10	1000	9.8787e+2^{7} (3.98e+0)	9.8522e+2^{8} (3.75e+1) =	1.0014e+3^{3} (4.11e−1) +	1.0013e+3^{5} (4.89e−1) +	1.0012e+3^{6} (4.36e−1) +	1.0024e+3^{1} (2.06e−1) +	1.0014e+3^{4} (3.47e−1) +	1.0015e+3^{2} (3.42e−1) +
DTLZ6	3	400	5.4612e+0^{8} (4.50e−5)	5.5051e+0^{5} (4.08e−3) +	5.5053e+0^{2} (1.65e−4) +	5.4960e+0^{7} (9.18e−4) +	5.4994e+0^{6} (6.45e−4) +	5.5052e+0^{4} (2.68e−4) +	5.5054e+0^{1} (1.68e−4) +	5.5053e+0^{3} (2.94e−4) +
	5	600	3.1897e+1^{8} (2.01e−3)	3.1915e+1^{7} (4.55e−2) +	3.1922e+1^{4} (2.52e−3) +	3.1921e+1^{6} (2.59e−3) +	3.1922e+1^{5} (3.25e−3) +	3.1925e+1^{1} (2.21e−3) +	3.1923e+1^{3} (2.36e−3) +	3.1923e+1^{2} (2.44e−3) +
	8	750	2.5480e+2^{8} (8.29e−2)	2.5520e+2^{7} (2.65e−1) +	2.5535e+2^{3} (1.92e−2) +	2.5536e+2^{2} (1.91e−2) +	2.5535e+2^{4} (2.48e−2) +	2.5538e+2^{1} (1.29e−2) +	2.5533e+2^{5} (1.82e−2) +	2.5533e+2^{6} (2.19e−2) +
	10	1000	1.0189e+3^{8} (3.96e−1)	1.0211e+3^{7} (6.92e−1) +	1.0214e+3^{2} (6.81e−2) +	1.0214e+3^{3} (5.69e−2) +	1.0213e+3^{4} (2.96e−1) +	1.0215e+3^{1} (2.96e−2) +	1.0213e+3^{5} (7.70e−2) +	1.0213e+3^{6} (8.64e−2) +
DTLZ7	3	1000	6.5741e+0^{8} (2.71e−3)	6.5872e+0^{7} (5.84e−3) +	6.6044e+0^{1} (3.44e−3) +	6.5945e+0^{6} (5.36e−3) +	6.5985e+0^{4} (3.27e−3) +	6.5979e+0^{5} (3.12e−3) +	6.6026e+0^{3} (3.64e−3) +	6.6033e+0^{2} (3.60e−3) +
	5	1000	2.4212e+1^{8} (3.09e−1)	2.5295e+1^{3} (2.34e−1) +	2.5235e+1^{5} (3.72e−1) +	2.5046e+1^{6} (3.67e−1) +	2.4985e+1^{7} (3.92e−1) +	2.5263e+1^{4} (3.79e−1) +	2.5408e+1^{1} (3.24e−1) +	2.5314e+1^{2} (5.82e−1) +
	8	1000	1.6326e+2^{8} (3.01e−1)	1.8750e+2^{1} (1.23e+0) +	1.8242e+2^{5} (9.57e−1) +	1.8106e+2^{7} (1.01e+0) +	1.8261e+2^{3} (1.00e+0) +	1.8173e+2^{6} (2.75e+0) +	1.8242e+2^{4} (1.03e+0) +	1.8281e+2^{2} (6.05e−1) +
	10	1500	6.2176e+2^{8} (2.35e+0)	7.2826e+2^{1} (4.30e+0) +	6.9682e+2^{5} (9.52e−1) +	6.9851e+2^{3} (1.82e+0) +	6.9774e+2^{4} (1.74e+0) +	7.1055e+2^{2} (1.36e+0) +	6.8022e+2^{6} (6.32e+0) +	6.7905e+2^{7} (4.18e+0) +
WFG2	3	400	7.8822e+0^{2} (1.17e−2)	7.8686e+0^{6} (1.62e−2) −	7.8810e+0^{3} (1.87e−2) =	7.8509e+0^{8} (1.39e−1) =	7.8577e+0^{7} (1.35e−1) =	7.8769e+0^{5} (1.80e−2) =	7.8856e+0^{1} (6.13e−3) =	7.8776e+0^{4} (1.77e−2) =
	5	750	3.1938e+1^{6} (1.80e−2)	3.1900e+1^{8} (2.06e−2) −	3.1944e+1^{3} (1.68e−2) =	3.1946e+1^{1} (1.55e−2) =	3.1940e+1^{5} (1.62e−2) =	3.1934e+1^{7} (1.78e−2) =	3.1941e+1^{4} (1.10e−2) =	3.1945e+1^{2} (1.31e−2) =
	8	1500	2.5563e+2^{4} (1.35e−1)	2.5563e+2^{3} (9.98e−2) =	2.5562e+2^{6} (1.01e−1) =	2.5565e+2^{1} (1.16e−1) =	2.5564e+2^{2} (1.13e−1) =	2.5562e+2^{8} (1.20e−1) =	2.5563e+2^{5} (1.19e−1) =	2.5562e+2^{7} (1.53e−1) =
	10	2000	1.0230e+3^{8} (3.81e−1)	1.0232e+3^{2} (1.94e−1) +	1.0232e+3^{4} (3.09e−1) +	1.0232e+3^{1} (3.19e−1) +	1.0232e+3^{5} (2.99e−1) +	1.0232e+3^{3} (3.01e−1) +	1.0231e+3^{7} (3.67e−1) =	1.0231e+3^{6} (2.92e−1) =
WFG3	3	400	7.0879e+0^{1} (1.25e−2)	6.9990e+0^{8} (4.99e−2) −	7.0631e+0^{2} (2.37e−2) −	7.0480e+0^{7} (2.11e−2) −	7.0563e+0^{6} (1.81e−2) −	7.0616e+0^{4} (1.95e−2) −	7.0608e+0^{5} (1.96e−2) −	7.0625e+0^{3} (1.87e−2) −
	5	750	2.8695e+1^{7} (3.09e−2)	2.8266e+1^{8} (3.44e−1) −	2.9028e+1^{4} (1.17e−1) +	2.8917e+1^{6} (1.22e−1) +	2.8942e+1^{5} (1.19e−1) +	2.9268e+1^{1} (1.10e−1) +	2.9126e+1^{3} (1.15e−1) +	2.9182e+1^{2} (9.61e−2) +
	8	1500	2.2840e+2^{3} (1.79e+0)	2.2093e+2^{8} (3.41e+0) −	2.2299e+2^{6} (2.42e+0) −	2.2132e+2^{7} (3.16e+0) −	2.2305e+2^{5} (3.17e+0) −	2.3469e+2^{1} (1.12e+0) +	2.2897e+2^{2} (2.61e+0) =	2.2837e+2^{4} (2.45e+0) =
	10	2000	9.1294e+2^{4} (5.57e+0)	9.0405e+2^{5} (1.25e+1) −	8.9662e+2^{8} (1.32e+1) −	8.9756e+2^{7} (1.28e+1) −	8.9824e+2^{6} (9.53e+0) −	9.4971e+2^{1} (4.99e+0) +	9.3078e+2^{2} (8.84e+0) +	9.2945e+2^{3} (8.01e+0) +
DTLZ1^{-1}	3	400	5.4412e+0^{8} (6.86e−4)	5.4612e+0^{7} (1.88e−2) +	5.4989e+0^{3} (8.40e−3) +	5.4927e+0^{6} (4.01e−3) +	5.4955e+0^{5} (2.09e−3) +	5.4977e+0^{4} (2.64e−3) +	5.5004e+0^{2} (2.76e−3) +	5.5010e+0^{1} (3.48e−3) +
	5	600	8.8938e+0^{8} (8.61e−4)	1.0886e+1^{5} (4.91e−2) +	1.1068e+1^{4} (2.70e−2) +	1.0701e+1^{7} (7.42e−2) +	1.0820e+1^{6} (5.59e−2) +	1.1285e+1^{3} (7.69e−3) +	1.1292e+1^{1} (7.42e−3) +	1.1291e+1^{2} (7.19e−3) +
	8	750	6.9671e+0^{8} (5.21e−1)	1.9710e+1^{6} (2.05e−1) +	2.0438e+1^{4} (1.43e−1) +	1.9386e+1^{7} (2.50e−1) +	2.0011e+1^{5} (1.70e−1) +	2.0731e+1^{1} (5.27e−2) +	2.0712e+1^{2} (4.75e−2) +	2.0711e+1^{3} (5.99e−2) +
	10	1000	6.8175e+0^{8} (4.76e−1)	2.8561e+1^{6} (3.30e−1) +	2.9997e+1^{1} (1.45e−1) +	2.8341e+1^{7} (2.26e−1) +	2.9519e+1^{5} (1.37e−1) +	2.9963e+1^{2} (7.31e−2) +	2.9958e+1^{3} (6.25e−2) +	2.9931e+1^{4} (5.45e−2) +
DTLZ2^{-1}	3	250	6.6097e+0^{8} (3.15e−3)	6.7062e+0^{1} (4.58e−3) +	6.6984e+0^{4} (3.37e−3) +	6.6940e+0^{6} (3.67e−3) +	6.6952e+0^{5} (3.82e−3) +	6.6887e+0^{7} (5.33e−3) +	6.6988e+0^{2} (2.27e−3) +	6.6986e+0^{3} (3.20e−3) +
	5	350	1.3713e+1^{8} (2.55e−3)	1.7786e+1^{1} (2.47e−2) +	1.7614e+1^{2} (3.04e−2) +	1.7554e+1^{4} (3.23e−2) +	1.7560e+1^{3} (3.34e−2) +	1.7552e+1^{5} (2.60e−2) +	1.7541e+1^{7} (2.53e−2) +	1.7548e+1^{6} (2.43e−2) +
	8	500	2.1948e+1^{8} (6.53e−1)	4.6462e+1^{1} (2.96e−1) +	4.4648e+1^{4} (2.96e−1) +	4.5340e+1^{2} (4.24e−1) +	4.5285e+1^{3} (3.06e−1) +	4.2317e+1^{5} (2.98e−1) +	4.1537e+1^{7} (2.05e−1) +	4.1568e+1^{6} (3.49e−1) +
	10	750	3.1443e+1^{8} (1.29e+0)	8.5683e+1^{1} (5.69e−1) +	8.2254e+1^{4} (7.01e−1) +	8.5027e+1^{2} (5.98e−1) +	8.4831e+1^{3} (4.27e−1) +	7.2512e+1^{5} (5.95e−1) +	7.0312e+1^{7} (7.56e−1) +	7.0474e+1^{6} (5.12e−1) +
DTLZ3^{-1}	3	1000	6.6067e+0^{8} (7.57e−4)	6.7087e+0^{1} (3.54e−3) +	6.6990e+0^{3} (2.46e−3) +	6.6984e+0^{5} (2.40e−3) +	6.6984e+0^{4} (2.55e−3) +	6.6957e+0^{7} (3.08e−3) +	6.6993e+0^{2} (2.48e−3) +	6.6984e+0^{6} (4.77e−3) +
	5	1000	1.3710e+1^{8} (1.10e−3)	1.7777e+1^{1} (6.02e−2) +	1.7654e+1^{2} (2.30e−2) +	1.7563e+1^{4} (4.21e−2) +	1.7583e+1^{3} (5.20e−2) +	1.7560e+1^{6} (3.40e−2) +	1.7562e+1^{5} (2.11e−2) +	1.7555e+1^{7} (2.64e−2) +
	8	1000	2.1460e+1^{8} (5.15e−1)	4.5850e+1^{1} (6.50e−1) +	4.4439e+1^{4} (6.47e−1) +	4.5044e+1^{3} (6.75e−1) +	4.5319e+1^{2} (5.59e−1) +	4.2347e+1^{5} (2.93e−1) +	4.1569e+1^{6} (3.60e−1) +	4.1538e+1^{7} (2.88e−1) +
	10	1500	3.1802e+1^{8} (1.08e+0)	8.5390e+1^{1} (9.27e−1) +	8.2273e+1^{4} (8.85e−1) +	8.5137e+1^{2} (9.73e−1) +	8.5001e+1^{3} (1.05e+0) +	7.2629e+1^{5} (5.95e−1) +	7.0476e+1^{6} (4.03e−1) +	7.0469e+1^{7} (4.95e−1) +
DTLZ4^{-1}	3	600	6.6069e+0^{8} (5.98e−4)	6.7095e+0^{1} (3.54e−3) +	6.6986e+0^{5} (2.29e−3) +	6.6991e+0^{3} (2.62e−3) +	6.7003e+0^{2} (2.25e−3) +	6.6951e+0^{7} (3.74e−3) +	6.6990e+0^{4} (2.55e−3) +	6.6983e+0^{6} (2.61e−3) +
	5	1000	1.3709e+1^{8} (2.91e−4)	1.7797e+1^{1} (2.02e−2) +	1.7626e+1^{2} (2.44e−2) +	1.7602e+1^{4} (3.86e−2) +	1.7609e+1^{3} (2.42e−2) +	1.7540e+1^{5} (1.92e−2) +	1.7529e+1^{7} (2.41e−2) +	1.7532e+1^{6} (2.26e−2) +
	8	1250	2.1151e+1^{8} (9.03e−1)	4.5472e+1^{1} (2.59e−1) +	4.2629e+1^{3} (1.81e+0) +	4.2083e+1^{4} (5.25e+0) +	4.3129e+1^{2} (3.49e+0) +	3.9904e+1^{7} (4.05e+0) +	4.0448e+1^{5} (1.67e+0) +	4.0132e+1^{6} (2.31e+0) +
	10	2000	3.2433e+1^{8} (1.41e+0)	8.2141e+1^{1} (5.41e−1) +	7.6491e+1^{4} (4.03e+0) +	8.1976e+1^{2} (5.01e+0) +	8.1591e+1^{3} (4.17e+0) +	6.9840e+1^{5} (2.37e+0) +	6.8593e+1^{6} (4.87e−1) +	6.8445e+1^{7} (2.54e+0) +
DTLZ5^{-1}	3	400	6.6951e+0^{8} (9.62e−4)	6.7708e+0^{4} (7.38e−3) +	6.7788e+0^{2} (3.44e−3) +	6.7649e+0^{6} (3.18e−3) +	6.7654e+0^{5} (3.52e−3) +	6.7648e+0^{7} (5.02e−3) +	6.7801e+0^{1} (3.08e−3) +	6.7785e+0^{3} (3.37e−3) +
	5	600	1.5624e+1^{8} (1.90e−2)	1.8829e+1^{5} (6.73e−2) +	1.8859e+1^{4} (2.65e−2) +	1.8719e+1^{7} (4.07e−2) +	1.8751e+1^{6} (3.62e−2) +	1.8964e+1^{3} (2.07e−2) +	1.8966e+1^{1} (1.74e−2) +	1.8965e+1^{2} (1.79e−2) +
	8	750	2.6076e+1^{8} (8.34e−1)	5.7956e+1^{1} (3.26e−1) +	5.6848e+1^{3} (3.72e−1) +	5.4975e+1^{7} (6.63e−1) +	5.5864e+1^{6} (6.93e−1) +	5.7174e+1^{2} (1.79e−1) +	5.5944e+1^{4} (2.22e−1) +	5.5874e+1^{5} (2.60e−1) +
	10	1000	3.7709e+1^{8} (2.46e+0)	1.1982e+2^{1} (6.20e−1) +	1.1629e+2^{2} (6.82e−1) +	1.1261e+2^{5} (1.56e+0) +	1.1444e+2^{4} (9.16e−1) +	1.1486e+2^{3} (6.06e−1) +	1.0954e+2^{6} (4.99e−1) +	1.0929e+2^{7} (7.98e−1) +
DTLZ6^{-1}	3	400	6.6192e+0^{8} (6.67e−4)	6.7169e+0^{1} (3.44e−3) +	6.7108e+0^{4} (2.17e−3) +	6.7084e+0^{5} (2.17e−3) +	6.7076e+0^{6} (2.13e−3) +	6.7021e+0^{7} (2.43e−3) +	6.7112e+0^{2} (2.22e−3) +	6.7109e+0^{3} (1.97e−3) +
	5	600	1.4127e+1^{8} (5.61e−3)	1.7947e+1^{1} (3.00e−2) +	1.7832e+1^{2} (1.87e−2) +	1.7763e+1^{7} (2.97e−2) +	1.7774e+1^{6} (3.15e−2) +	1.7788e+1^{5} (2.07e−2) +	1.7826e+1^{3} (2.38e−2) +	1.7825e+1^{4} (1.98e−2) +
	8	750	2.3014e+1^{8} (6.20e−1)	4.8427e+1^{1} (2.03e−1) +	4.6544e+1^{4} (2.02e−1) +	4.6917e+1^{3} (3.38e−1) +	4.6974e+1^{2} (2.10e−1) +	4.5272e+1^{5} (1.72e−1) +	4.4494e+1^{7} (2.31e−1) +	4.4573e+1^{6} (2.59e−1) +
	10	1000	3.1107e+1^{8} (1.54e+0)	9.1331e+1^{1} (5.09e−1) +	8.7601e+1^{4} (7.55e−1) +	8.9272e+1^{3} (4.89e−1) +	8.9573e+1^{2} (5.40e−1) +	8.1344e+1^{5} (5.32e−1) +	7.8288e+1^{7} (6.29e−1) +	7.8432e+1^{6} (5.77e−1) +
DTLZ7^{-1}	3	1000	7.2226e+0^{8} (3.31e−4)	7.2444e+0^{7} (5.76e−3) +	7.2500e+0^{2} (7.88e−4) +	7.2488e+0^{5} (9.12e−4) +	7.2489e+0^{4} (9.28e−4) +	7.2486e+0^{6} (9.08e−4) +	7.2497e+0^{3} (9.43e−4) +	7.2501e+0^{1} (8.82e−4) +
	5	1000	2.7127e+1^{8} (1.12e−1)	2.8524e+1^{3} (7.46e−2) +	2.8271e+1^{7} (7.09e−1) +	2.8413e+1^{6} (6.48e−2) +	2.8427e+1^{5} (6.18e−2) +	2.8497e+1^{4} (6.04e−2) +	2.8585e+1^{1} (3.50e−2) +	2.8569e+1^{2} (3.58e−2) +
	8	1000	1.8244e+2^{8} (2.11e+0)	2.1843e+2^{3} (1.81e+0) +	2.1770e+2^{4} (6.16e−1) +	2.0964e+2^{7} (2.14e+0) +	2.1608e+2^{6} (1.20e+0) +	2.1720e+2^{5} (1.14e+0) +	2.1952e+2^{2} (7.01e−1) +	2.1962e+2^{1} (4.51e−1) +
	10	1500	6.7985e+2^{8} (7.02e+0)	8.5696e+2^{1} (6.32e+0) +	8.4437e+2^{5} (2.14e+0) +	8.2869e+2^{7} (3.95e+0) +	8.3246e+2^{6} (3.10e+0) +	8.4705e+2^{4} (2.56e+0) +	8.5382e+2^{2} (4.26e+0) +	8.5378e+2^{3} (2.73e+0) +
WFG1^{-1}	3	400	4.8355e+0^{1} (6.24e−3)	4.8007e+0^{6} (3.59e−2) −	4.7967e+0^{8} (3.47e−2) −	4.8020e+0^{5} (2.70e−2) −	4.8113e+0^{2} (3.02e−2) −	4.8112e+0^{3} (3.35e−2) −	4.8079e+0^{4} (3.20e−2) −	4.8006e+0^{7} (4.53e−2) −
	5	750	6.6508e+0^{8} (2.13e−1)	8.2351e+0^{2} (1.31e−1) +	8.2116e+0^{4} (4.52e−1) +	8.1748e+0^{7} (6.23e−2) +	8.2329e+0^{3} (6.82e−2) +	8.2028e+0^{5} (6.37e−1) +	8.2015e+0^{6} (6.41e−1) +	8.2953e+0^{1} (4.67e−1) +
	8	1500	5.1348e+0^{8} (5.34e−1)	1.3730e+1^{1} (1.66e−1) +	1.2357e+1^{5} (1.03e+0) +	1.2081e+1^{6} (7.90e−1) +	1.1705e+1^{7} (1.45e+0) +	1.2805e+1^{2} (9.61e−1) +	1.2752e+1^{3} (9.63e−1) +	1.2634e+1^{4} (1.09e+0) +
	10	2000	4.7674e+0^{8} (3.44e−1)	1.8425e+1^{1} (1.90e−1) +	1.5730e+1^{7} (1.61e+0) +	1.5867e+1^{6} (1.52e+0) +	1.6935e+1^{4} (1.29e+0) +	1.6521e+1^{5} (1.96e+0) +	1.7780e+1^{2} (1.03e+0) +	1.6974e+1^{3} (1.51e+0) +
WFG2^{-1}	3	400	6.1177e+0^{8} (1.91e−3)	6.1407e+0^{4} (1.62e−2) +	6.1433e+0^{3} (7.24e−3) +	6.1261e+0^{6} (6.59e−3) +	6.1244e+0^{7} (6.74e−3) +	6.1464e+0^{1} (7.80e−3) +	6.1449e+0^{2} (6.88e−3) +	6.1399e+0^{5} (6.60e−3) +
	5	750	1.0283e+1^{8} (3.61e−3)	1.1360e+1^{5} (3.72e−2) +	1.1373e+1^{4} (2.01e−2) +	1.1293e+1^{7} (2.17e−2) +	1.1315e+1^{6} (1.76e−2) +	1.1458e+1^{2} (1.38e−2) +	1.1457e+1^{3} (1.27e−2) +	1.1461e+1^{1} (1.24e−2) +
	8	1500	6.8255e+0^{8} (5.69e−1)	1.9186e+1^{1} (1.04e−1) +	1.9068e+1^{2} (8.88e−2) +	1.8868e+1^{4} (1.15e−1) +	1.8990e+1^{3} (7.16e−2) +	1.8584e+1^{7} (1.39e−1) +	1.8603e+1^{5} (1.17e−1) +	1.8589e+1^{6} (1.25e−1) +
	10	2000	6.1547e+0^{8} (5.67e−1)	2.6065e+1^{1} (8.44e−2) +	2.5920e+1^{2} (1.09e−1) +	2.5769e+1^{4} (1.51e−1) +	2.5882e+1^{3} (1.38e−1) +	2.5260e+1^{5} (1.74e−1) +	2.5206e+1^{6} (2.39e−1) +	2.4743e+1^{7} (2.99e+0) +
WFG3^{-1}	3	400	5.4406e+0^{7} (1.40e−3)	5.4356e+0^{8} (2.93e−2) =	5.4950e+0^{2} (5.90e−3) +	5.4848e+0^{6} (5.55e−3) +	5.4863e+0^{5} (5.79e−3) +	5.4893e+0^{4} (4.85e−3) +	5.4962e+0^{1} (5.95e−3) +	5.4944e+0^{3} (4.91e−3) +
	5	750	8.3640e+0^{8} (2.02e−3)	1.0788e+1^{6} (6.48e−2) +	1.1076e+1^{4} (2.78e−2) +	1.0776e+1^{7} (8.30e−2) +	1.0872e+1^{5} (5.06e−2) +	1.1269e+1^{3} (1.14e−2) +	1.1280e+1^{1} (6.40e−3) +	1.1280e+1^{2} (1.20e−2) +
	8	1500	7.7292e+0^{8} (1.48e−1)	1.9519e+1^{6} (2.09e−1) +	2.0470e+1^{4} (9.94e−2) +	1.9272e+1^{7} (2.28e−1) +	2.0076e+1^{5} (1.17e−1) +	2.0606e+1^{3} (9.28e−2) +	2.0628e+1^{1} (6.29e−2) +	2.0624e+1^{2} (8.79e−2) +
	10	2000	7.8773e+0^{8} (2.25e−1)	2.8667e+1^{6} (3.56e−1) +	2.9907e+1^{1} (1.64e−1) +	2.8089e+1^{7} (3.30e−1) +	2.9441e+1^{5} (1.81e−1) +	2.9578e+1^{2} (1.01e−1) +	2.9555e+1^{3} (7.11e−2) +	2.9546e+1^{4} (1.05e−1) +
WFG4^{-1}	3	400	6.6129e+0^{8} (2.97e−3)	6.7077e+0^{1} (4.54e−3) +	6.6973e+0^{3} (2.08e−3) +	6.6948e+0^{6} (3.97e−3) +	6.6958e+0^{5} (2.87e−3) +	6.6894e+0^{7} (4.29e−3) +	6.6970e+0^{4} (2.92e−3) +	6.6980e+0^{2} (2.45e−3) +
	5	750	1.3305e+1^{8} (1.01e−2)	1.7794e+1^{1} (2.10e−2) +	1.7665e+1^{2} (2.14e−2) +	1.7601e+1^{4} (3.29e−2) +	1.7605e+1^{3} (2.62e−2) +	1.7594e+1^{5} (2.74e−2) +	1.7551e+1^{7} (2.65e−2) +	1.7552e+1^{6} (1.91e−2) +
	8	1500	2.3640e+1^{8} (5.99e−1)	4.5904e+1^{3} (2.34e−1) +	4.4796e+1^{4} (3.07e−1) +	4.6241e+1^{1} (3.07e−1) +	4.6081e+1^{2} (1.87e−1) +	4.2273e+1^{5} (1.78e−1) +	4.1545e+1^{7} (2.49e−1) +	4.1560e+1^{6} (2.04e−1) +
	10	2000	3.3120e+1^{8} (6.71e−1)	8.4738e+1^{3} (5.33e−1) +	8.3352e+1^{4} (5.03e−1) +	8.6814e+1^{1} (5.30e−1) +	8.6551e+1^{2} (3.26e−1) +	7.2384e+1^{5} (5.08e−1) +	7.0416e+1^{7} (4.32e−1) +	7.0481e+1^{6} (5.72e−1) +
WFG5^{-1}	3	400	6.6007e+0^{8} (2.94e−3)	6.6860e+0^{1} (3.96e−3) +	6.6827e+0^{3} (2.69e−3) +	6.6773e+0^{6} (3.89e−3) +	6.6785e+0^{5} (3.32e−3) +	6.6696e+0^{7} (4.54e−3) +	6.6826e+0^{4} (2.69e−3) +	6.6837e+0^{2} (3.02e−3) +
	5	750	1.3327e+1^{8} (1.51e−2)	1.7742e+1^{1} (2.57e−2) +	1.7607e+1^{2} (1.75e−2) +	1.7523e+1^{7} (3.54e−2) +	1.7531e+1^{6} (2.79e−2) +	1.7581e+1^{3} (2.13e−2) +	1.7573e+1^{5} (2.38e−2) +	1.7575e+1^{4} (2.56e−2) +
	8	1500	2.2978e+1^{8} (5.07e−1)	4.6450e+1^{1} (2.90e−1) +	4.4911e+1^{4} (1.74e−1) +	4.5741e+1^{2} (2.68e−1) +	4.5483e+1^{3} (2.45e−1) +	4.3409e+1^{5} (1.98e−1) +	4.2758e+1^{6} (1.34e−1) +	4.2735e+1^{7} (1.80e−1) +
	10	2000	3.1054e+1^{8} (1.23e+0)	8.5925e+1^{1} (6.10e−1) +	8.2764e+1^{4} (4.21e−1) +	8.5558e+1^{2} (4.11e−1) +	8.5071e+1^{3} (4.33e−1) +	7.5696e+1^{5} (3.86e−1) +	7.3537e+1^{7} (3.46e−1) +	7.3588e+1^{6} (4.91e−1) +
WFG6^{-1}	3	400	6.6085e+0^{8} (1.52e−3)	6.6978e+0^{1} (5.54e−3) +	6.6945e+0^{4} (3.35e−3) +	6.6913e+0^{5} (4.26e−3) +	6.6907e+0^{6} (3.69e−3) +	6.6862e+0^{7} (4.57e−3) +	6.6946e+0^{3} (3.78e−3) +	6.6953e+0^{2} (2.61e−3) +
	5	750	1.3291e+1^{8} (6.20e−3)	1.7779e+1^{1} (2.43e−2) +	1.7627e+1^{2} (2.95e−2) +	1.7583e+1^{4} (3.18e−2) +	1.7590e+1^{3} (2.85e−2) +	1.7563e+1^{5} (2.50e−2) +	1.7526e+1^{7} (2.07e−2) +	1.7530e+1^{6} (2.37e−2) +
	8	1500	2.2527e+1^{8} (9.68e−1)	4.6132e+1^{1} (2.45e−1) +	4.4314e+1^{4} (3.22e−1) +	4.5482e+1^{2} (3.70e−1) +	4.5172e+1^{3} (3.01e−1) +	4.2418e+1^{5} (1.64e−1) +	4.1571e+1^{6} (2.04e−1) +	4.1547e+1^{7} (2.29e−1) +
	10	2000	2.9438e+1^{8} (1.64e+0)	8.5005e+1^{1} (5.28e−1) +	8.1188e+1^{4} (6.47e−1) +	8.4990e+1^{2} (4.89e−1) +	8.4565e+1^{3} (5.90e−1) +	7.3433e+1^{5} (5.25e−1) +	7.0604e+1^{7} (4.03e−1) +	7.0636e+1^{6} (5.21e−1) +
WFG7^{-1}	3	400	6.5931e+0^{8} (8.55e−3)	6.6707e+0^{6} (1.32e−2) +	6.6789e+0^{2} (6.44e−3) +	6.6753e+0^{5} (9.57e−3) +	6.6753e+0^{4} (9.15e−3) +	6.6693e+0^{7} (8.04e−3) +	6.6805e+0^{1} (8.71e−3) +	6.6780e+0^{3} (7.75e−3) +
	5	750	1.3300e+1^{8} (1.70e−2)	1.7408e+1^{7} (9.63e−2) +	1.7559e+1^{1} (3.65e−2) +	1.7492e+1^{4} (5.25e−2) +	1.7485e+1^{5} (4.93e−2) +	1.7499e+1^{2} (4.06e−2) +	1.7494e+1^{3} (2.97e−2) +	1.7479e+1^{6} (2.91e−2) +
	8	1500	2.2182e+1^{8} (7.13e−1)	4.5133e+1^{2} (3.64e−1) +	4.4240e+1^{4} (3.80e−1) +	4.5184e+1^{1} (3.01e−1) +	4.4873e+1^{3} (3.40e−1) +	4.2564e+1^{5} (2.15e−1) +	4.1626e+1^{6} (3.03e−1) +	4.1585e+1^{7} (3.39e−1) +
	10	2000	2.8614e+1^{8} (1.31e+0)	8.2196e+1^{3} (1.24e+0) +	8.0638e+1^{4} (1.34e+0) +	8.4089e+1^{1} (1.02e+0) +	8.3564e+1^{2} (9.41e−1) +	7.2611e+1^{5} (6.43e−1) +	7.0569e+1^{7} (6.69e−1) +	7.0806e+1^{6} (4.62e−1) +
WFG8^{-1}	3	400	6.6095e+0^{8} (1.04e−3)	6.7079e+0^{1} (3.35e−3) +	6.6977e+0^{5} (1.98e−3) +	6.6973e+0^{6} (2.24e−3) +	6.6984e+0^{3} (1.87e−3) +	6.6918e+0^{7} (2.96e−3) +	6.6983e+0^{4} (2.60e−3) +	6.6986e+0^{2} (2.41e−3) +
	5	750	1.3313e+1^{8} (2.15e−2)	1.7800e+1^{1} (1.91e−2) +	1.7628e+1^{2} (2.43e−2) +	1.7583e+1^{4} (3.24e−2) +	1.7597e+1^{3} (3.06e−2) +	1.7560e+1^{5} (2.31e−2) +	1.7515e+1^{7} (3.21e−2) +	1.7520e+1^{6} (2.47e−2) +
	8	1500	2.2680e+1^{8} (8.63e−1)	4.5873e+1^{1} (2.98e−1) +	4.4024e+1^{4} (2.33e−1) +	4.5022e+1^{2} (3.95e−1) +	4.4686e+1^{3} (3.67e−1) +	4.1961e+1^{5} (1.94e−1) +	4.1281e+1^{7} (1.96e−1) +	4.1337e+1^{6} (2.36e−1) +
	10	2000	2.9153e+1^{8} (1.12e+0)	8.4057e+1^{2} (6.35e−1) +	8.0873e+1^{4} (5.44e−1) +	8.4314e+1^{1} (6.89e−1) +	8.3941e+1^{3} (5.04e−1) +	7.1610e+1^{5} (5.00e−1) +	6.9678e+1^{7} (5.96e−1) +	6.9679e+1^{6} (5.72e−1) +
WFG9^{-1}	3	400	6.5556e+0^{8} (1.46e−2)	6.6171e+0^{6} (2.11e−2) +	6.6298e+0^{2} (2.15e−2) +	6.6213e+0^{5} (1.62e−2) +	6.6242e+0^{4} (1.79e−2) +	6.6149e+0^{7} (1.86e−2) +	6.6311e+0^{1} (1.29e−2) +	6.6297e+0^{3} (1.73e−2) +
	5	750	1.3283e+1^{8} (4.53e−2)	1.7107e+1^{7} (1.25e−1) +	1.7452e+1^{2} (6.66e−2) +	1.7342e+1^{6} (5.48e−2) +	1.7345e+1^{5} (5.60e−2) +	1.7418e+1^{4} (6.49e−2) +	1.7460e+1^{1} (4.20e−2) +	1.7452e+1^{3} (6.24e−2) +
	8	1500	2.3121e+1^{8} (7.19e−1)	4.3509e+1^{4} (5.51e−1) +	4.4970e+1^{3} (2.97e−1) +	4.5476e+1^{2} (2.24e−1) +	4.5477e+1^{1} (3.10e−1) +	4.3346e+1^{5} (2.96e−1) +	4.2757e+1^{6} (3.73e−1) +	4.2641e+1^{7} (4.03e−1) +
	10	2000	3.0616e+1^{8} (1.20e+0)	7.8560e+1^{4} (1.16e+0) +	8.3637e+1^{3} (7.81e−1) +	8.5186e+1^{1} (6.47e−1) +	8.4982e+1^{2} (5.89e−1) +	7.6029e+1^{5} (5.18e−1) +	7.3911e+1^{7} (9.39e−1) +	7.3932e+1^{6} (7.27e−1) +
+/−/=				74/7/3	77/4/3	77/4/3	77/4/3	79/2/3	77/2/5	77/2/5
% of satisfaction				88.10%	91.67%	91.67%	91.67%	94.05%	91.67%	91.67%

Table 12: Mean and standard deviations (in parenthesis) of the SPD indicator obtained by MOEAs using the MOEA/D framework on MOPs with irregular PF shapes. The two best mean values per MOP are highlighted in grayscale, where the darker tone corresponds to the best one. The symbols "+", "−", and "=" are placed when the MOEA performs significantly better, significantly worse, or statistically equivalent to MOEA/D based on a one-tailed Wilcoxon test using a significance level of $\alpha = 0.05$. The % of satisfaction refers to the percentage of MOPs where the MOEA performs significantly better than MOEA/D. The superscripts are the obtained rank in the comparison.

MOP	Obj.	Gen.	MOEA/D	AdaW	MOEA/D-AdaRSE	MOEA/D-AdaGAE	MOEA/D-AdaMPT	MOEA/D-AdaCOU	MOEA/D-AdaPT	MOEA/D-AdaKRA
DTLZ5	3	400	9.5807e+0^{8} (2.44e−3)	1.0475e+1^{1} (1.73e−2) +	1.0441e+1^{4} (8.88e−3) +	1.0363e+1^{7} (2.12e−2) +	1.0391e+1^{6} (1.89e−2) +	1.0443e+1^{2} (8.95e−3) +	1.0440e+1^{5} (8.30e−3) +	1.0443e+1^{3} (8.42e−3) +
	5	600	8.2579e+0^{8} (9.33e−2)	2.1431e+1^{1} (1.63e+0) +	1.7421e+1^{4} (2.46e+0) +	1.5919e+1^{7} (2.04e+0) +	1.7348e+1^{5} (1.96e+0) +	1.6918e+1^{6} (2.53e+0) +	1.9041e+1^{3} (3.25e+0) +	1.9787e+1^{2} (3.27e+0) +
	8	750	1.0713e+1^{8} (1.13e+0)	4.4308e+1^{1} (3.67e+0) +	1.9340e+1^{5} (3.18e+0) +	1.7078e+1^{7} (2.91e+0) +	1.7232e+1^{6} (2.87e+0) +	2.3886e+1^{4} (3.11e+0) +	2.8689e+1^{2} (5.38e+0) +	2.6729e+1^{3} (6.09e+0) +
	10	1000	1.1711e+1^{8} (1.75e+0)	6.8069e+1^{1} (9.41e+0) +	2.4657e+1^{5} (3.57e+0) +	2.2109e+1^{7} (3.71e+0) +	2.3311e+1^{6} (2.84e+0) +	3.2873e+1^{4} (1.96e+0) +	4.0410e+1^{2} (3.29e+0) +	3.9336e+1^{3} (4.97e+0) +
DTLZ6	3	400	9.5793e+0^{8} (4.56e−4)	1.0473e+1^{1} (1.07e−2) +	1.0466e+1^{3} (1.78e−3) +	1.0370e+1^{7} (9.99e−3) +	1.0409e+1^{6} (6.80e−3) +	1.0466e+1^{5} (2.26e−3) +	1.0467e+1^{2} (1.54e−3) +	1.0466e+1^{4} (3.07e−3) +
	5	600	6.5083e+0^{8} (9.17e−2)	1.6187e+1^{1} (7.19e−1) +	1.1693e+1^{4} (1.25e+0) +	1.0080e+1^{7} (1.17e+0) +	1.0271e+1^{6} (1.24e+0) +	1.1208e+1^{5} (1.08e+0) +	1.3733e+1^{3} (1.68e+0) +	1.3841e+1^{2} (1.48e+0) +
	8	750	7.1162e+0^{8} (3.62e−1)	3.2469e+1^{1} (5.03e+0) +	1.4508e+1^{5} (1.51e+0) +	1.3983e+1^{7} (1.37e+0) +	1.4234e+1^{6} (1.99e+0) +	1.6121e+1^{4} (1.47e+0) +	1.7707e+1^{3} (1.63e+0) +	1.8140e+1^{2} (1.48e+0) +
	10	1000	7.6380e+0^{8} (2.46e−1)	3.9083e+1^{1} (5.55e+0) +	1.5855e+1^{5} (1.55e+0) +	1.5698e+1^{7} (1.63e+0) +	1.5812e+1^{6} (2.59e+0) +	2.1001e+1^{2} (1.33e+0) +	2.0698e+1^{4} (1.80e+0) +	2.0809e+1^{3} (1.72e+0) +
DTLZ7	3	1000	2.1486e+1^{8} (4.51e−1)	2.4268e+1^{1} (1.74e−1) +	2.3538e+1^{3} (4.12e−1) +	2.3290e+1^{7} (4.09e−1) +	2.3366e+1^{6} (4.02e−1) +	2.3421e+1^{5} (5.02e−1) +	2.3594e+1^{2} (4.66e−1) +	2.3510e+1^{4} (4.28e−1) +
	5	1000	7.4502e+1^{8} (4.56e+0)	1.4114e+2^{1} (8.57e+0) +	1.2045e+2^{4} (1.19e+1) +	1.2224e+2^{2} (1.24e+1) +	1.1976e+2^{5} (1.37e+1) +	1.1139e+2^{7} (9.80e+0) +	1.2048e+2^{3} (9.56e+0) +	1.1813e+2^{6} (1.55e+1) +
	8	1000	7.3342e+1^{8} (2.93e+0)	1.5401e+2^{1} (7.15e−1) +	1.2041e+2^{4} (1.17e+0) +	1.2002e+2^{5} (1.82e+0) +	1.2076e+2^{2} (8.41e−1) +	1.1522e+2^{7} (5.07e+0) +	1.1944e+2^{6} (2.45e+0) +	1.2057e+2^{3} (1.40e+0) +
	10	1500	1.1017e+2^{8} (3.43e+0)	2.7490e+2^{1} (1.09e−1) +	1.9025e+2^{4} (9.33e−1) +	1.9084e+2^{3} (1.71e+0) +	1.9095e+2^{2} (2.29e+0) +	1.8818e+2^{6} (1.39e+0) +	1.8762e+2^{7} (3.26e+0) +	1.8866e+2^{5} (2.84e+0) +
WFG2	3	400	1.8528e+1^{8} (5.66e−1)	2.0577e+1^{1} (2.51e−1) +	1.8938e+1^{2} (3.79e−1) +	1.8586e+1^{7} (1.39e+0) +	1.8855e+1^{5} (1.17e+0) +	1.8909e+1^{3} (4.08e−1) +	1.8831e+1^{6} (4.35e−1) +	1.8890e+1^{4} (3.98e−1) +
	5	750	3.6648e+1^{5} (1.42e+0)	4.0413e+1^{1} (7.11e−1) +	3.6620e+1^{6} (3.92e−1) −	3.6806e+1^{2} (5.63e−1) =	3.6447e+1^{7} (1.17e+0) −	3.6401e+1^{8} (1.54e+0) =	3.6648e+1^{4} (7.26e−1) =	3.6650e+1^{3} (4.19e−1) =
	8	1500	4.4107e+1^{8} (1.28e+0)	5.3898e+1^{1} (6.59e−1) +	4.4674e+1^{3} (9.42e−1) =	4.4657e+1^{6} (1.12e+0) =	4.4657e+1^{5} (5.45e−1) =	4.4678e+1^{2} (9.55e−1) =	4.4384e+1^{7} (1.18e+0) =	4.4666e+1^{4} (8.92e−1) =
	10	2000	5.2314e+1^{8} (1.51e+0)	6.4138e+1^{1} (1.54e+0) +	5.2559e+1^{6} (1.67e+0) =	5.3047e+1^{3} (9.81e−1) =	5.3263e+1^{2} (1.31e+0) +	5.2704e+1^{4} (1.35e+0) =	5.2535e+1^{7} (9.84e−1) =	5.2683e+1^{5} (1.20e+0) =
WFG3	3	400	1.1865e+1^{8} (4.21e−1)	1.2465e+1^{4} (3.77e−1) +	1.2515e+1^{2} (3.56e−1) +	1.2286e+1^{6} (3.87e−1) +	1.2414e+1^{5} (3.72e−1) +	1.2232e+1^{7} (3.28e−1) +	1.2671e+1^{1} (3.29e−1) +	1.2507e+1^{3} (2.88e−1) +
	5	750	1.2412e+1^{8} (5.49e−1)	3.7416e+1^{5} (1.49e+0) +	3.8083e+1^{4} (1.66e+0) +	3.3418e+1^{7} (1.22e+0) +	3.4912e+1^{6} (1.56e+0) +	3.8644e+1^{3} (1.52e+0) +	4.2810e+1^{2} (1.45e+0) +	4.3013e+1^{1} (7.65e−1) +
	8	1500	2.2470e+1^{8} (1.43e+0)	7.6903e+1^{1} (4.18e+0) +	6.9430e+1^{4} (2.97e+0) +	6.0497e+1^{7} (3.20e+0) +	6.4438e+1^{6} (2.83e+0) +	6.6311e+1^{5} (2.75e+0) +	7.0528e+1^{2} (1.88e+0) +	6.9787e+1^{3} (1.99e+0) +
	10	2000	2.5701e+1^{8} (2.68e+0)	1.2711e+2^{1} (3.87e+0) +	1.1130e+2^{2} (4.28e+0) +	9.9550e+1^{7} (4.67e+0) +	1.0735e+2^{6} (3.79e+0) +	1.0948e+2^{5} (3.86e+0) +	1.1045e+2^{3} (2.67e+0) +	1.1016e+2^{4} (2.57e+0) +
DTLZ1^{-1}	3	400	2.0907e+1^{8} (4.06e−3)	2.2560e+1^{7} (1.55e−1) +	2.3103e+1^{6} (6.64e−2) +	2.3103e+1^{5} (6.04e−2) +	2.3154e+1^{1} (3.10e−2) +	2.3134e+1^{2} (3.40e−2) +	2.3119e+1^{4} (4.43e−2) +	2.3124e+1^{3} (4.64e−2) +
	5	600	2.5966e+1^{8} (5.97e−3)	6.6327e+1^{5} (6.16e−1) +	6.9180e+1^{4} (4.18e−1) +	6.2651e+1^{7} (1.05e+0) +	6.5066e+1^{6} (8.41e−1) +	7.2001e+1^{1} (1.59e−1) +	7.1487e+1^{3} (1.42e−1) +	7.1510e+1^{2} (1.55e−1) +
	8	750	2.5942e+1^{8} (8.50e−1)	1.0496e+2^{2} (1.79e+0) +	1.0518e+2^{1} (7.55e−1) +	9.7948e+1^{7} (1.15e+0) +	1.0226e+2^{3} (9.14e−1) +	9.9943e+1^{4} (7.24e−1) +	9.9079e+1^{6} (6.55e−1) +	9.9250e+1^{5} (8.87e−1) +
	10	1000	2.5662e+1^{8} (1.16e+0)	1.6242e+2^{3} (3.32e+0) +	1.6890e+2^{1} (1.10e+0) +	1.5338e+2^{4} (2.09e+0) +	1.6403e+2^{2} (1.18e+0) +	1.5303e+2^{5} (8.87e−1) +	1.5248e+2^{6} (6.36e−1) +	1.5227e+2^{7} (6.09e−1) +
DTLZ2^{-1}	3	250	2.7603e+1^{8} (5.77e−2)	3.0716e+1^{1} (3.80e−1) +	3.0463e+1^{4} (3.87e−1) +	2.9313e+1^{7} (6.03e−1) +	2.9780e+1^{5} (4.58e−1) +	2.9625e+1^{6} (4.19e−1) +	3.0512e+1^{3} (3.31e−1) +	3.0603e+1^{2} (3.56e−1) +
	5	350	3.5972e+1^{8} (1.01e−1)	1.2416e+2^{1} (1.15e+0) +	1.1975e+2^{3} (1.30e+0) +	1.0701e+2^{7} (2.14e+0) +	1.0976e+2^{6} (1.27e+0) +	1.2234e+2^{2} (7.86e−1) +	1.1957e+2^{4} (9.08e−1) +	1.1943e+2^{5} (8.74e−1) +
	8	500	7.1649e+1^{8} (6.52e+0)	1.4632e+2^{1} (4.86e−1) +	1.4158e+2^{5} (2.18e+0) +	1.2799e+2^{7} (3.45e+0) +	1.3482e+2^{6} (2.10e+0) +	1.4517e+2^{2} (1.54e+0) +	1.4367e+2^{3} (2.23e+0) +	1.4243e+2^{4} (2.77e+0) +
	10	750	8.2551e+1^{8} (7.89e+0)	2.5865e+2^{1} (7.96e−1) +	2.3742e+2^{5} (3.40e+0) +	2.1275e+2^{7} (2.95e+0) +	2.2327e+2^{6} (3.05e+0) +	2.4433e+2^{2} (3.99e+0) +	2.4086e+2^{4} (3.64e+0) +	2.4118e+2^{3} (3.95e+0) +
DTLZ3^{-1}	3	1000	2.7632e+1^{8} (1.14e−2)	3.1090e+1^{4} (3.31e−1) +	3.1256e+1^{2} (1.48e−1) +	3.0603e+1^{7} (3.72e−1) +	3.0792e+1^{5} (3.10e−1) +	3.0765e+1^{6} (2.43e−1) +	3.1276e+1^{1} (1.78e−1) +	3.1224e+1^{3} (2.83e−1) +
	5	1000	3.5957e+1^{8} (4.27e−2)	1.2431e+2^{2} (1.99e+0) +	1.2140e+2^{5} (1.11e+0) +	1.0638e+2^{7} (1.93e+0) +	1.0919e+2^{6} (1.67e+0) +	1.2510e+2^{1} (8.55e−1) +	1.2202e+2^{3} (5.88e−1) +	1.2187e+2^{4} (5.28e−1) +
	8	1000	7.8256e+1^{8} (3.89e+0)	1.4565e+2^{2} (7.46e−1) +	1.4224e+2^{5} (1.66e+0) +	1.2491e+2^{7} (3.13e+0) +	1.3321e+2^{6} (2.25e+0) +	1.4674e+2^{1} (1.13e+0) +	1.4478e+2^{4} (1.90e+0) +	1.4489e+2^{3} (1.47e+0) +
	10	1500	8.7145e+1^{8} (1.10e+1)	2.5788e+2^{1} (9.97e−1) +	2.4003e+2^{5} (2.78e+0) +	2.0944e+2^{7} (3.59e+0) +	2.2409e+2^{6} (3.62e+0) +	2.4621e+2^{2} (3.86e+0) +	2.4397e+2^{4} (3.96e+0) +	2.4404e+2^{3} (4.10e+0) +
DTLZ4^{-1}	3	600	2.7639e+1^{8} (1.54e−2)	3.1361e+1^{2} (1.84e−1) +	3.1266e+1^{4} (1.87e−1) +	3.0857e+1^{6} (2.76e−1) +	3.1088e+1^{5} (1.75e−1) +	3.0835e+1^{7} (2.36e−1) +	3.1362e+1^{1} (1.29e−1) +	3.1321e+1^{3} (1.27e−1) +
	5	1000	3.5945e+1^{8} (9.83e−3)	1.3173e+2^{1} (6.77e−1) +	1.2595e+2^{3} (6.41e−1) +	1.1777e+2^{7} (8.82e−1) +	1.1950e+2^{6} (1.01e+0) +	1.2688e+2^{2} (3.28e−1) +	1.2356e+2^{4} (5.66e−1) +	1.2353e+2^{5} (4.81e−1) +
	8	1250	8.3004e+1^{8} (5.30e+0)	1.4875e+2^{1} (2.66e−1) +	1.4665e+2^{3} (4.82e+0) +	1.4108e+2^{7} (5.35e+0) +	1.4429e+2^{6} (2.90e+0) +	1.4708e+2^{2} (4.86e+0) +	1.4652e+2^{4} (2.94e+0) +	1.4549e+2^{5} (4.07e+0) +
	10	2000	1.0805e+2^{8} (9.64e+0)	2.6314e+2^{1} (2.90e−1) +	2.5176e+2^{2} (3.46e+0) +	2.3901e+2^{7} (3.05e+0) +	2.4376e+2^{6} (2.69e+0) +	2.4893e+2^{3} (7.20e+0) +	2.4665e+2^{4} (3.62e+0) +	2.4630e+2^{5} (7.02e+0) +
DTLZ5^{-1}	3	400	2.3726e+1^{8} (1.08e−2)	2.5913e+1^{6} (2.24e−1) +	2.6463e+1^{2} (1.36e−1) +	2.5732e+1^{7} (1.96e−1) +	2.5929e+1^{4} (1.62e−1) +	2.5919e+1^{5} (2.05e−1) +	2.6487e+1^{1} (1.19e−1) +	2.6454e+1^{3} (1.18e−1) +
	5	600	3.7309e+1^{8} (7.42e−1)	9.7881e+1^{5} (9.37e−1) +	1.0021e+2^{2} (4.84e−1) +	9.1440e+1^{7} (1.03e+0) +	9.3849e+1^{6} (1.18e+0) +	1.0185e+2^{1} (4.88e−1) +	9.9365e+1^{4} (4.64e−1) +	9.9375e+1^{3} (3.99e−1) +
	8	750	5.0738e+1^{8} (3.90e+0)	1.3473e+2^{1} (1.07e+0) +	1.2906e+2^{3} (2.03e+0) +	1.1461e+2^{7} (2.66e+0) +	1.2090e+2^{6} (2.51e+0) +	1.3174e+2^{2} (1.68e+0) +	1.2836e+2^{4} (1.93e+0) +	1.2767e+2^{5} (2.33e+0) +
	10	1000	5.5216e+1^{8} (3.91e+0)	2.3320e+2^{1} (2.03e+0) +	2.1097e+2^{3} (2.35e+0) +	1.8213e+2^{7} (3.78e+0) +	1.9323e+2^{6} (3.28e+0) +	2.1523e+2^{2} (2.27e+0) +	2.0742e+2^{4} (2.13e+0) +	2.0659e+2^{5} (2.17e+0) +
DTLZ6^{-1}	3	400	2.6249e+1^{8} (6.88e−3)	2.9665e+1^{4} (1.70e−1) +	2.9812e+1^{3} (8.91e−2) +	2.9181e+1^{7} (1.56e−1) +	2.9285e+1^{5} (1.45e−1) +	2.9186e+1^{6} (1.90e−1) +	2.9823e+1^{2} (9.70e−2) +	2.9829e+1^{1} (9.86e−2) +
	5	600	3.5610e+1^{8} (2.35e−1)	1.1866e+2^{1} (8.36e−1) +	1.1736e+2^{3} (3.70e−1) +	1.0801e+2^{7} (1.00e+0) +	1.1003e+2^{6} (9.73e−1) +	1.1798e+2^{2} (4.20e−1) +	1.1511e+2^{4} (5.56e−1) +	1.1506e+2^{5} (4.79e−1) +
	8	750	6.6295e+1^{8} (5.44e+0)	1.4412e+2^{2} (4.29e−1) +	1.4193e+2^{3} (8.85e−1) +	1.3125e+2^{7} (2.60e+0) +	1.3496e+2^{6} (2.50e+0) +	1.4419e+2^{1} (1.59e+0) +	1.4069e+2^{5} (2.05e+0) +	1.4174e+2^{4} (1.50e+0) +
	10	1000	7.3376e+1^{8} (7.62e+0)	2.5340e+2^{1} (8.65e−1) +	2.3417e+2^{3} (2.95e+0) +	2.1203e+2^{7} (3.39e+0) +	2.2046e+2^{6} (2.51e+0) +	2.3904e+2^{2} (4.07e+0) +	2.3153e+2^{5} (3.45e+0) +	2.3299e+2^{4} (3.04e+0) +
DTLZ7^{-1}	3	1000	1.2447e+1^{8} (4.71e−2)	1.4837e+1^{1} (6.52e−1) +	1.3925e+1^{4} (2.00e−1) +	1.3697e+1^{7} (2.31e−1) +	1.3801e+1^{6} (1.89e−1) +	1.3870e+1^{5} (2.14e−1) +	1.3989e+1^{2} (1.43e−1) +	1.3946e+1^{3} (1.88e−1) +
	5	1000	3.6432e+1^{8} (2.16e+0)	7.2118e+1^{1} (1.35e+1) +	4.6627e+1^{6} (6.23e+0) +	4.6606e+1^{7} (6.63e−1) +	4.7413e+1^{5} (7.99e−1) +	4.9331e+1^{4} (6.61e−1) +	4.9844e+1^{2} (7.09e−1) +	4.9707e+1^{3} (6.78e−1) +
	8	1000	4.7868e+1^{8} (1.91e+0)	1.2803e+2^{1} (4.52e+0) +	9.4565e+1^{2} (1.04e+0) +	8.9746e+1^{7} (2.81e+0) +	9.3289e+1^{5} (1.73e+0) +	9.3025e+1^{6} (2.10e+0) +	9.4225e+1^{3} (1.45e+0) +	9.4007e+1^{4} (1.23e+0) +
	10	1500	6.5395e+1^{8} (2.72e+0)	2.5315e+2^{1} (5.08e+0) +	1.5977e+2^{2} (2.09e+0) +	1.5566e+2^{5} (2.02e+0) +	1.5622e+2^{4} (1.94e+0) +	1.5886e+2^{3} (2.42e+0) +	1.5489e+2^{7} (2.79e+0) +	1.5560e+2^{6} (2.43e+0) +
WFG1^{-1}	3	400	1.7804e+1^{3} (3.17e−1)	1.8223e+1^{1} (6.23e−1) +	1.7424e+1^{8} (8.26e−1) −	1.7733e+1^{6} (6.63e−1) =	1.7937e+1^{2} (7.32e−1) =	1.7780e+1^{4} (7.85e−1) =	1.7773e+1^{5} (8.55e−1) =	1.7589e+1^{7} (1.10e+0) =
	5	750	1.4531e+1^{8} (8.03e−1)	4.0415e+1^{4} (9.72e−1) +	4.0206e+1^{5} (2.54e+0) +	3.8399e+1^{7} (8.56e−1) +	3.9412e+1^{6} (9.04e−1) +	4.1332e+1^{2} (3.80e+0) +	4.1301e+1^{3} (3.84e+0) +	4.1677e+1^{1} (2.86e+0) +
	8	1500	1.3283e+1^{8} (8.04e−1)	6.4802e+1^{1} (1.08e+0) +	5.5978e+1^{5} (3.85e+0) +	5.3260e+1^{6} (2.89e+0) +	5.1654e+1^{7} (9.66e+0) +	6.1064e+1^{2} (3.87e+0) +	6.0902e+1^{3} (4.03e+0) +	6.0407e+1^{4} (4.60e+0) +
	10	2000	1.3202e+1^{8} (8.30e−1)	8.7819e+1^{2} (1.18e+0) +	7.1449e+1^{6} (1.06e+1) +	6.9204e+1^{7} (9.86e+0) +	7.7859e+1^{5} (4.90e+0) +	8.2019e+1^{4} (1.09e+1) +	8.8469e+1^{1} (4.09e+0) +	8.3799e+1^{3} (1.11e+1) +
WFG2^{-1}	3	400	2.7994e+1^{8} (2.83e−1)	3.1213e+1^{1} (2.17e−1) +	3.0607e+1^{3} (3.43e−1) +	3.0046e+1^{7} (2.11e−1) +	3.0093e+1^{6} (3.07e−1) +	3.0349e+1^{5} (2.78e−1) +	3.0672e+1^{2} (1.83e−1) +	3.0602e+1^{4} (2.36e−1) +
	5	750	2.7190e+1^{8} (1.93e−2)	7.6816e+1^{4} (3.98e−1) +	7.4938e+1^{5} (7.22e−1) +	7.0613e+1^{7} (7.10e−1) +	7.2137e+1^{6} (1.00e+0) +	7.7528e+1^{2} (5.38e−1) +	7.7403e+1^{3} (4.60e−1) +	7.7725e+1^{1} (4.42e−1) +
	8	1500	1.7358e+1^{8} (6.64e−1)	1.0535e+2^{1} (6.37e−1) +	9.7896e+1^{2} (1.17e+0) +	9.4274e+1^{4} (1.32e+0) +	9.6560e+1^{3} (1.05e+0) +	9.2514e+1^{5} (1.40e+0) +	9.2403e+1^{6} (1.43e+0) +	9.1963e+1^{7} (1.69e+0) +
	10	2000	1.7186e+1^{8} (8.32e−1)	1.5449e+2^{1} (8.46e−1) +	1.4646e+2^{2} (1.71e+0) +	1.4072e+2^{4} (2.63e+0) +	1.4473e+2^{3} (1.62e+0) +	1.3829e+2^{5} (2.09e+0) +	1.3816e+2^{6} (2.51e+0) +	1.3481e+2^{7} (2.30e+1) +
WFG3^{-1}	3	400	2.0953e+1^{8} (7.10e−3)	2.2470e+1^{7} (2.09e−1) +	2.3162e+1^{2} (5.33e−2) +	2.3133e+1^{6} (3.73e−2) +	2.3146e+1^{4} (3.78e−2) +	2.3144e+1^{5} (3.91e−2) +	2.3178e+1^{1} (5.37e−2) +	2.3158e+1^{3} (4.61e−2) +
	5	750	2.0052e+1^{8} (5.81e−3)	6.6112e+1^{6} (7.41e−1) +	7.0201e+1^{4} (3.97e−1) +	6.5399e+1^{7} (8.59e−1) +	6.6999e+1^{5} (5.16e−1) +	7.2130e+1^{1} (1.36e−1) +	7.1973e+1^{2} (1.36e−1) +	7.1925e+1^{3} (1.76e−1) +
	8	1500	2.3780e+1^{8} (1.25e+0)	1.0570e+2^{2} (1.55e+0) +	1.0616e+2^{1} (5.26e−1) +	9.8644e+1^{7} (1.15e+0) +	1.0342e+2^{3} (6.14e−1) +	9.9646e+1^{4} (1.18e+0) +	9.9624e+1^{5} (9.95e−1) +	9.9581e+1^{6} (1.27e+0) +
	10	2000	2.3679e+1^{8} (1.38e+0)	1.6730e+2^{2} (2.84e+0) +	1.6912e+2^{1} (9.89e−1) +	1.5524e+2^{4} (2.34e+0) +	1.6480e+2^{3} (9.43e−1) +	1.5190e+2^{5} (9.41e−1) +	1.5130e+2^{6} (8.81e−1) +	1.5121e+2^{7} (1.27e+0) +
WFG4^{-1}	3	400	2.7699e+1^{8} (1.00e−1)	3.1160e+1^{1} (1.83e−1) +	3.0583e+1^{4} (2.84e−1) +	2.9985e+1^{7} (3.91e−1) +	3.0242e+1^{5} (5.08e−1) +	2.9992e+1^{6} (3.18e−1) +	3.0611e+1^{3} (2.69e−1) +	3.0694e+1^{2} (2.87e−1) +
	5	750	3.3764e+1^{8} (1.33e−1)	1.2874e+2^{1} (9.75e−1) +	1.1974e+2^{4} (1.01e+0) +	1.0948e+2^{7} (1.34e+0) +	1.1162e+2^{6} (1.47e+0) +	1.2224e+2^{2} (6.63e−1) +	1.1966e+2^{5} (6.31e−1) +	1.1983e+2^{3} (4.50e−1) +
	8	1500	5.7414e+1^{8} (2.75e+0)	1.4808e+2^{1} (3.33e−1) +	1.4481e+2^{5} (8.71e−1) +	1.3465e+2^{7} (2.09e+0) +	1.3858e+2^{6} (1.53e+0) +	1.4725e+2^{2} (1.17e+0) +	1.4631e+2^{3} (8.45e−1) +	1.4583e+2^{4} (1.30e+0) +
	10	2000	7.2817e+1^{8} (4.36e+0)	2.6080e+2^{1} (5.65e−1) +	2.4027e+2^{5} (3.48e+0) +	2.1795e+2^{7} (2.68e+0) +	2.2723e+2^{6} (2.34e+0) +	2.4870e+2^{2} (2.59e+0) +	2.4522e+2^{3} (3.88e+0) +	2.4495e+2^{4} (4.00e+0) +
WFG5^{-1}	3	400	2.6848e+1^{8} (2.21e−1)	2.9844e+1^{1} (3.50e−1) +	2.9604e+1^{4} (3.21e−1) +	2.8809e+1^{6} (3.73e−1) +	2.8999e+1^{5} (3.28e−1) +	2.8761e+1^{7} (3.61e−1) +	2.9629e+1^{3} (2.03e−1) +	2.9636e+1^{2} (1.93e−1) +
	5	750	3.2933e+1^{8} (3.25e−1)	1.2366e+2^{1} (7.84e−1) +	1.1709e+2^{3} (8.18e−1) +	1.0770e+2^{7} (1.59e+0) +	1.0898e+2^{6} (1.09e+0) +	1.1888e+2^{2} (6.78e−1) +	1.1593e+2^{4} (5.04e−1) +	1.1564e+2^{5} (6.32e−1) +
	8	1500	5.4874e+1^{8} (2.57e+0)	1.4666e+2^{1} (5.07e−1) +	1.4434e+2^{5} (9.82e−1) +	1.3599e+2^{7} (1.56e+0) +	1.3993e+2^{6} (1.21e+0) +	1.4646e+2^{2} (7.01e−1) +	1.4462e+2^{3} (1.03e+0) +	1.4440e+2^{4} (1.07e+0) +
	10	2000	6.5854e+1^{8} (4.83e+0)	2.5821e+2^{1} (8.77e−1) +	2.4281e+2^{4} (2.79e+0) +	2.2143e+2^{7} (3.00e+0) +	2.3058e+2^{6} (2.89e+0) +	2.4625e+2^{2} (3.99e+0) +	2.4219e+2^{5} (3.26e+0) +	2.4302e+2^{3} (3.03e+0) +
WFG6^{-1}	3	400	2.7742e+1^{8} (5.94e−2)	3.0727e+1^{2} (3.08e−1) +	3.0646e+1^{4} (2.95e−1) +	2.9891e+1^{7} (5.05e−1) +	2.9969e+1^{5} (4.84e−1) +	2.9956e+1^{6} (4.12e−1) +	3.0755e+1^{1} (2.35e−1) +	3.0716e+1^{3} (2.91e−1) +
	5	750	3.3792e+1^{8} (8.63e−2)	1.2711e+2^{1} (9.86e−1) +	1.2269e+2^{3} (6.25e−1) +	1.1261e+2^{7} (1.17e+0) +	1.1517e+2^{6} (1.42e+0) +	1.2380e+2^{2} (7.62e−1) +	1.2062e+2^{4} (7.51e−1) +	1.2047e+2^{5} (8.85e−1) +
	8	1500	5.2070e+1^{8} (3.77e+0)	1.4753e+2^{2} (4.21e−1) +	1.4621e+2^{5} (7.33e−1) +	1.3770e+2^{7} (1.38e+0) +	1.4137e+2^{6} (1.18e+0) +	1.4812e+2^{1} (6.42e−1) +	1.4625e+2^{4} (1.05e+0) +	1.4651e+2^{3} (9.49e−1) +
	10	2000	6.3232e+1^{8} (4.92e+0)	2.6017e+2^{1} (6.96e−1) +	2.4685e+2^{3} (2.85e+0) +	2.2570e+2^{7} (2.79e+0) +	2.3503e+2^{6} (3.00e+0) +	2.5090e+2^{2} (3.53e+0) +	2.4487e+2^{5} (3.79e+0) +	2.4629e+2^{4} (3.98e+0) +
WFG7^{-1}	3	400	2.7538e+1^{8} (1.28e−1)	3.0814e+1^{1} (4.40e−1) +	3.0036e+1^{2} (4.40e−1) +	2.9270e+1^{7} (5.19e−1) +	2.9390e+1^{5} (5.02e−1) +	2.9280e+1^{6} (5.20e−1) +	3.0000e+1^{3} (3.94e−1) +	2.9858e+1^{4} (4.80e−1) +
	5	750	3.3247e+1^{8} (1.68e−1)	1.2744e+2^{1} (1.25e+0) +	1.1750e+2^{5} (1.59e+0) +	1.0829e+2^{7} (1.86e+0) +	1.0923e+2^{6} (1.90e+0) +	1.2020e+2^{2} (1.03e+0) +	1.1796e+2^{3} (6.92e−1) +	1.1791e+2^{4} (8.91e−1) +
	8	1500	5.0986e+1^{8} (3.83e+0)	1.4704e+2^{1} (3.99e−1) +	1.4489e+2^{3} (1.25e+0) +	1.3648e+2^{7} (2.28e+0) +	1.4034e+2^{6} (1.93e+0) +	1.4653e+2^{2} (1.64e+0) +	1.4369e+2^{5} (2.66e+0) +	1.4369e+2^{4} (4.54e+0) +
	10	2000	6.1070e+1^{8} (4.06e+0)	2.5928e+2^{1} (7.88e−1) +	2.4406e+2^{2} (6.93e+0) +	2.2546e+2^{7} (7.60e+0) +	2.3459e+2^{6} (6.95e+0) +	2.4185e+2^{3} (8.36e+0) +	2.3666e+2^{5} (8.36e+0) +	2.3842e+2^{4} (7.65e+0) +
WFG8^{-1}	3	400	2.7739e+1^{8} (6.55e−2)	3.1194e+1^{4} (2.02e−1) +	3.1252e+1^{1} (1.62e−1) +	3.0694e+1^{6} (2.93e−1) +	3.0878e+1^{5} (2.73e−1) +	3.0546e+1^{7} (2.10e−1) +	3.1202e+1^{3} (2.13e−1) +	3.1238e+1^{2} (1.61e−1) +
	5	750	3.3730e+1^{8} (1.48e−1)	1.2952e+2^{1} (8.64e−1) +	1.2373e+2^{3} (7.50e−1) +	1.1468e+2^{7} (1.19e+0) +	1.1666e+2^{6} (1.18e+0) +	1.2461e+2^{2} (6.52e−1) +	1.2092e+2^{5} (7.05e−1) +	1.2098e+2^{4} (6.12e−1) +
	8	1500	5.3972e+1^{8} (4.10e+0)	1.4820e+2^{2} (3.53e−1) +	1.4682e+2^{3} (5.96e−1) +	1.3941e+2^{7} (1.64e+0) +	1.4277e+2^{6} (1.19e+0) +	1.4843e+2^{1} (4.70e−1) +	1.4669e+2^{4} (1.10e+0) +	1.4648e+2^{5} (1.32e+0) +
	10	2000	6.8756e+1^{8} (3.79e+0)	2.6148e+2^{1} (5.66e−1) +	2.4851e+2^{3} (2.19e+0) +	2.3085e+2^{7} (3.11e+0) +	2.3884e+2^{6} (2.14e+0) +	2.5034e+2^{2} (3.43e+0) +	2.4575e+2^{4} (4.08e+0) +	2.4547e+2^{5} (4.20e+0) +
WFG9^{-1}	3	400	2.6211e+1^{8} (2.34e−1)	2.9606e+1^{1} (2.82e−1) +	2.8389e+1^{2} (4.98e−1) +	2.7599e+1^{7} (5.12e−1) +	2.7804e+1^{5} (5.57e−1) +	2.7641e+1^{6} (6.69e−1) +	2.8364e+1^{3} (4.69e−1) +	2.8282e+1^{4} (5.27e−1) +
	5	750	3.1122e+1^{8} (5.56e−1)	1.2234e+2^{1} (9.85e−1) +	1.0973e+2^{5} (1.76e+0) +	1.0012e+2^{7} (1.86e+0) +	1.0145e+2^{6} (1.94e+0) +	1.1325e+2^{2} (1.57e+0) +	1.1174e+2^{3} (1.40e+0) +	1.1164e+2^{4} (1.32e+0) +
	8	1500	5.0406e+1^{8} (3.47e+0)	1.4583e+2^{1} (5.55e−1) +	1.3905e+2^{2} (2.31e+0) +	1.2888e+2^{7} (2.61e+0) +	1.3237e+2^{6} (2.78e+0) +	1.3850e+2^{3} (3.55e+0) +	1.3703e+2^{4} (3.08e+0) +	1.3649e+2^{5} (4.20e+0) +
	10	2000	5.7658e+1^{8} (2.45e+0)	2.5773e+2^{1} (9.64e−1) +	2.2852e+2^{3} (3.91e+0) +	2.1087e+2^{7} (2.83e+0) +	2.1803e+2^{6} (3.10e+0) +	2.3265e+2^{2} (4.07e+0) +	2.2828e+2^{4} (4.74e+0) +	2.2701e+2^{5} (3.22e+0) +
+/−/=				84/0/0	80/2/2	80/0/4	81/1/2	80/0/4	80/0/4	80/0/4
% of satisfaction				100.00%	95.24%	95.24%	96.43%	95.24%	95.24%	95.24%

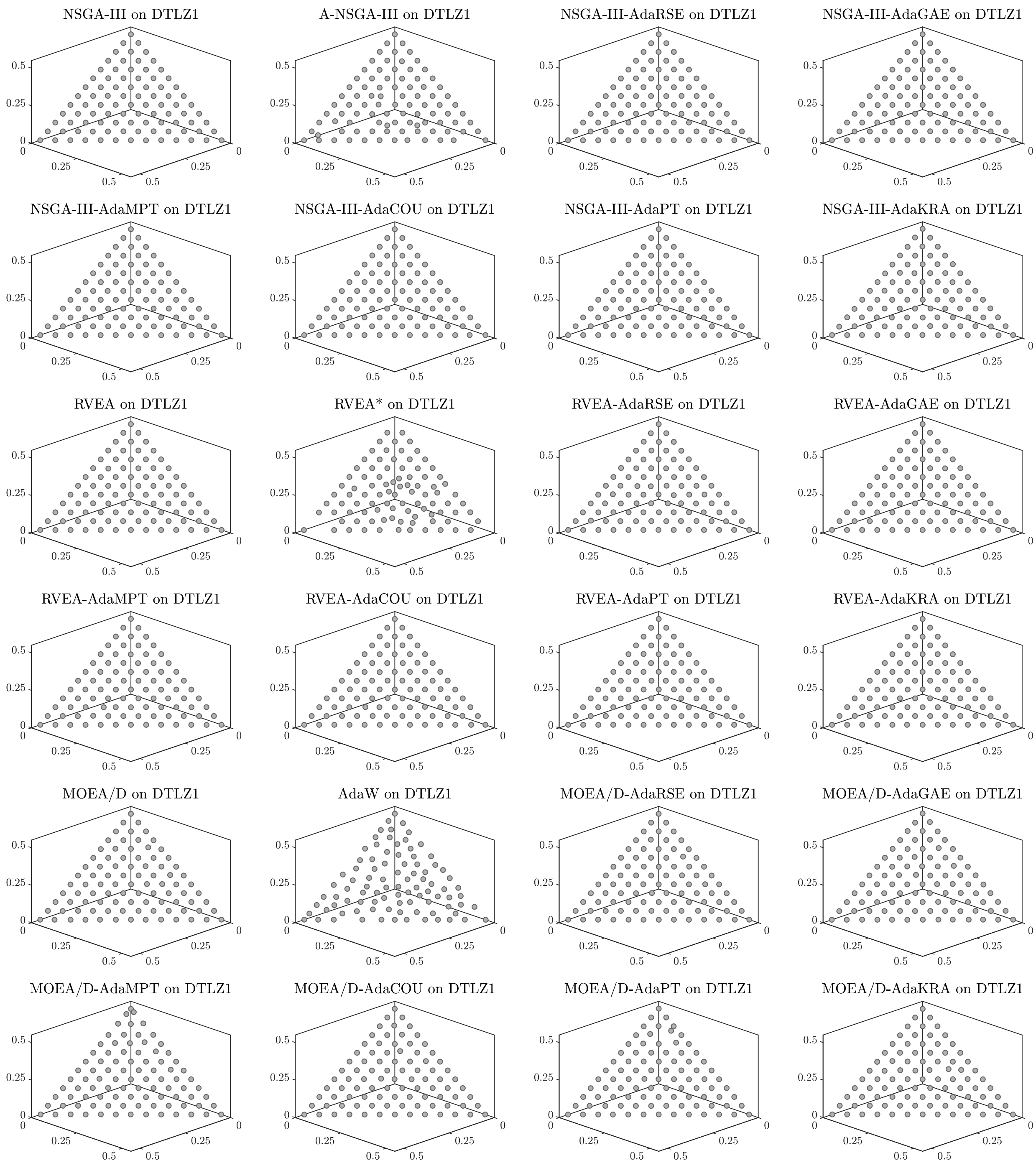

Figure 1: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 3 objective functions.

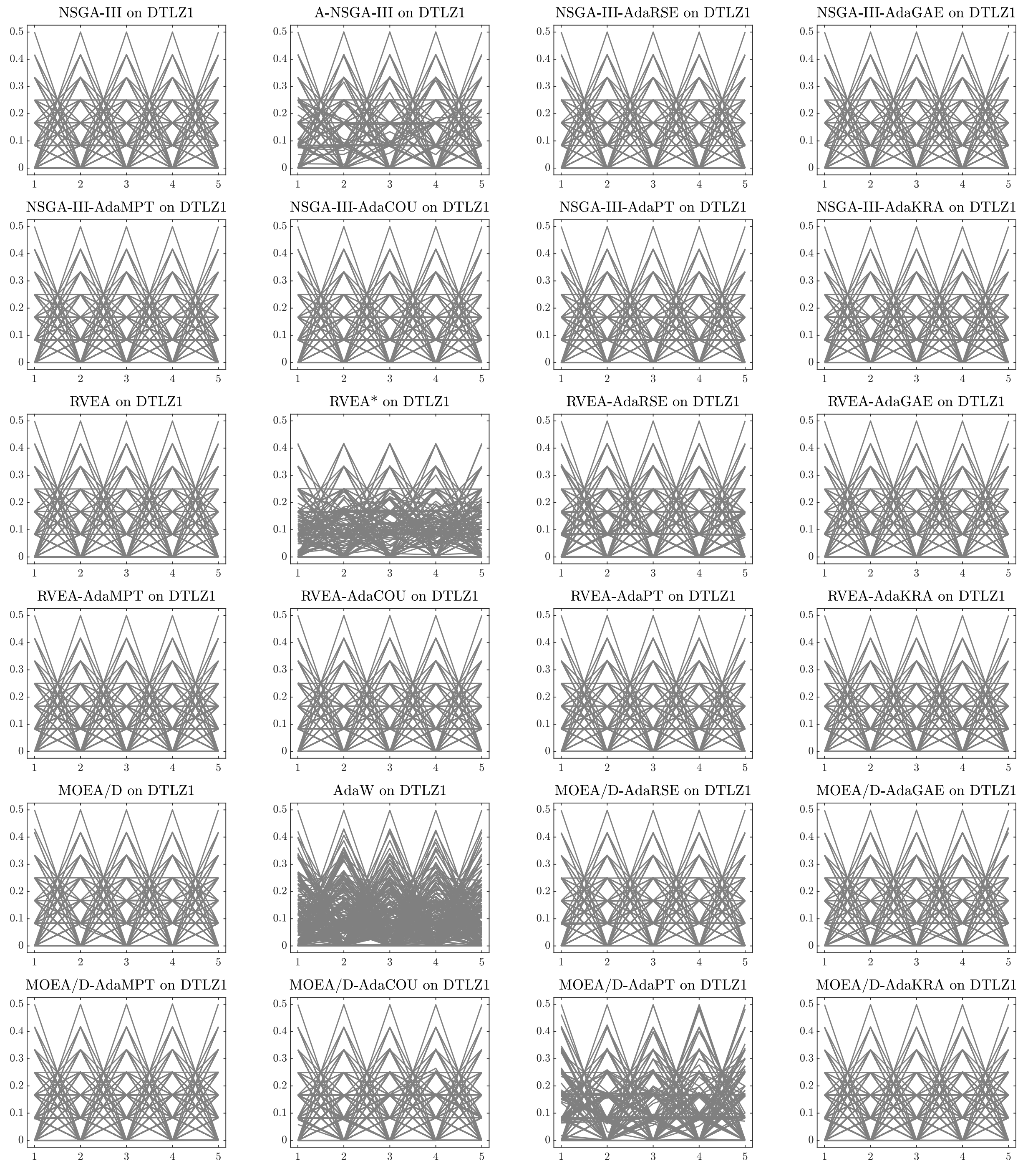

Figure 2: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 5 objective functions.

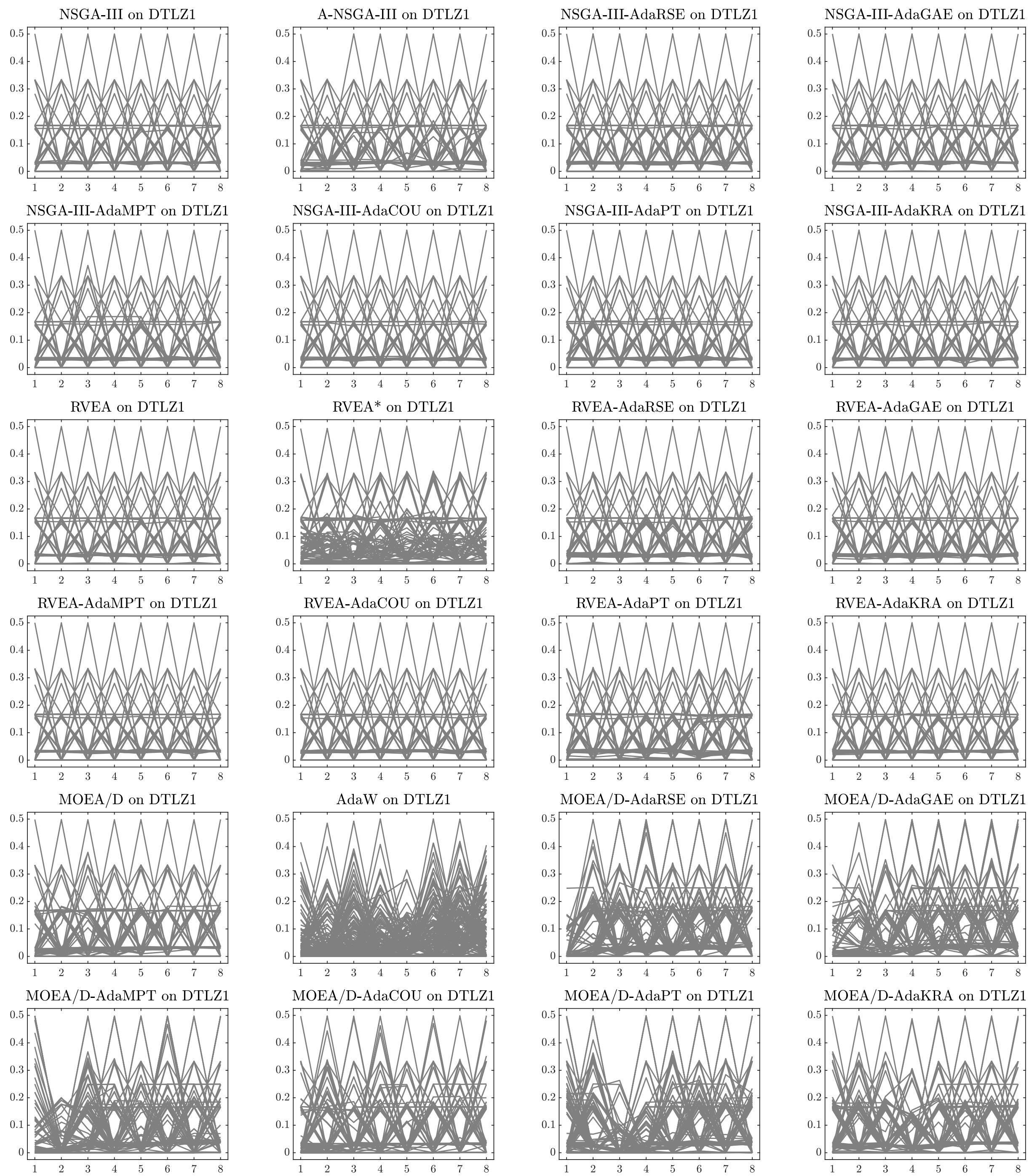

Figure 3: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 8 objective functions.

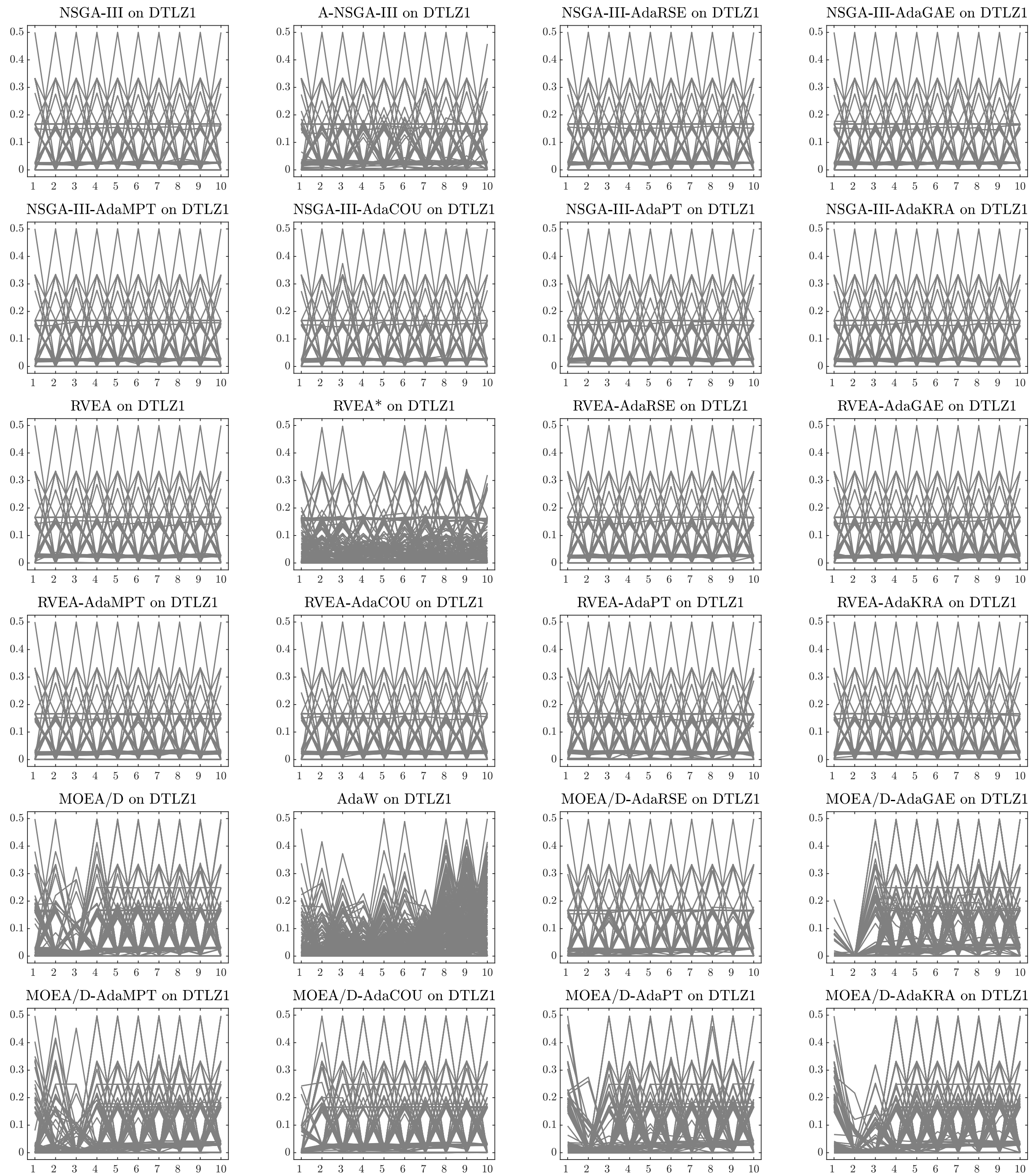

Figure 4: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 10 objective functions.

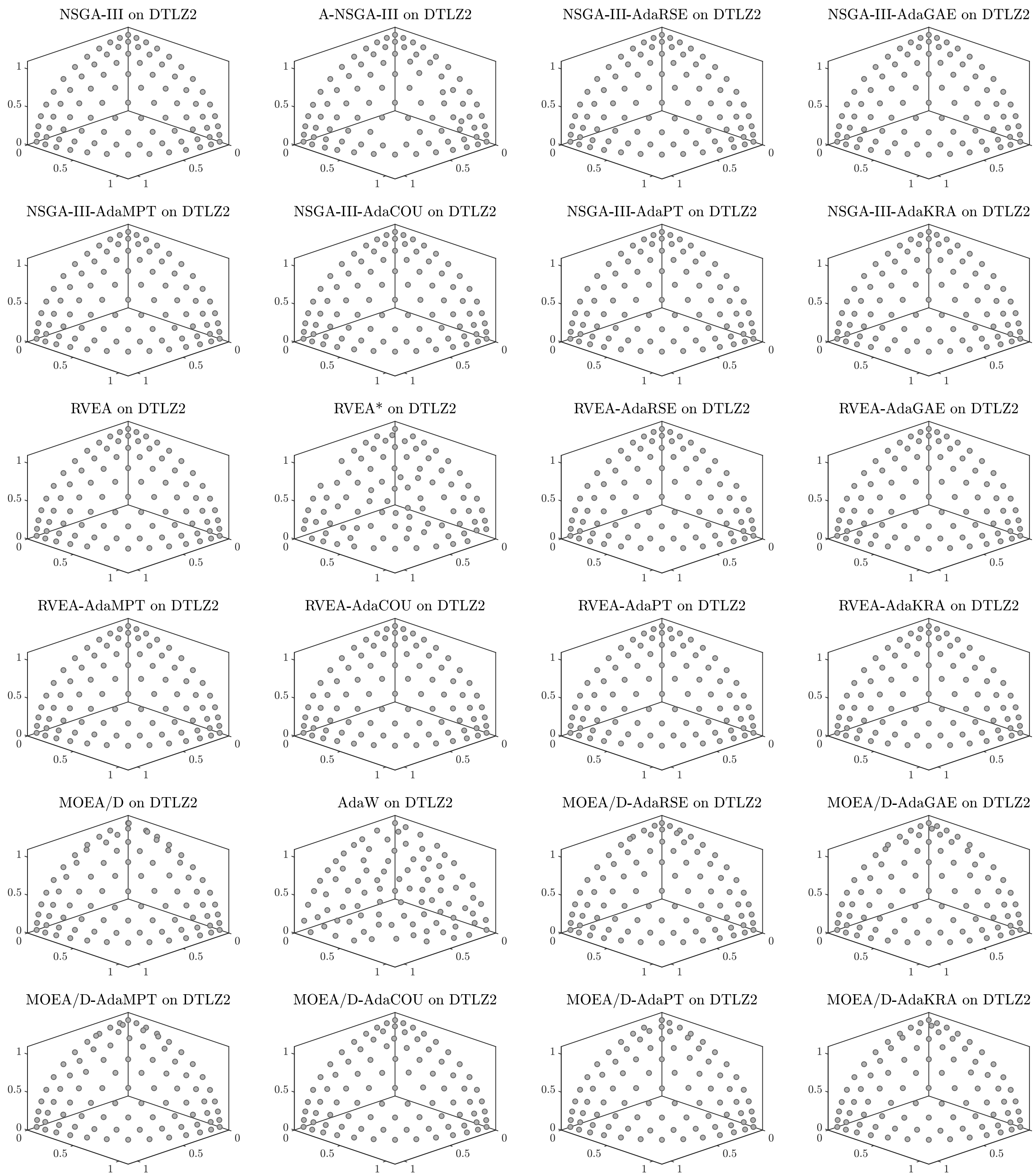

Figure 5: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2 with 3 objective functions.

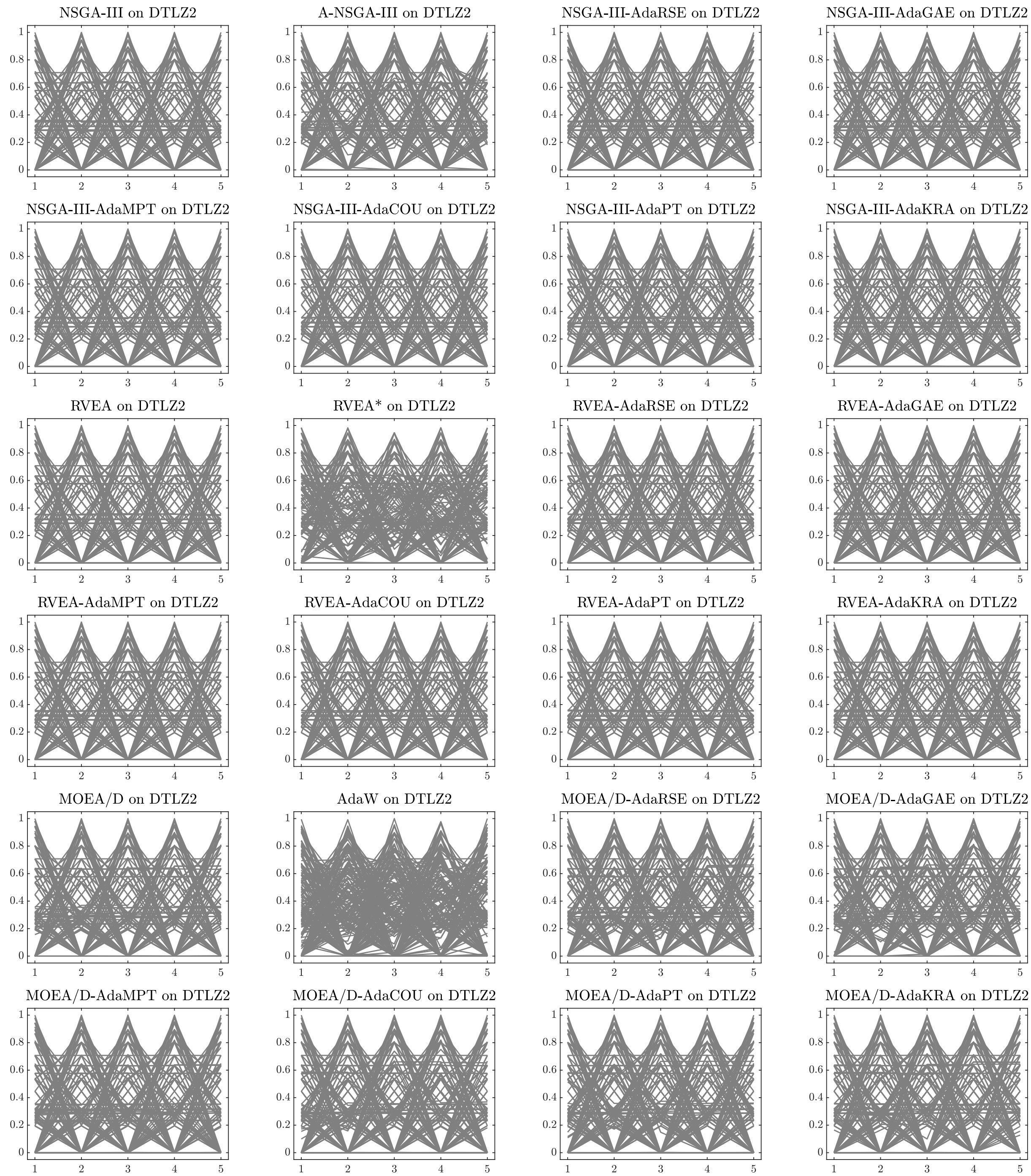

Figure 6: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2 with 5 objective functions.

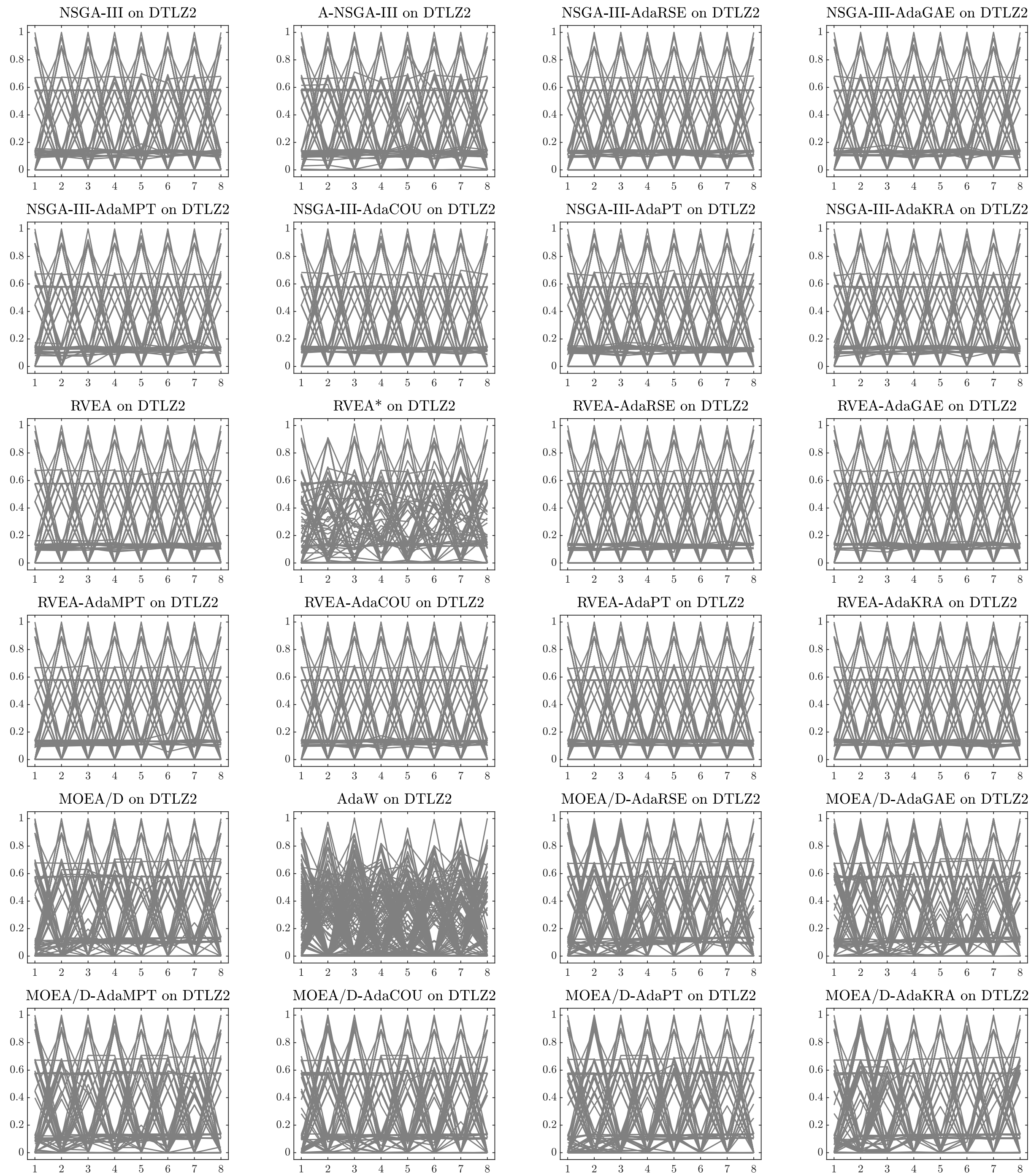

Figure 7: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2 with 8 objective functions.

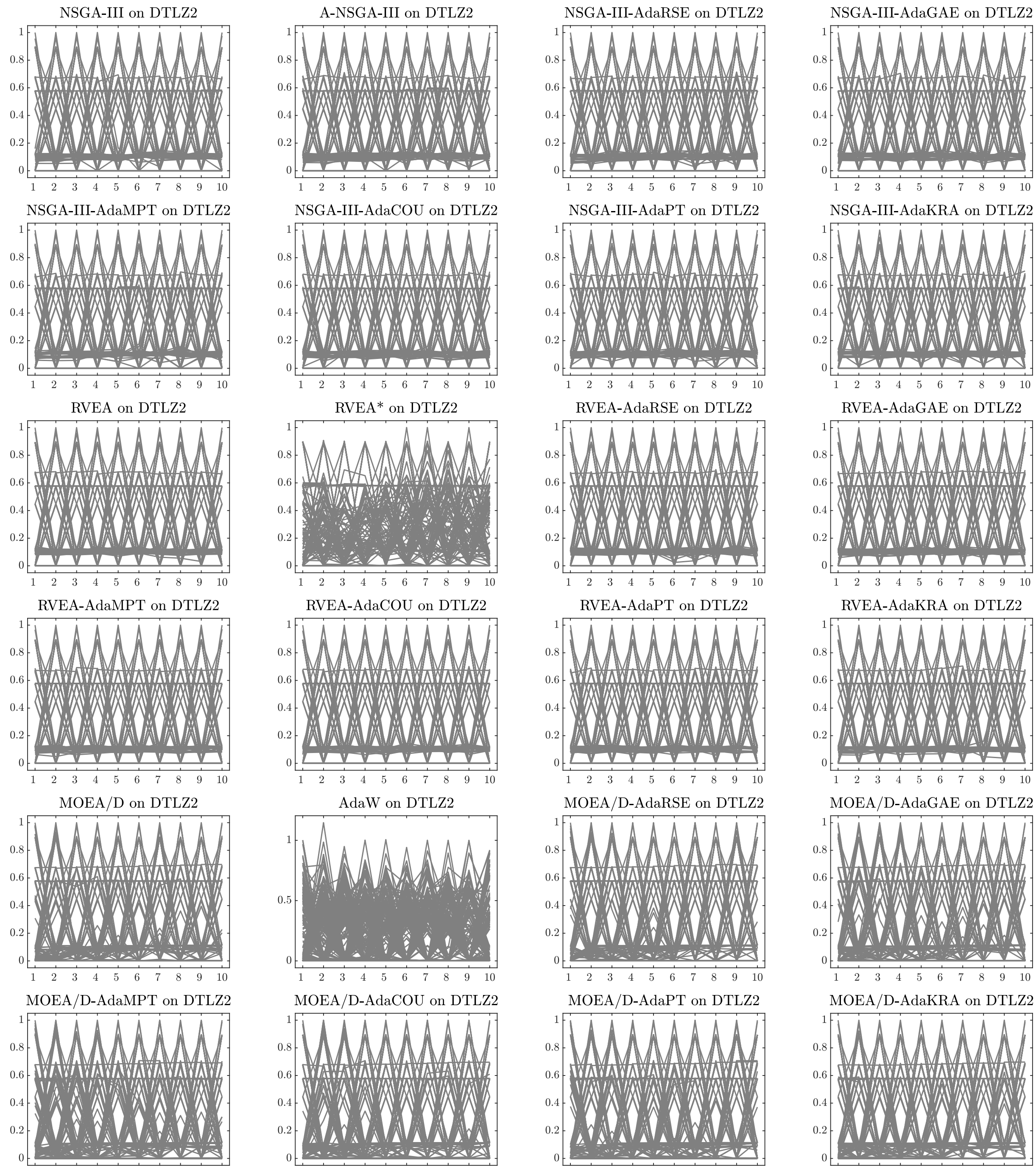

Figure 8: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2 with 10 objective functions.

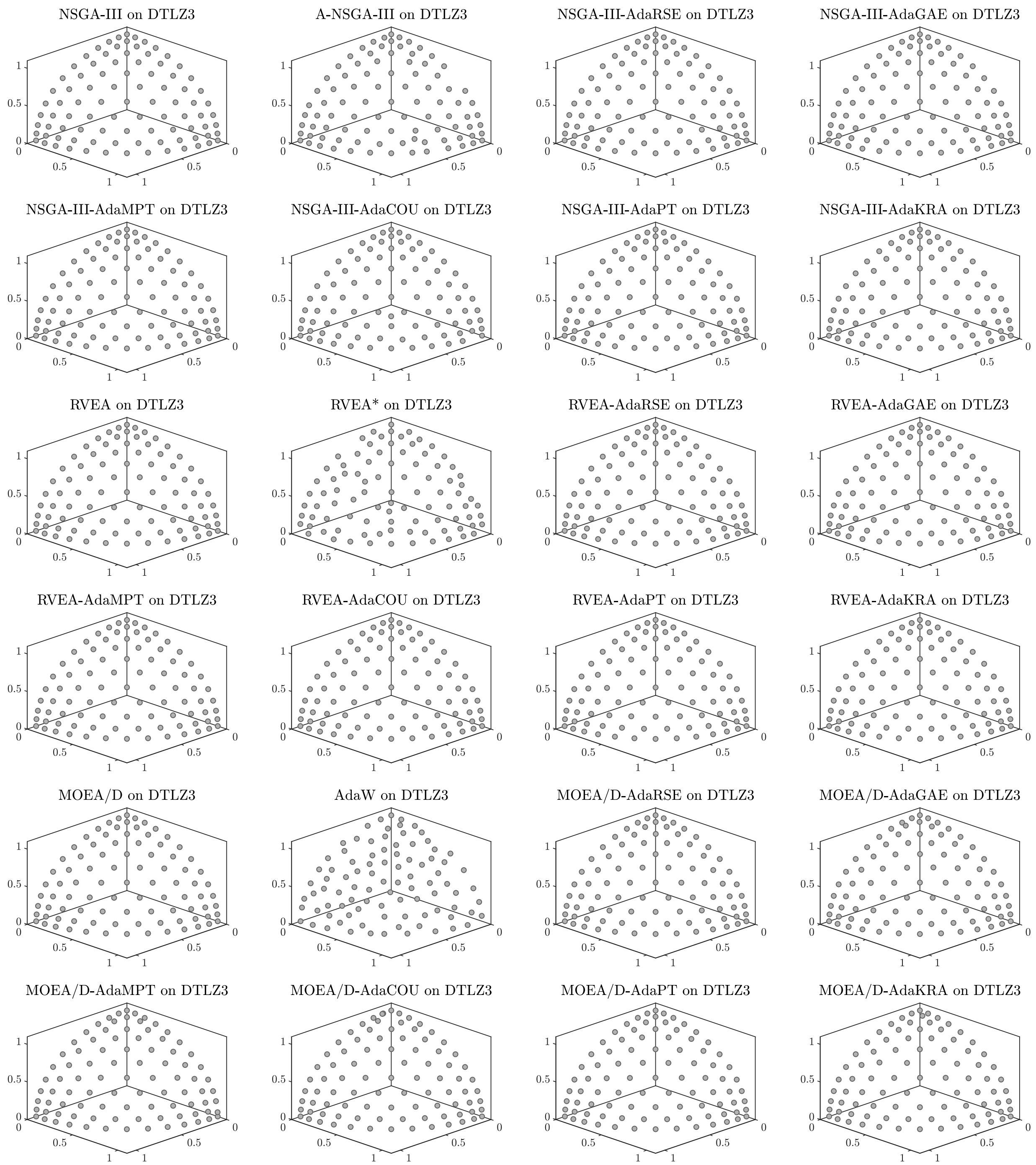

Figure 9: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3 with 3 objective functions.

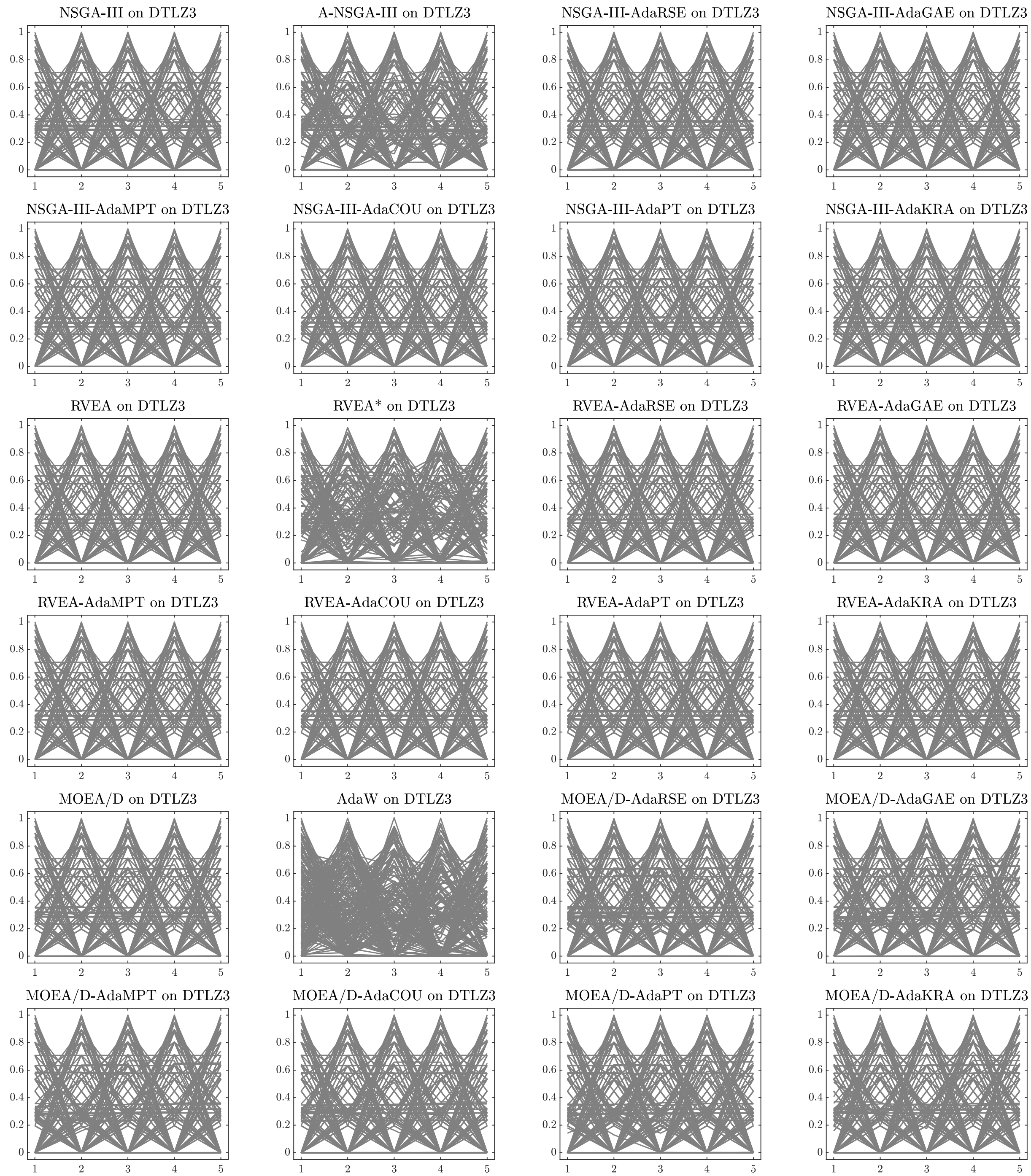

Figure 10: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3 with 5 objective functions.

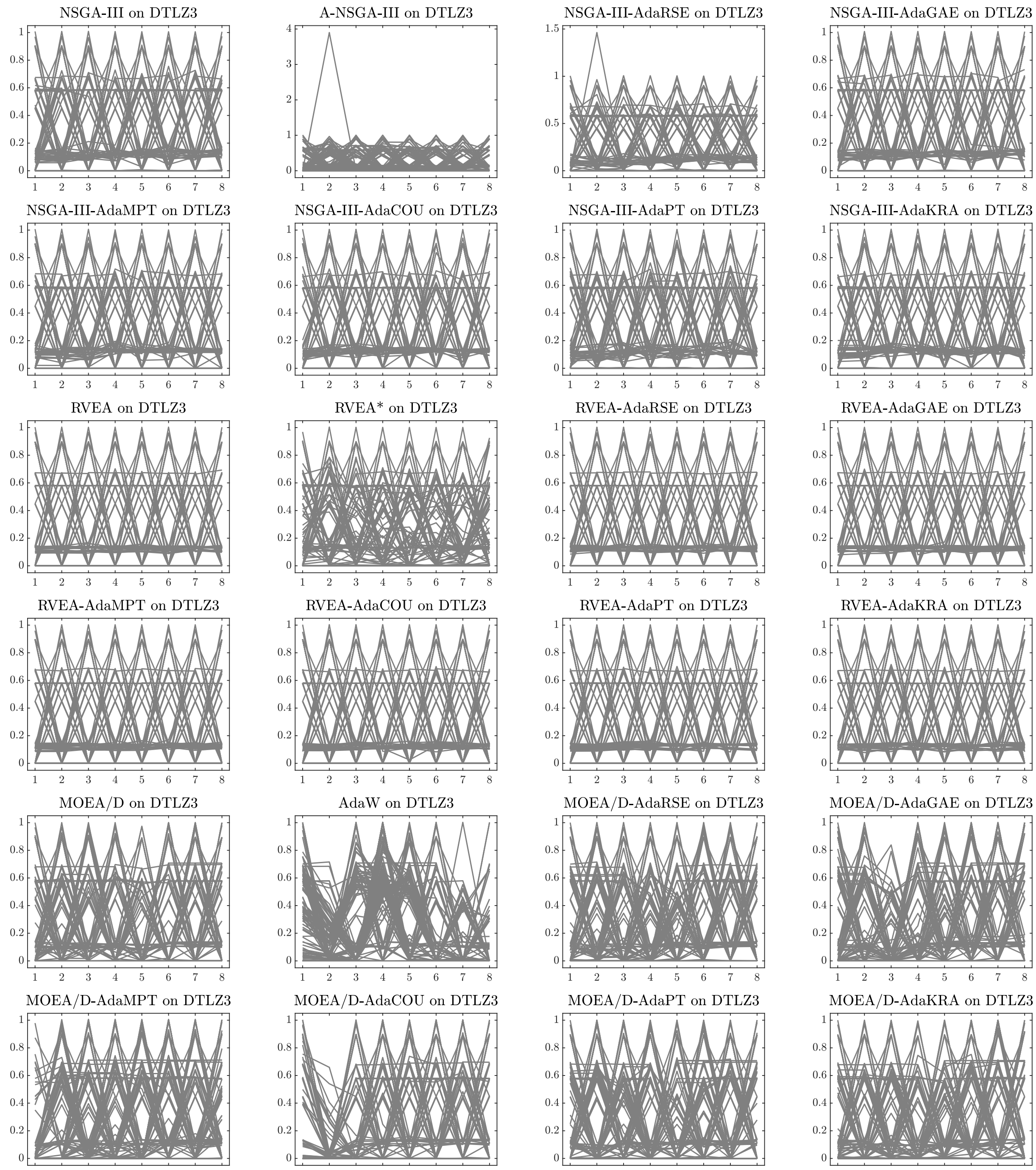

Figure 11: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3 with 8 objective functions.

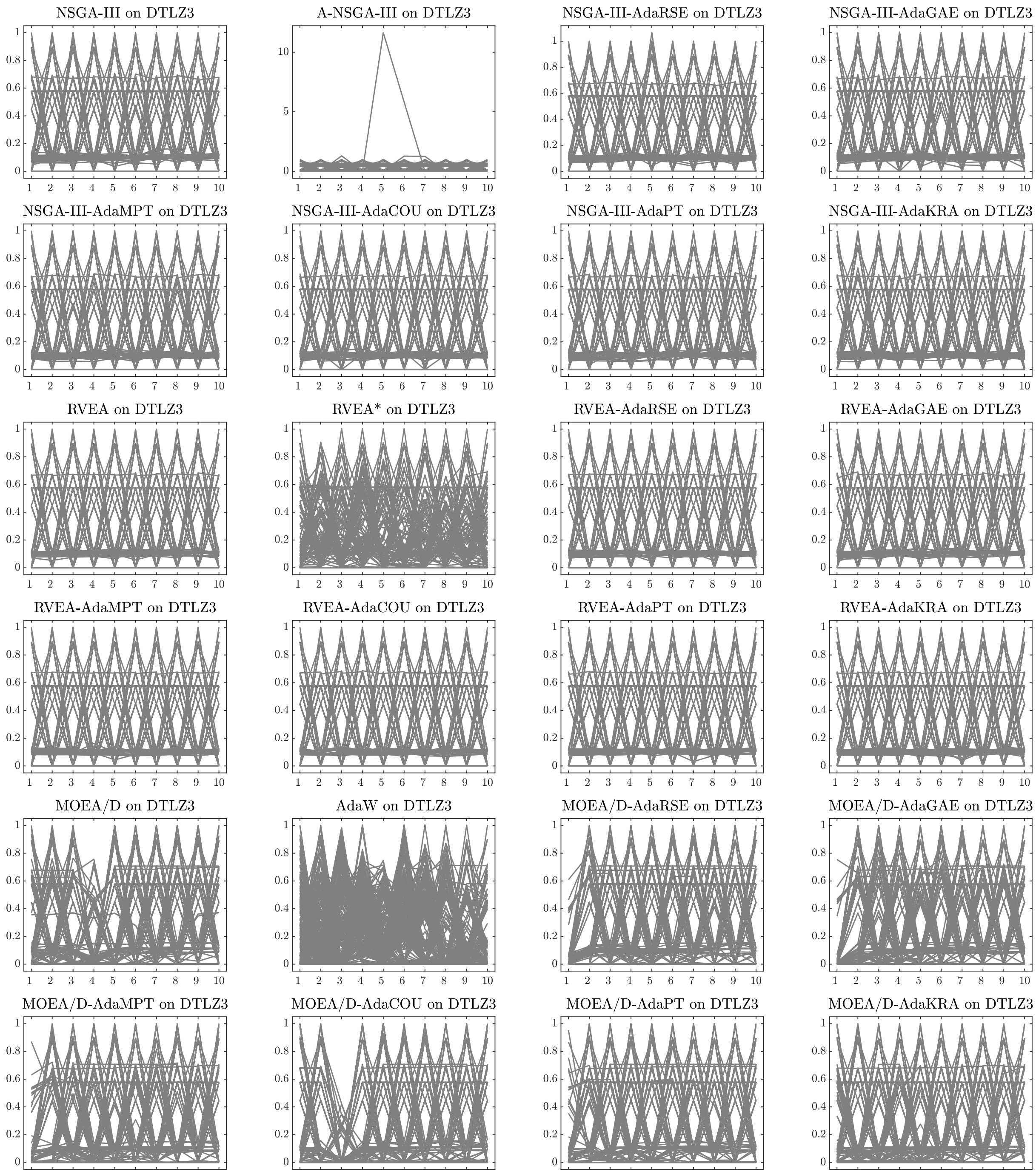

Figure 12: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3 with 10 objective functions.

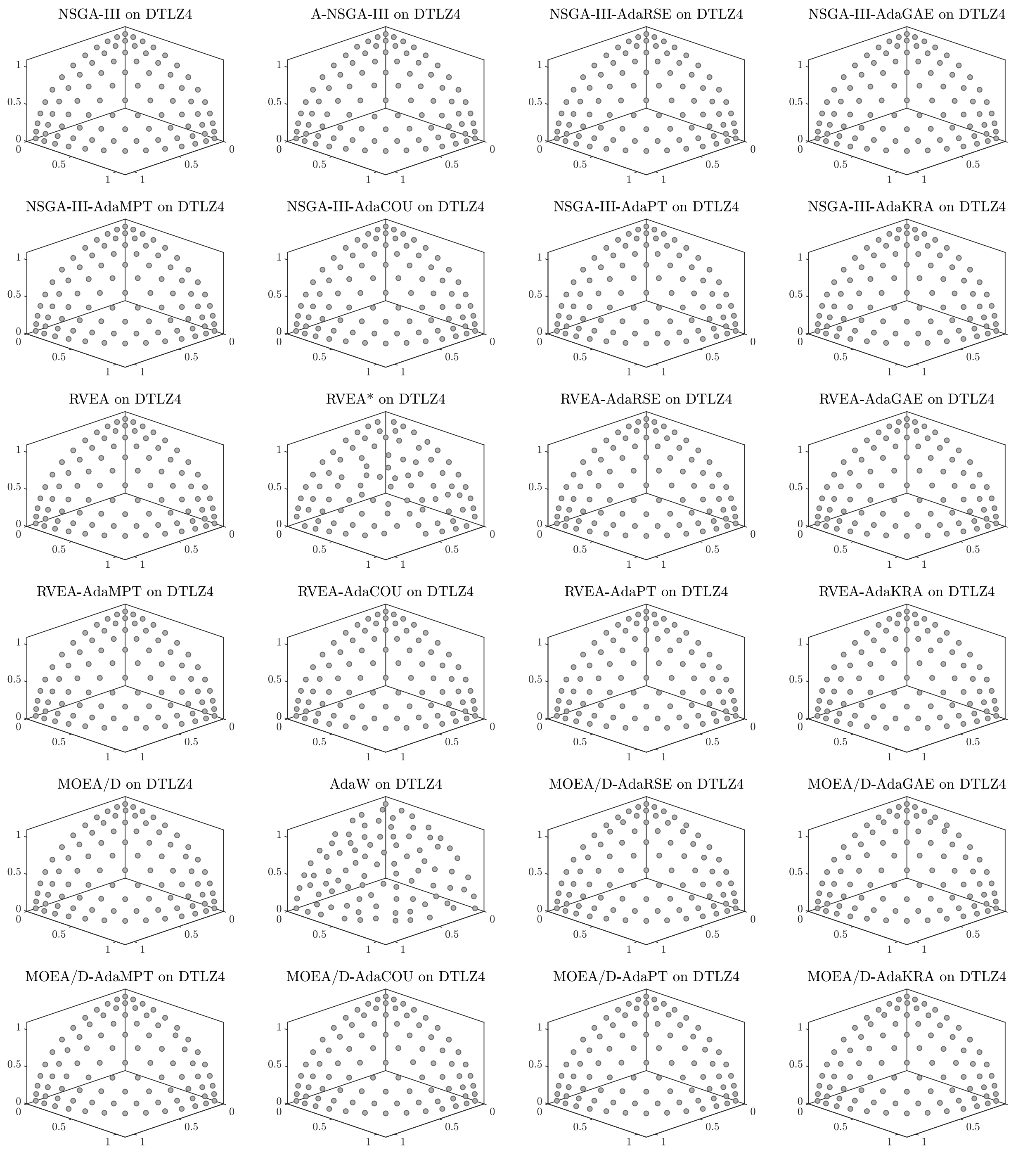

Figure 13: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4 with 3 objective functions.

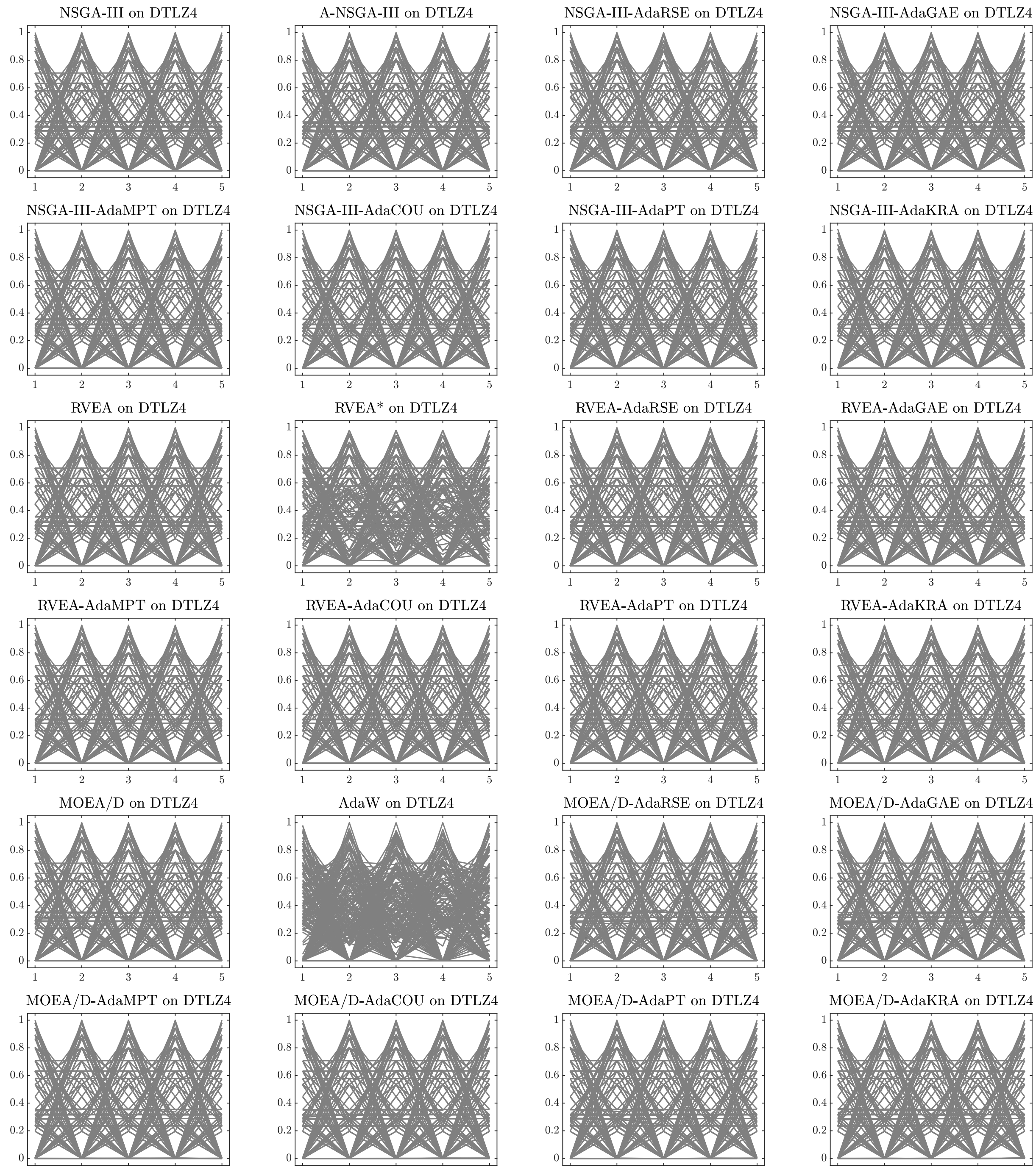

Figure 14: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4 with 5 objective functions.

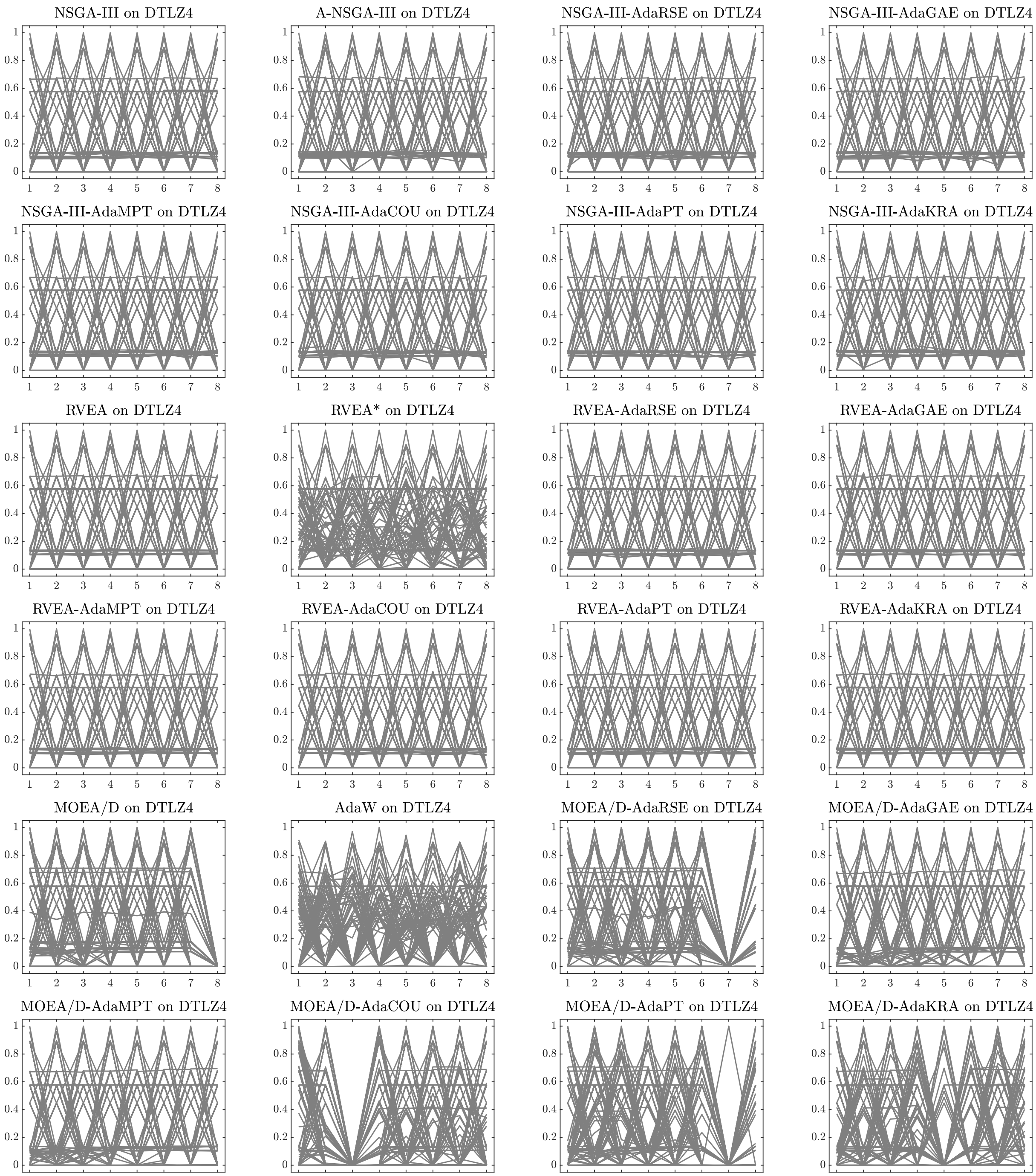

Figure 15: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4 with 8 objective functions.

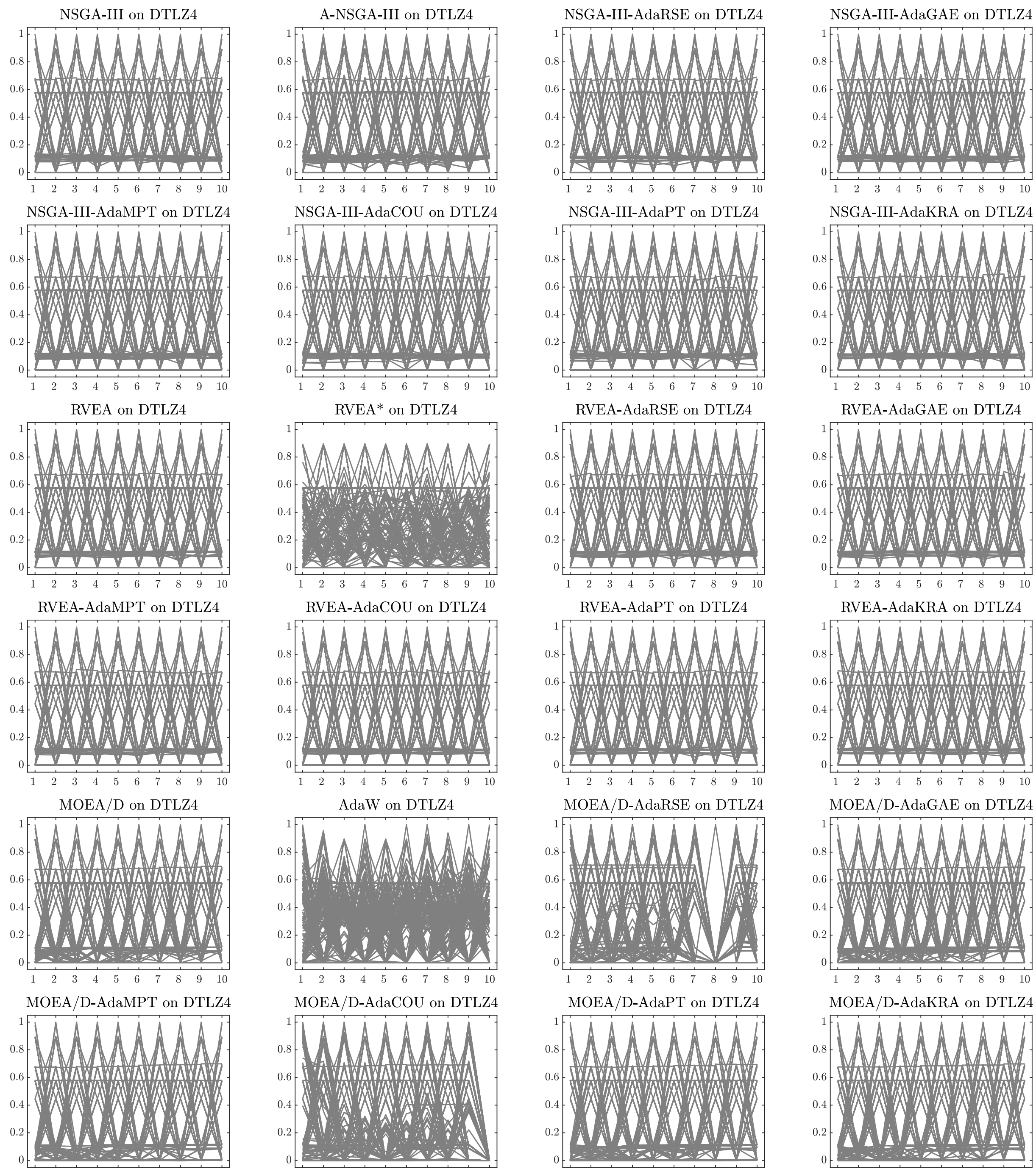

Figure 16: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4 with 10 objective functions.

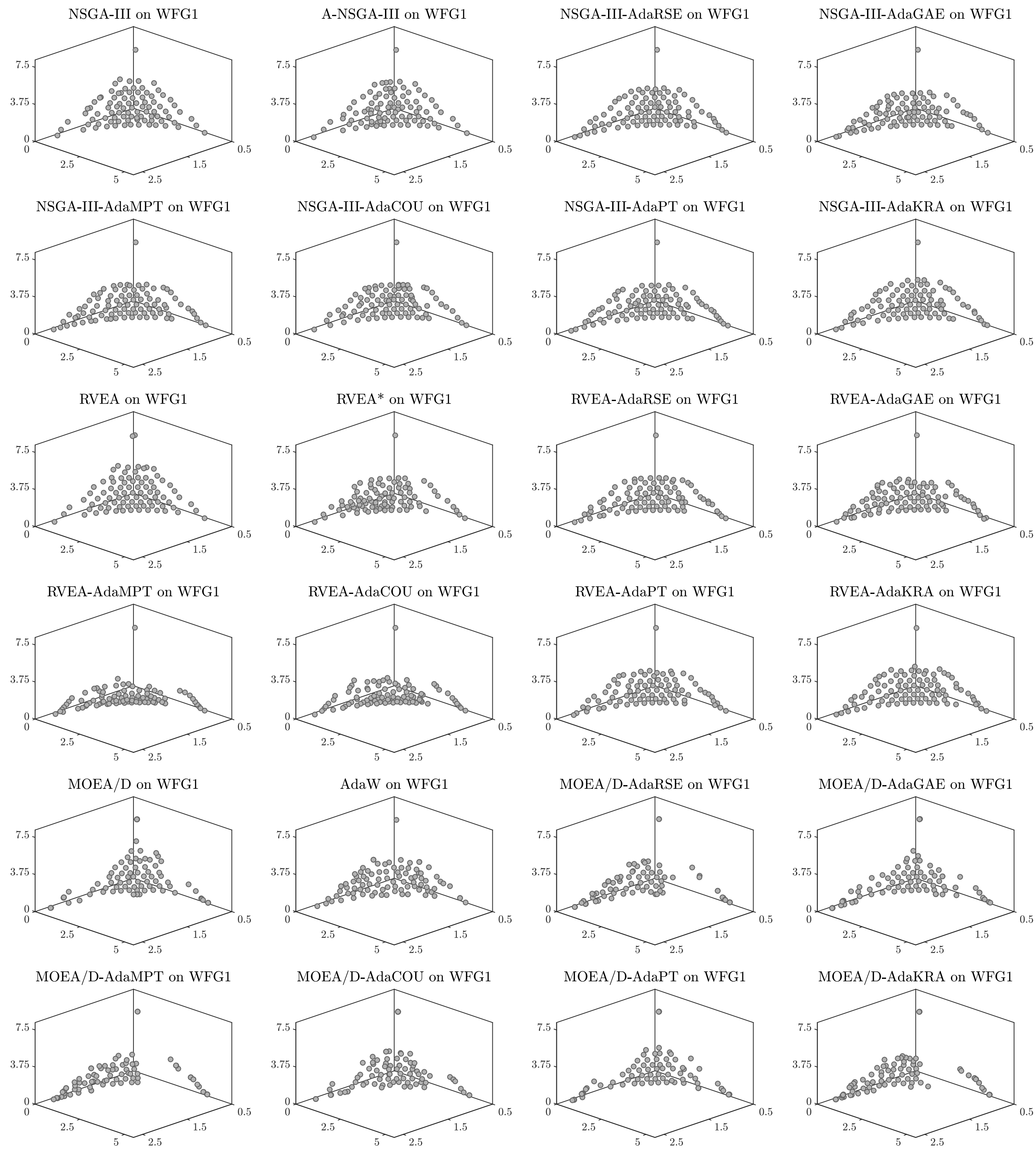

Figure 17: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1 with 3 objective functions.

Figure 18: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1 with 5 objective functions.

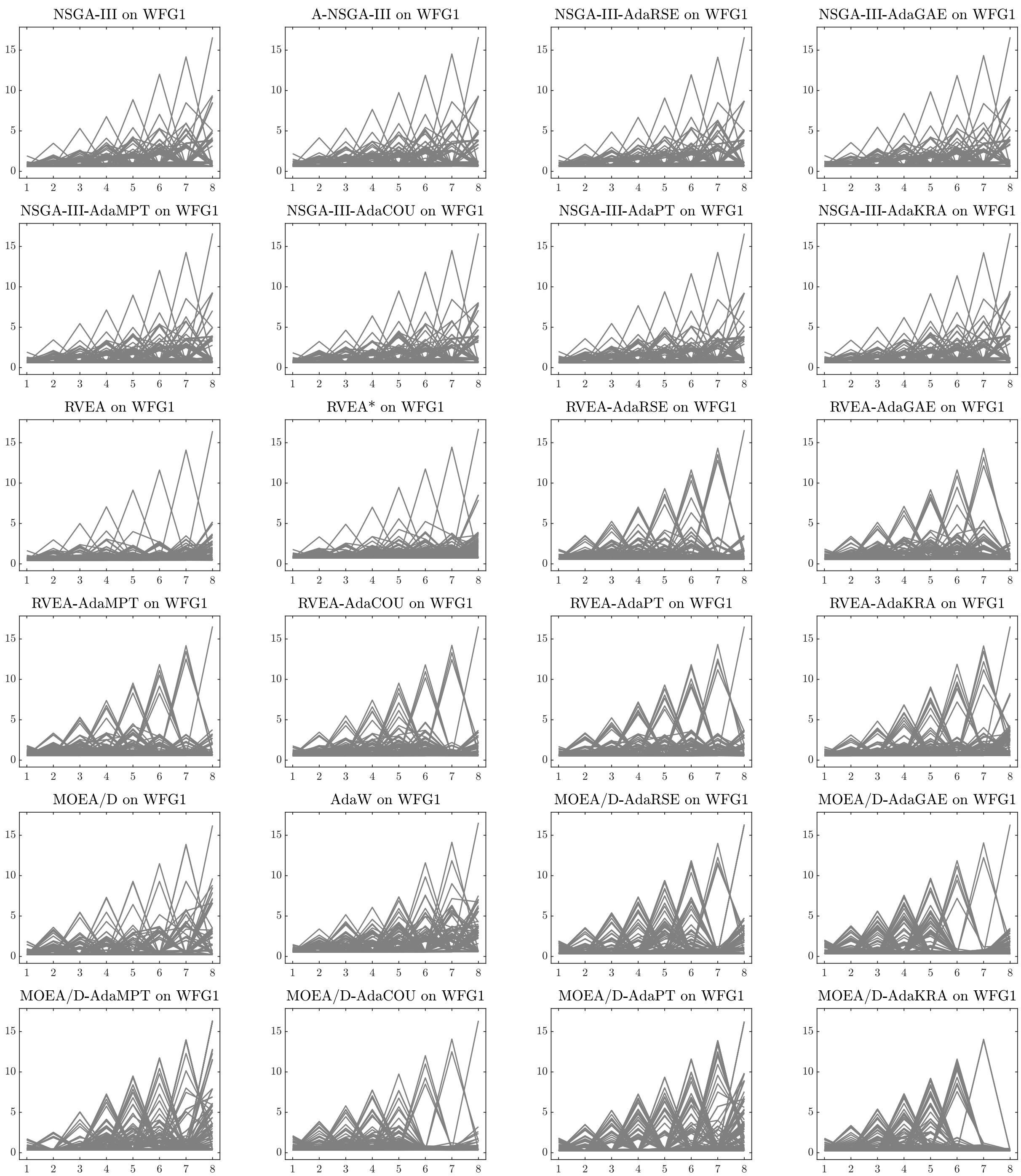

Figure 19: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1 with 8 objective functions.

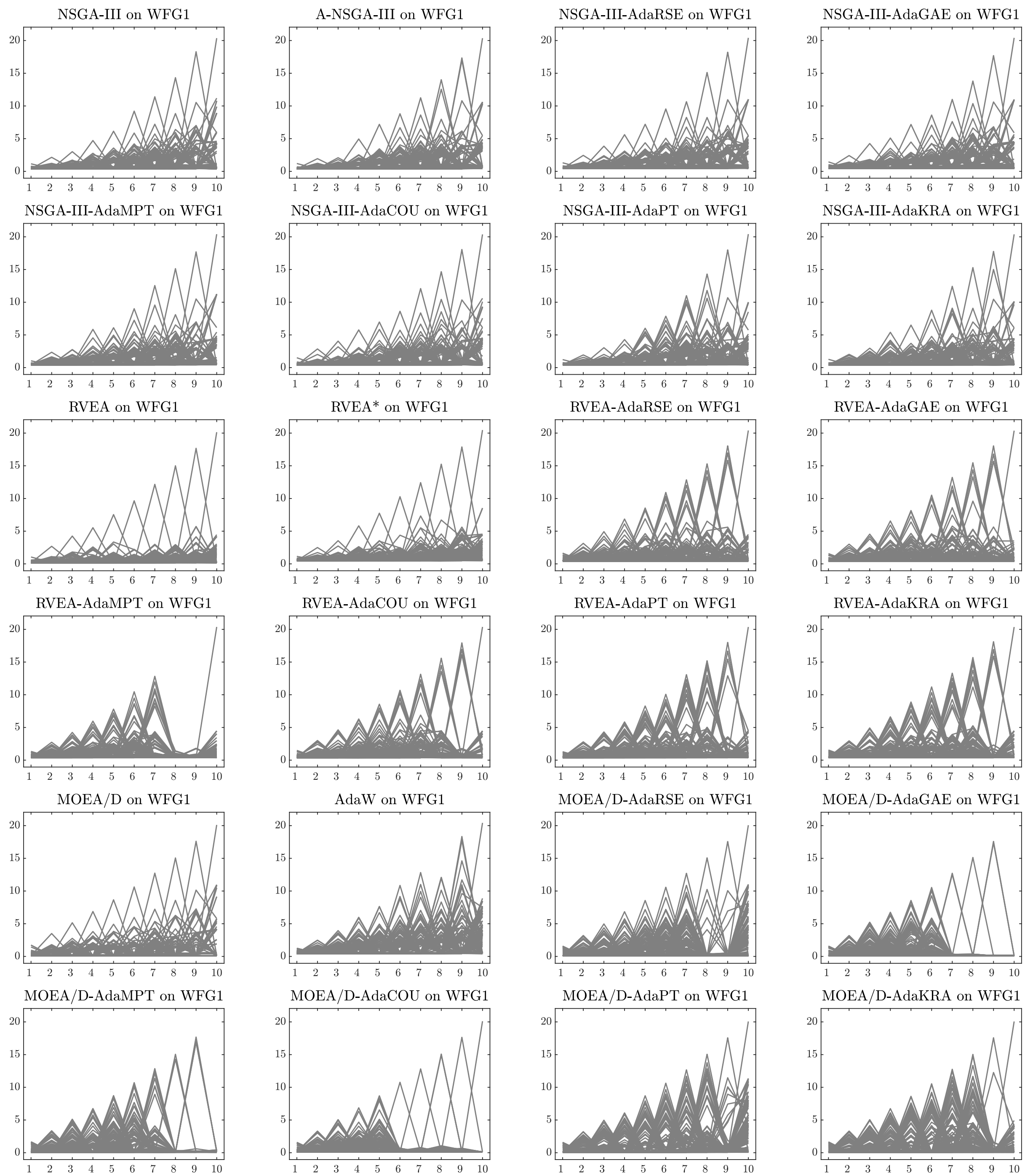

Figure 20: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1 with 10 objective functions.

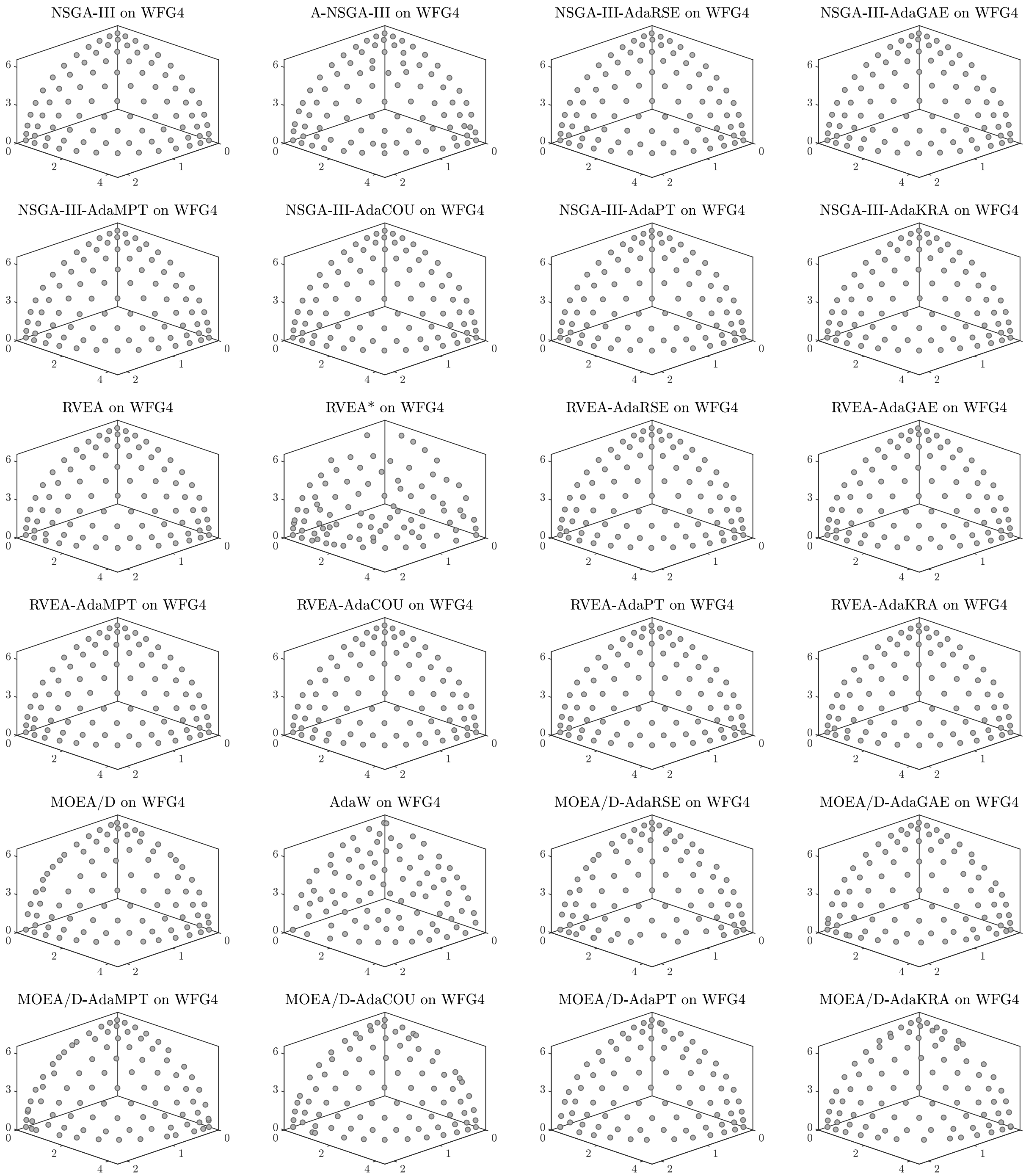

Figure 21: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 3 objective functions.

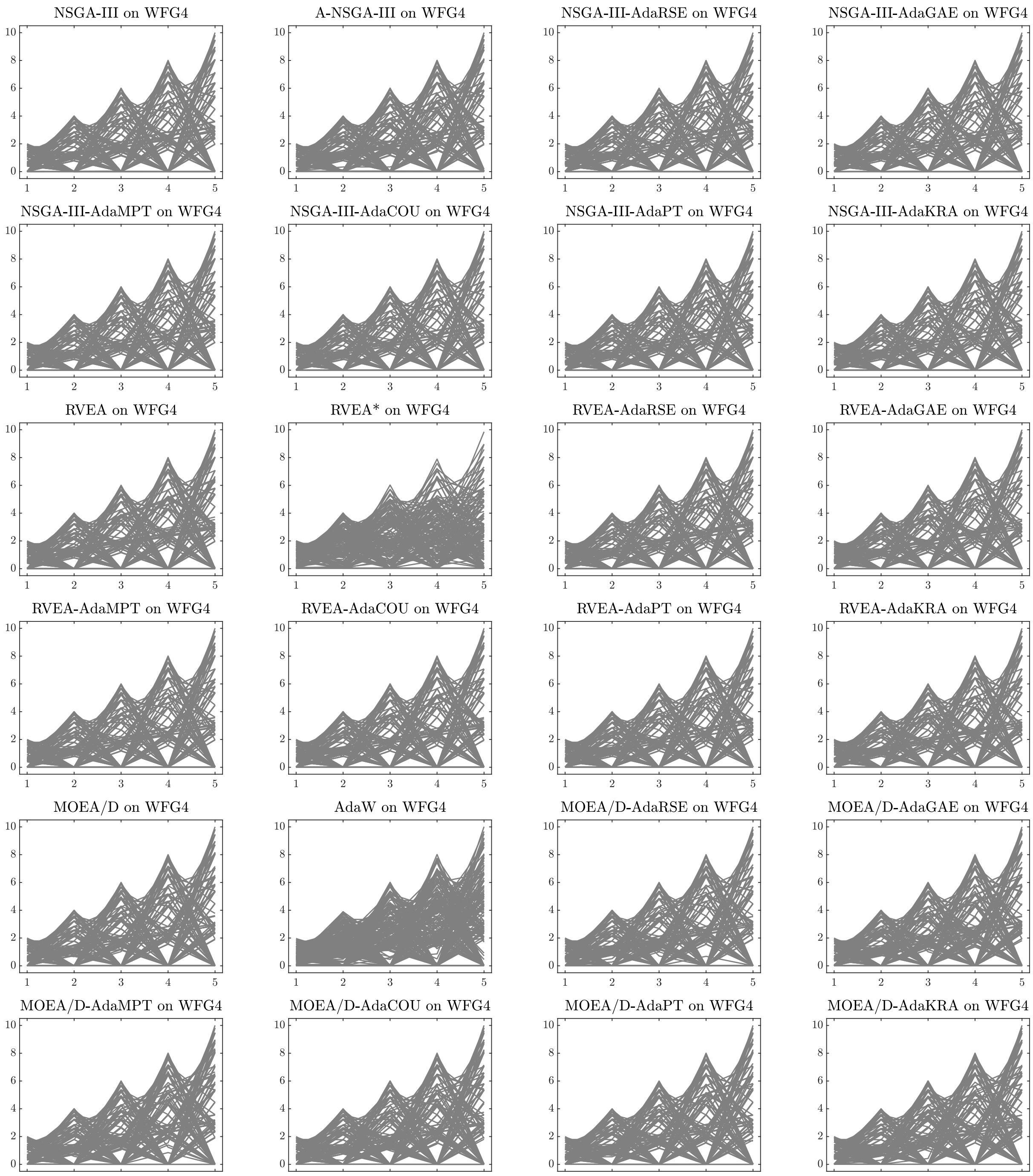

Figure 22: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 5 objective functions.

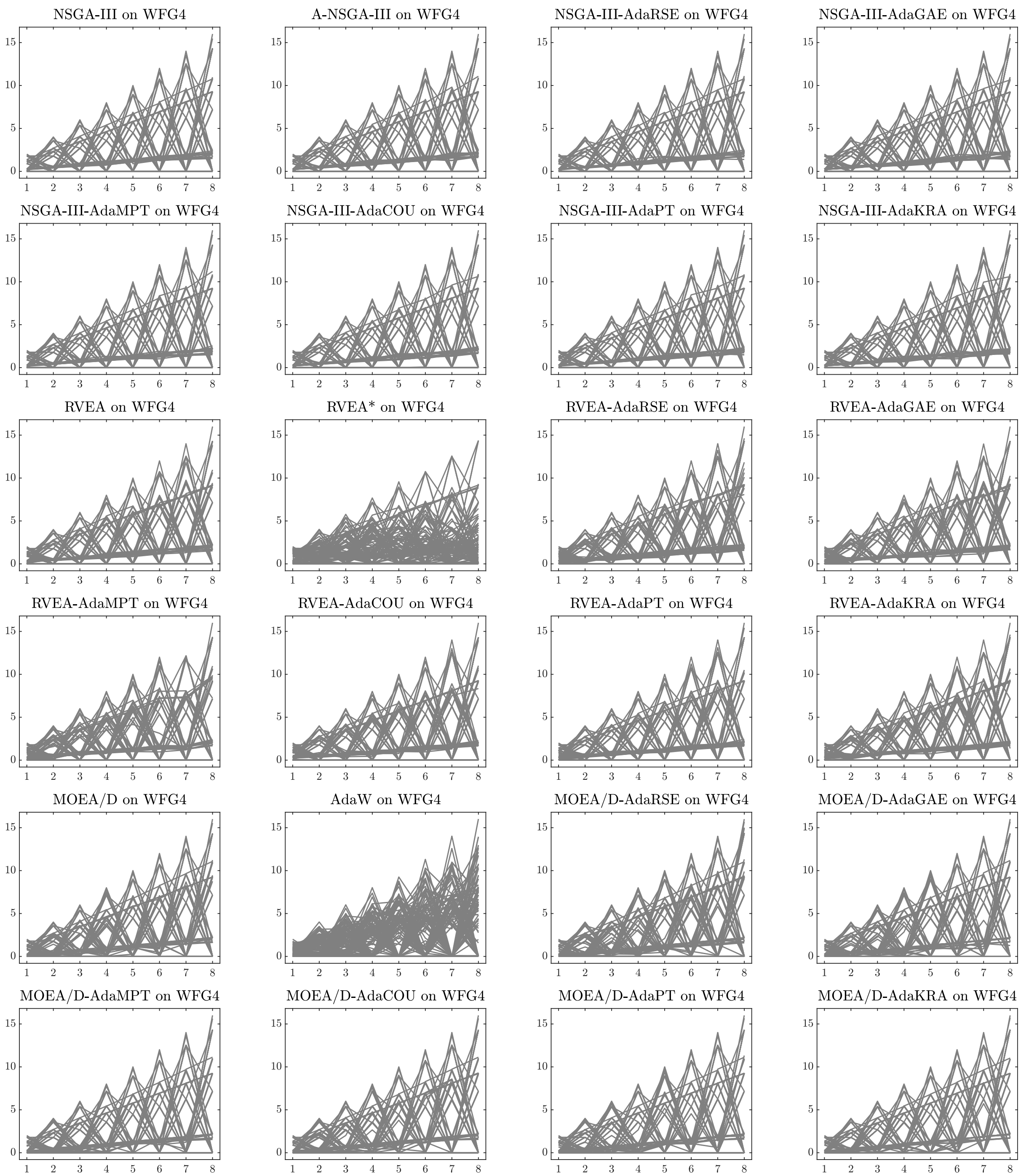

Figure 23: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 8 objective functions.

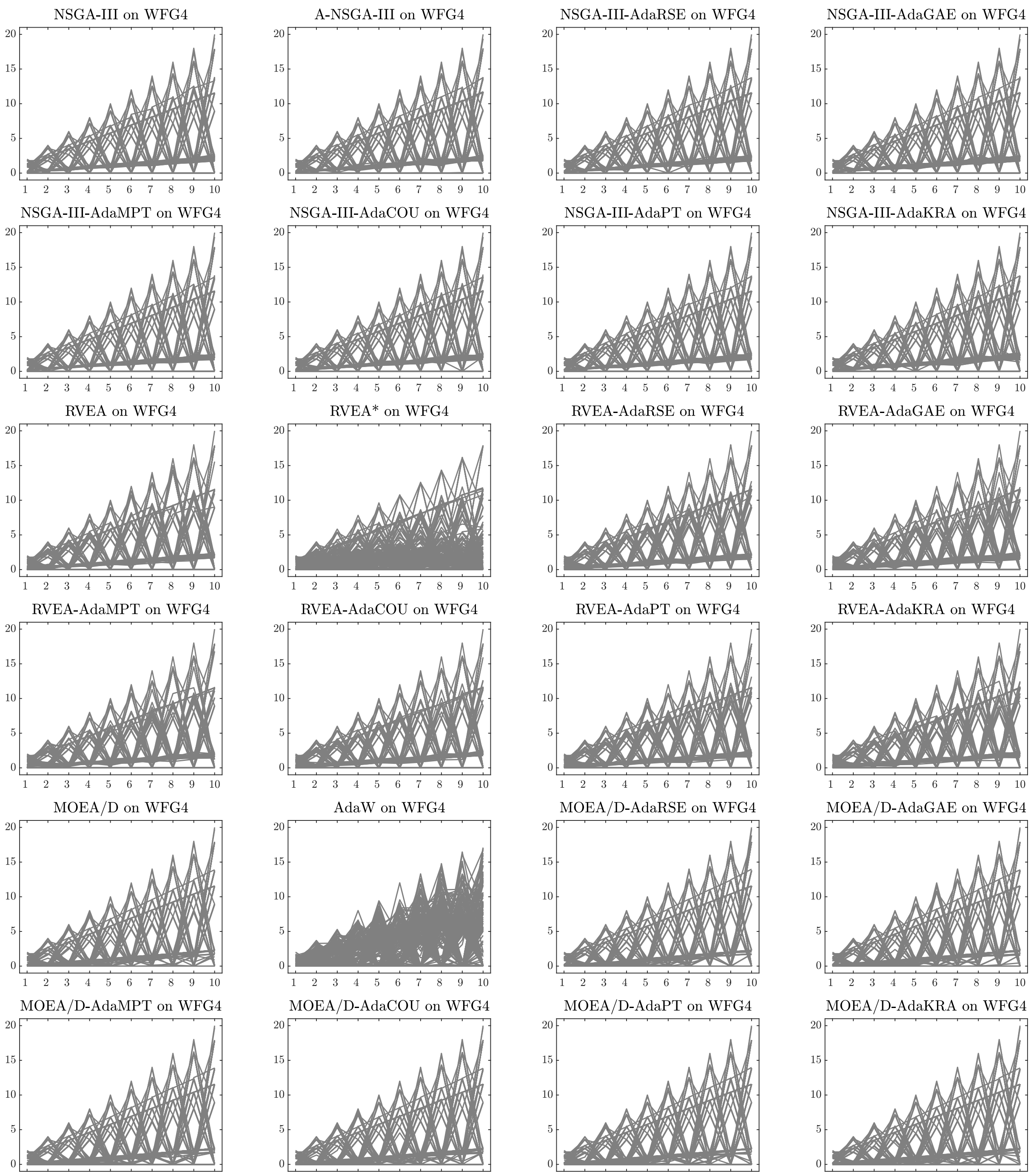

Figure 24: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 10 objective functions.

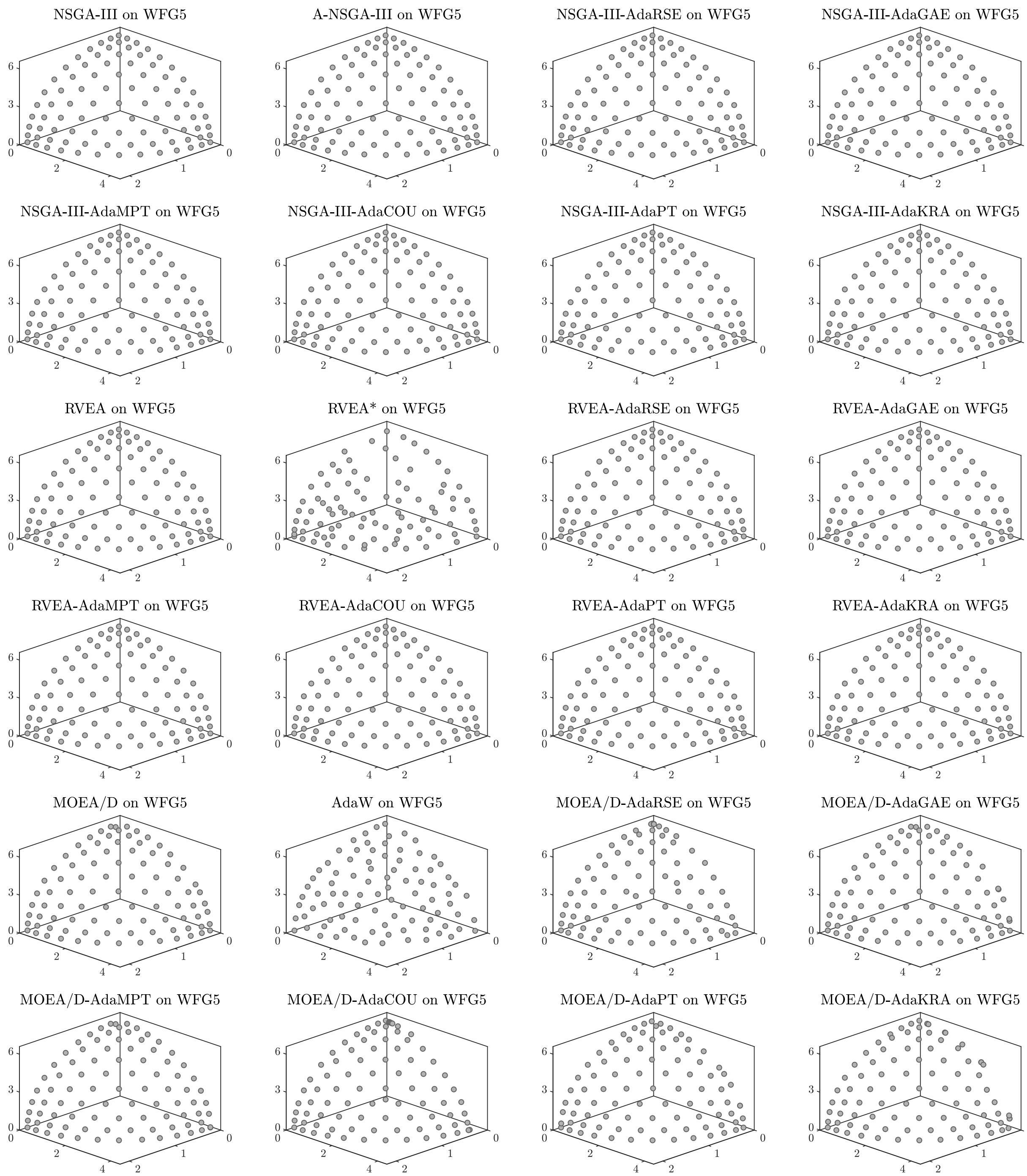

Figure 25: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5 with 3 objective functions.

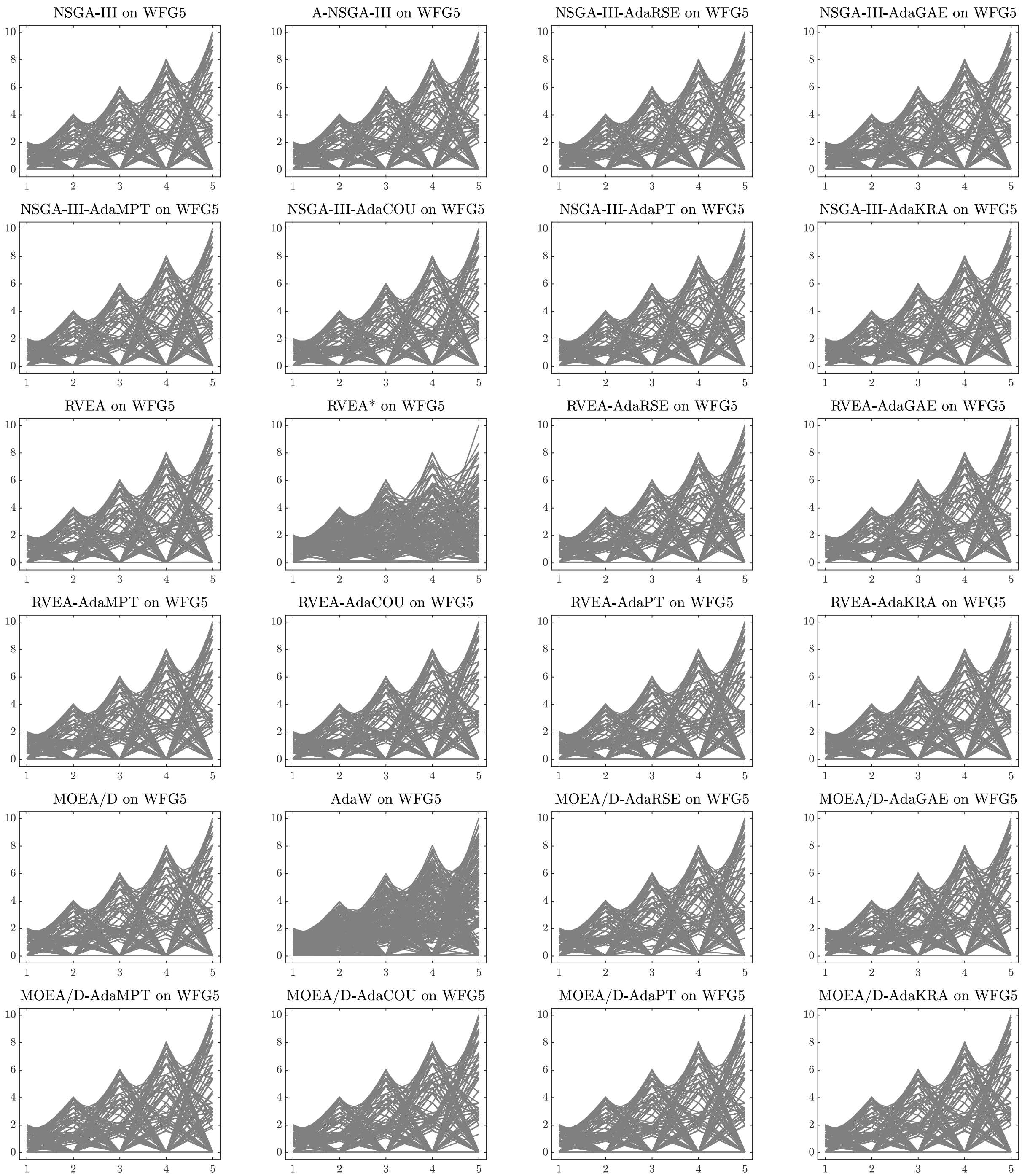

Figure 26: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5 with 5 objective functions.

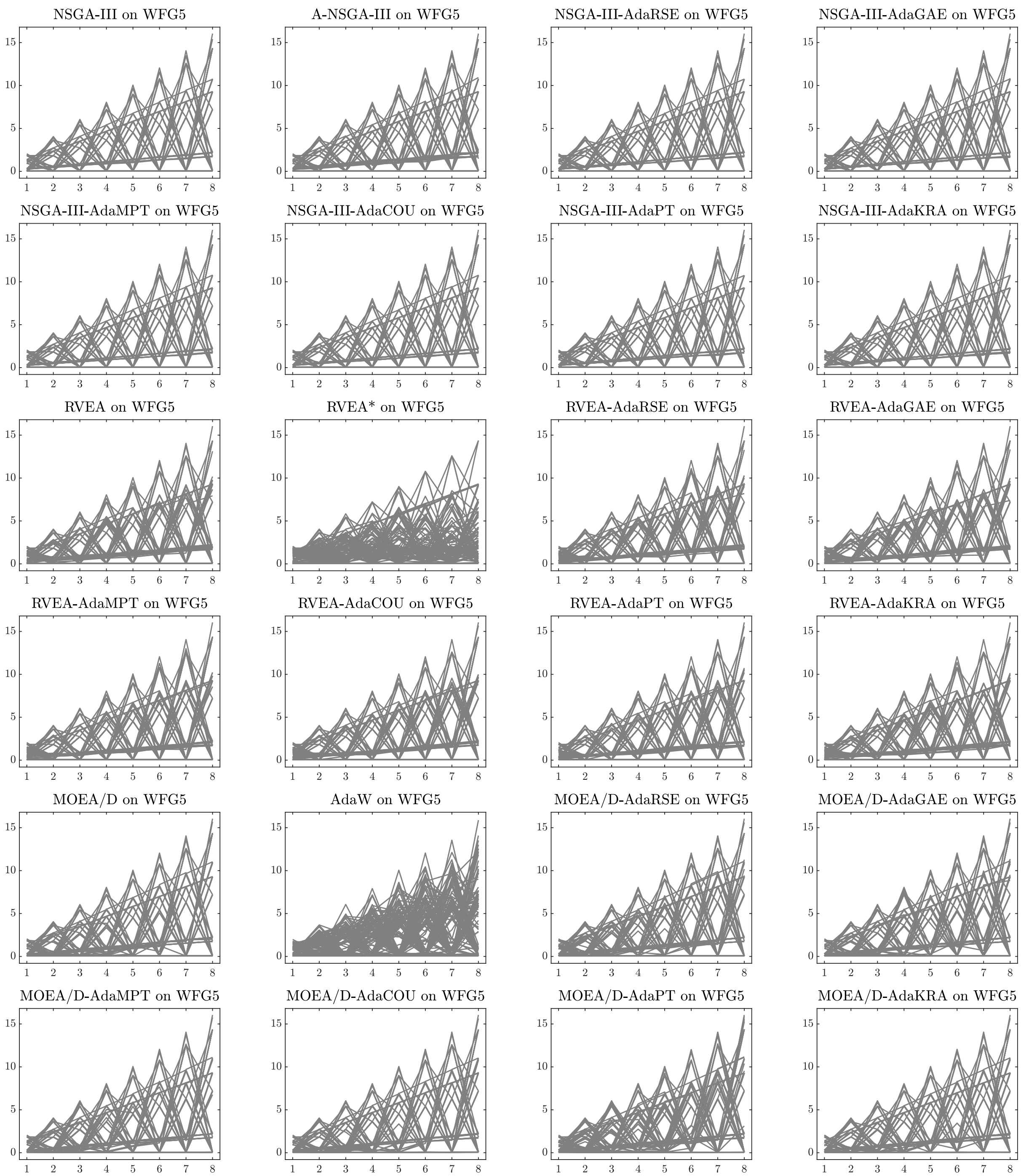

Figure 27: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5 with 8 objective functions.

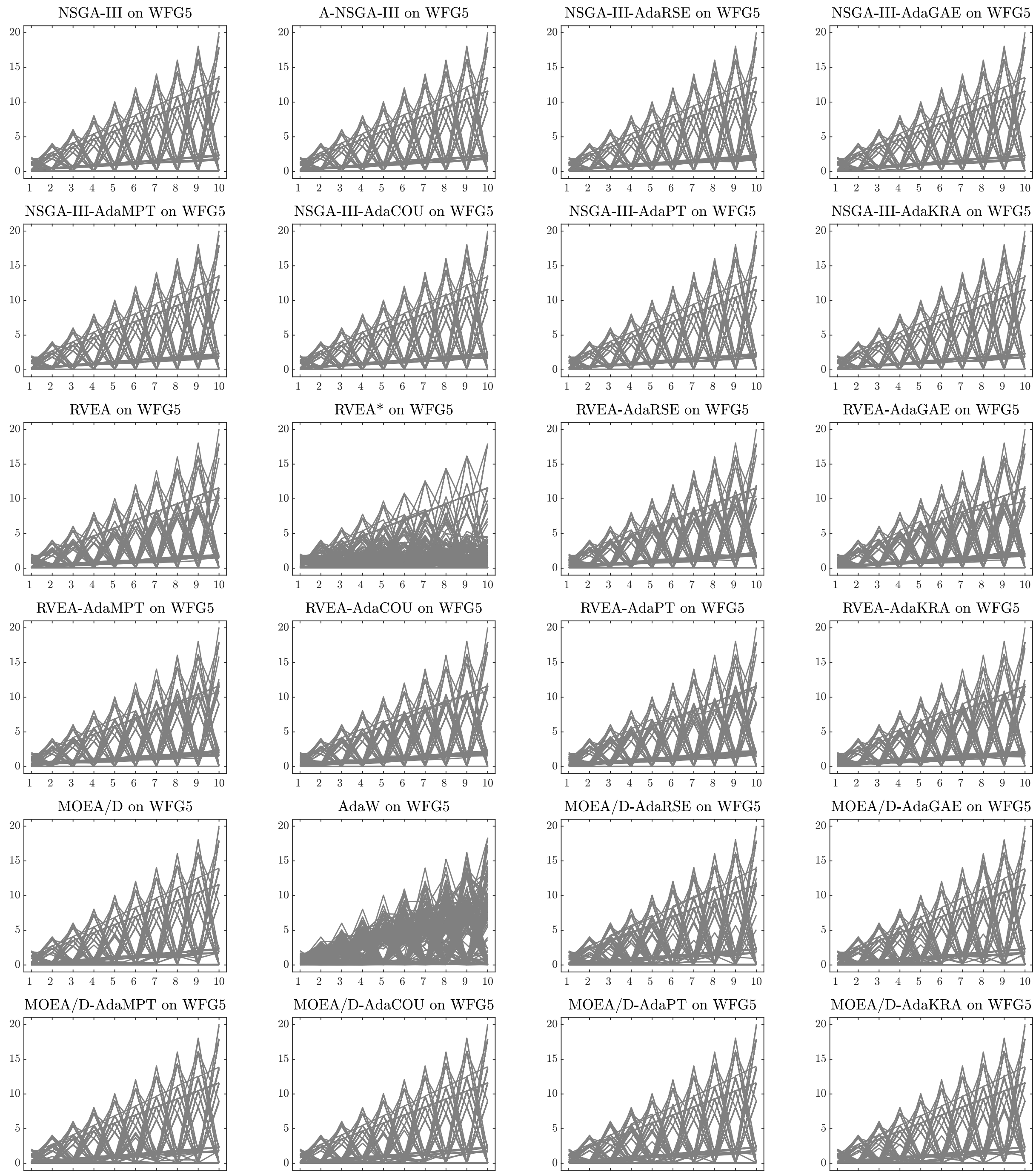

Figure 28: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5 with 10 objective functions.

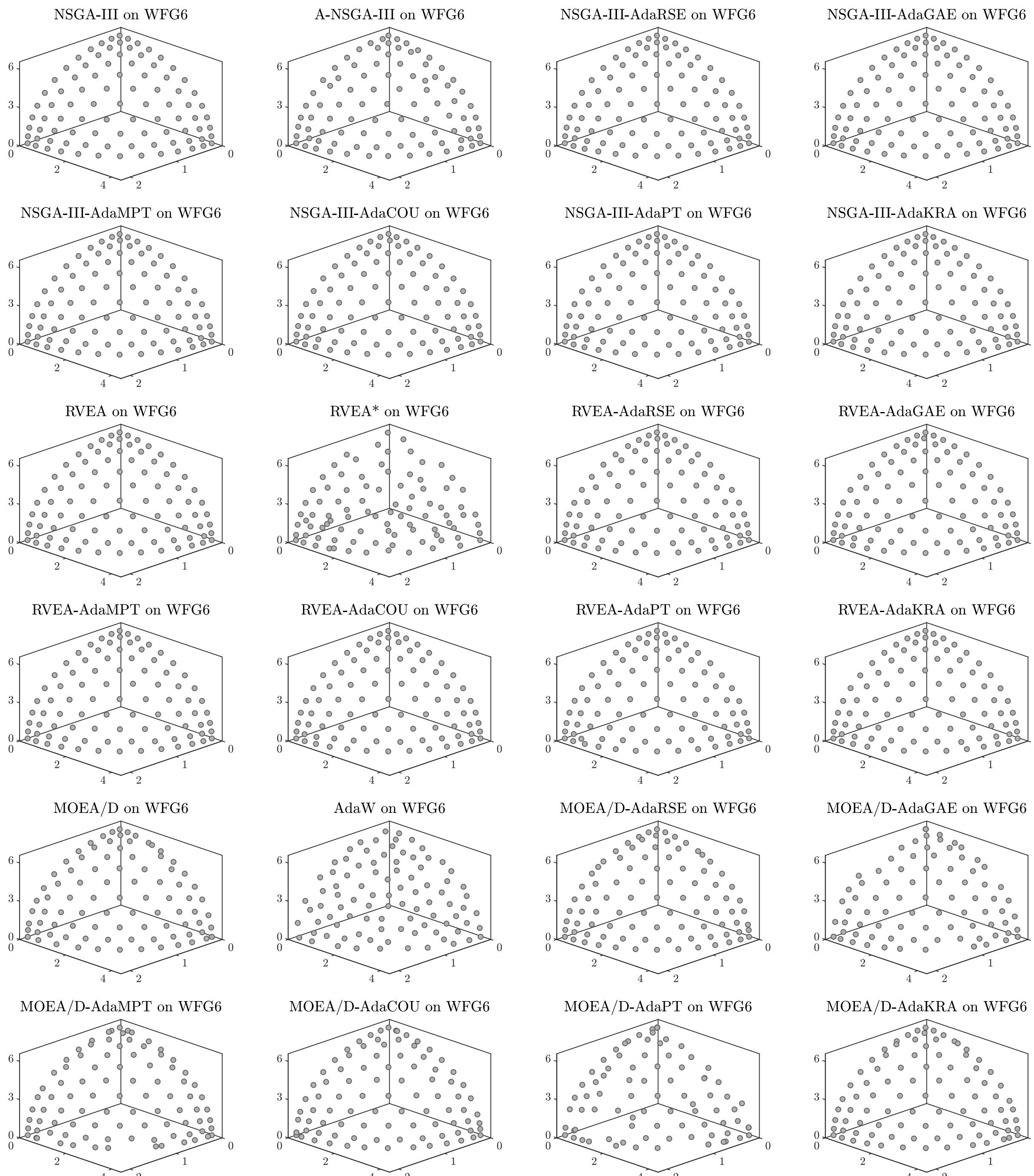

Figure 29: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6 with 3 objective functions.

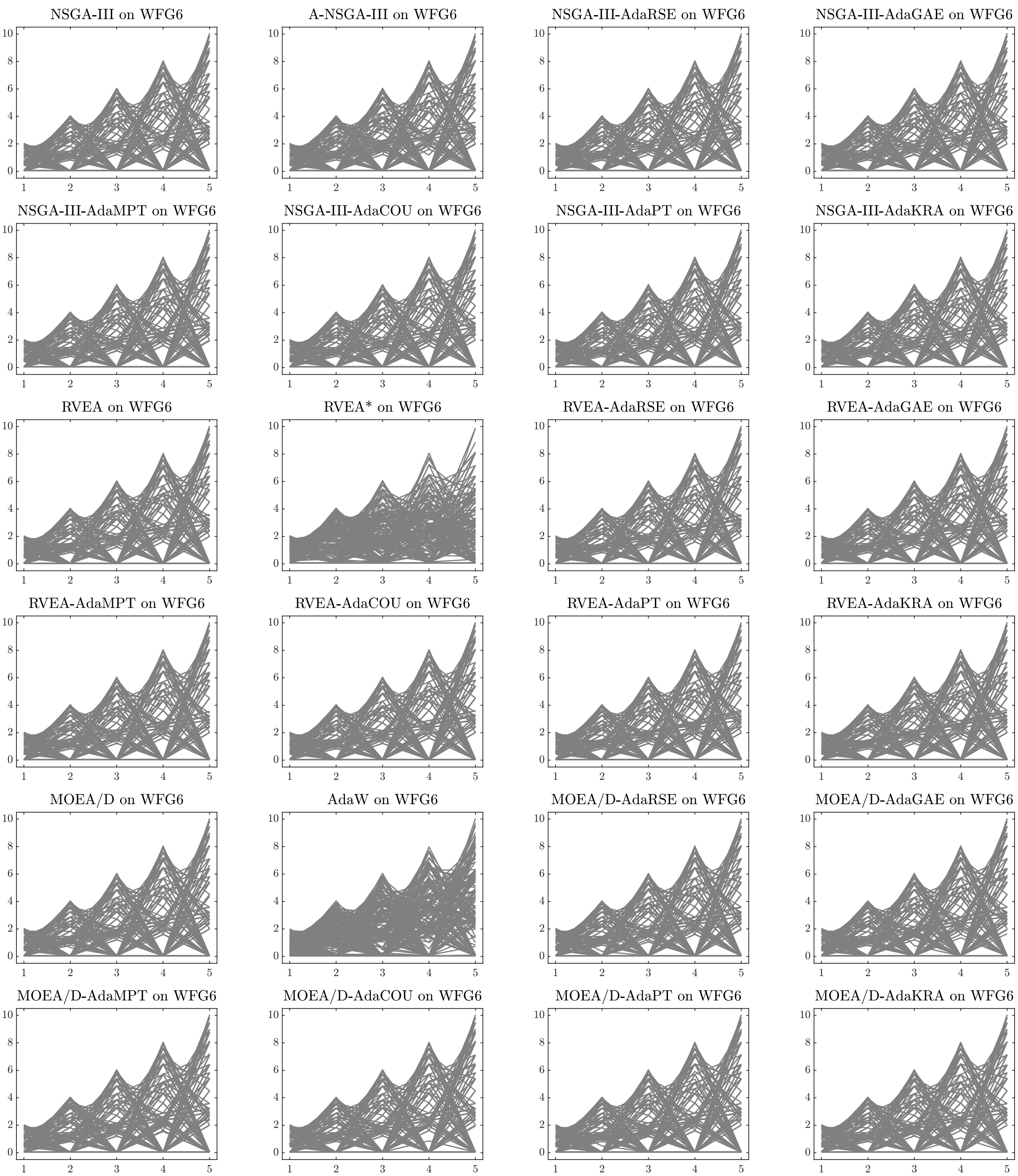

Figure 30: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6 with 5 objective functions.

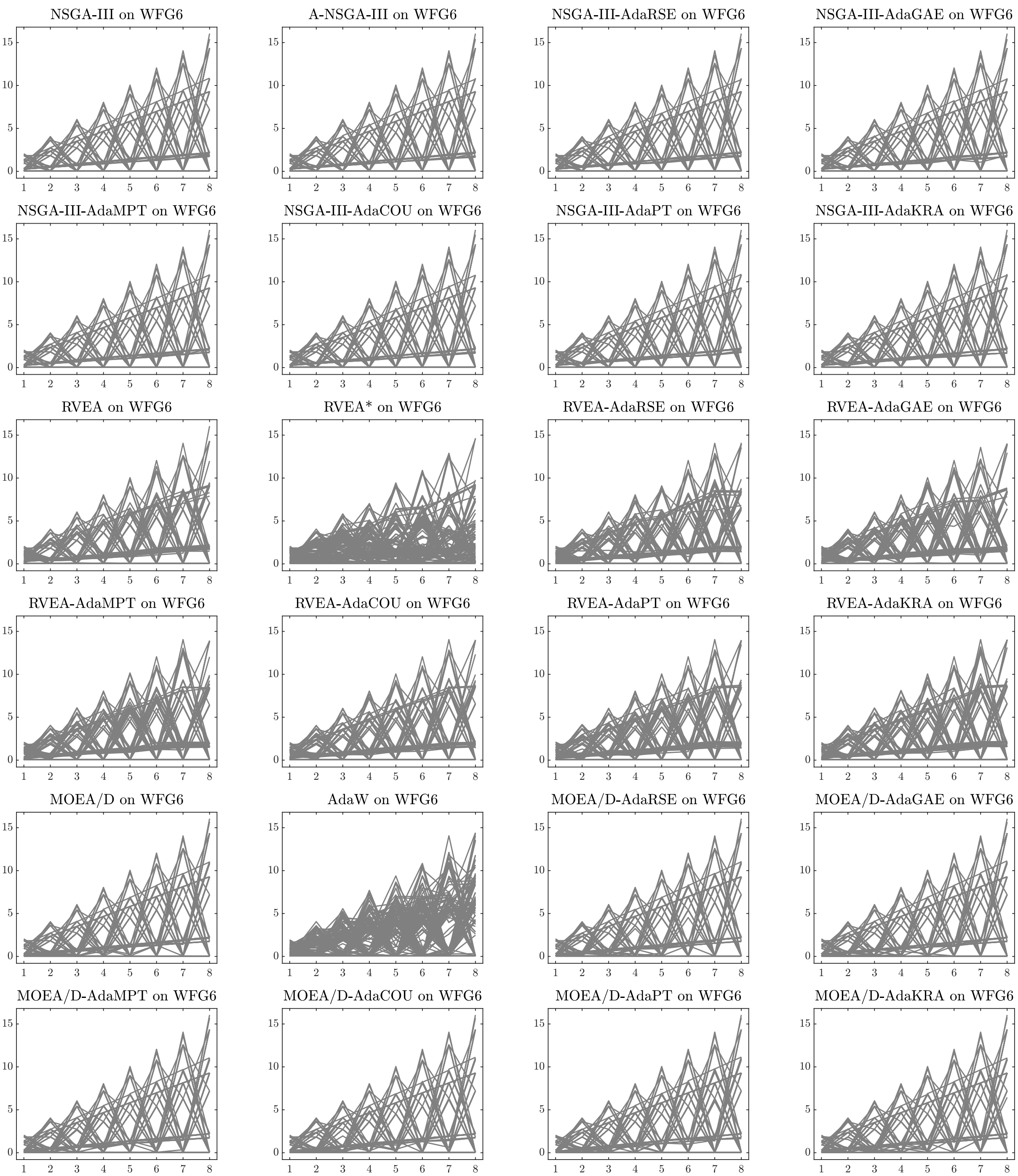

Figure 31: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6 with 8 objective functions.

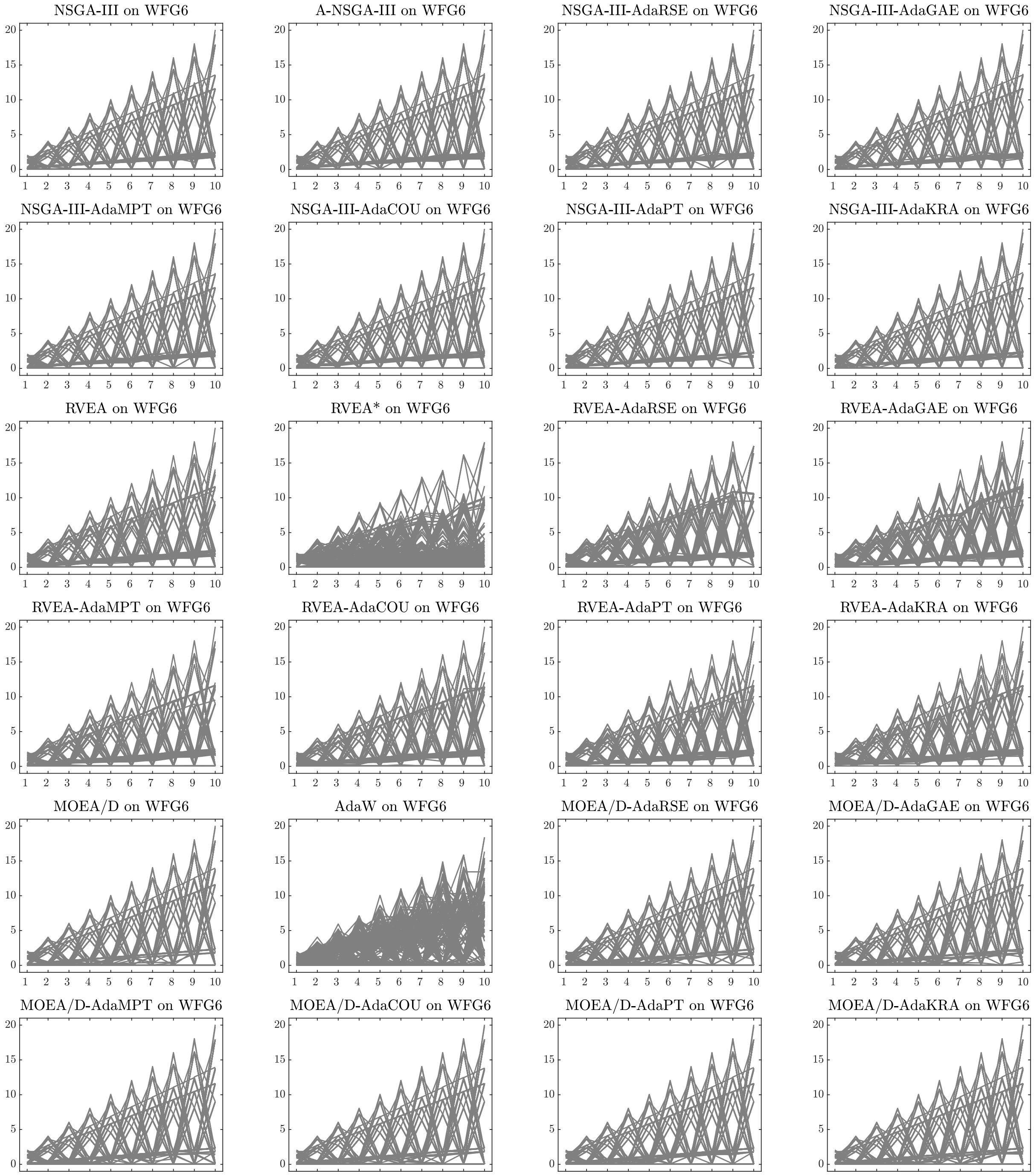

Figure 32: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6 with 10 objective functions.

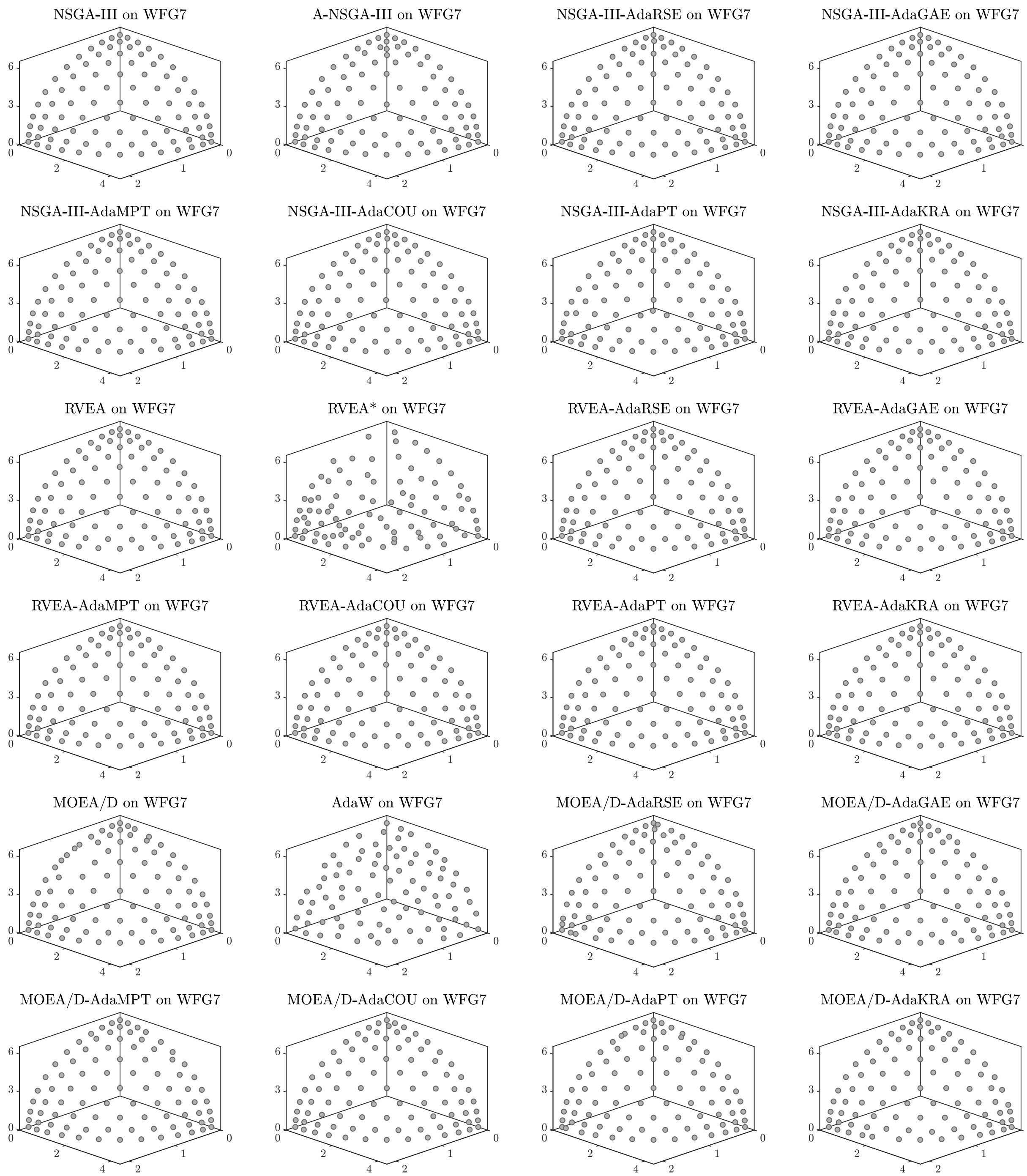

Figure 33: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7 with 3 objective functions.

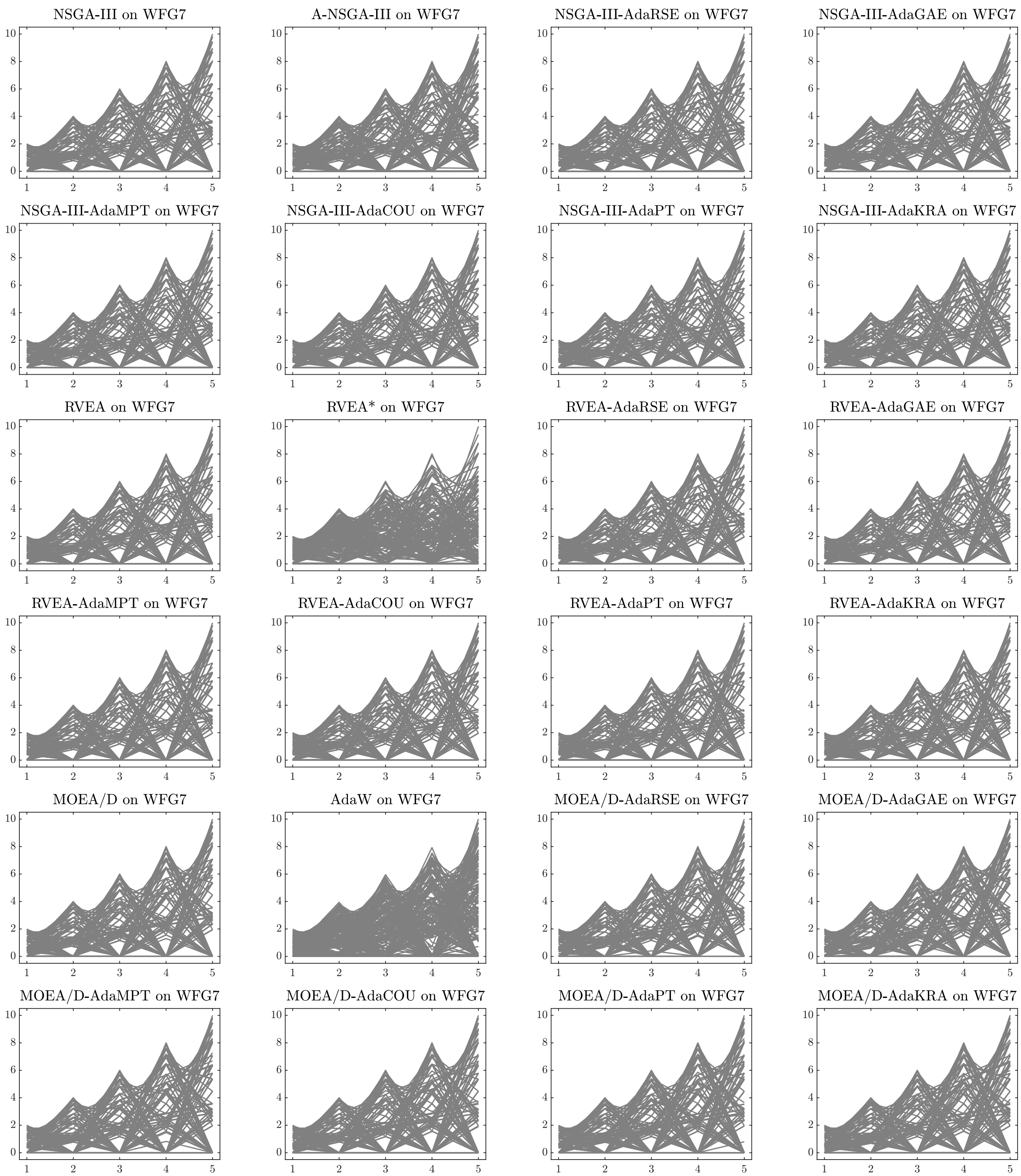

Figure 34: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7 with 5 objective functions.

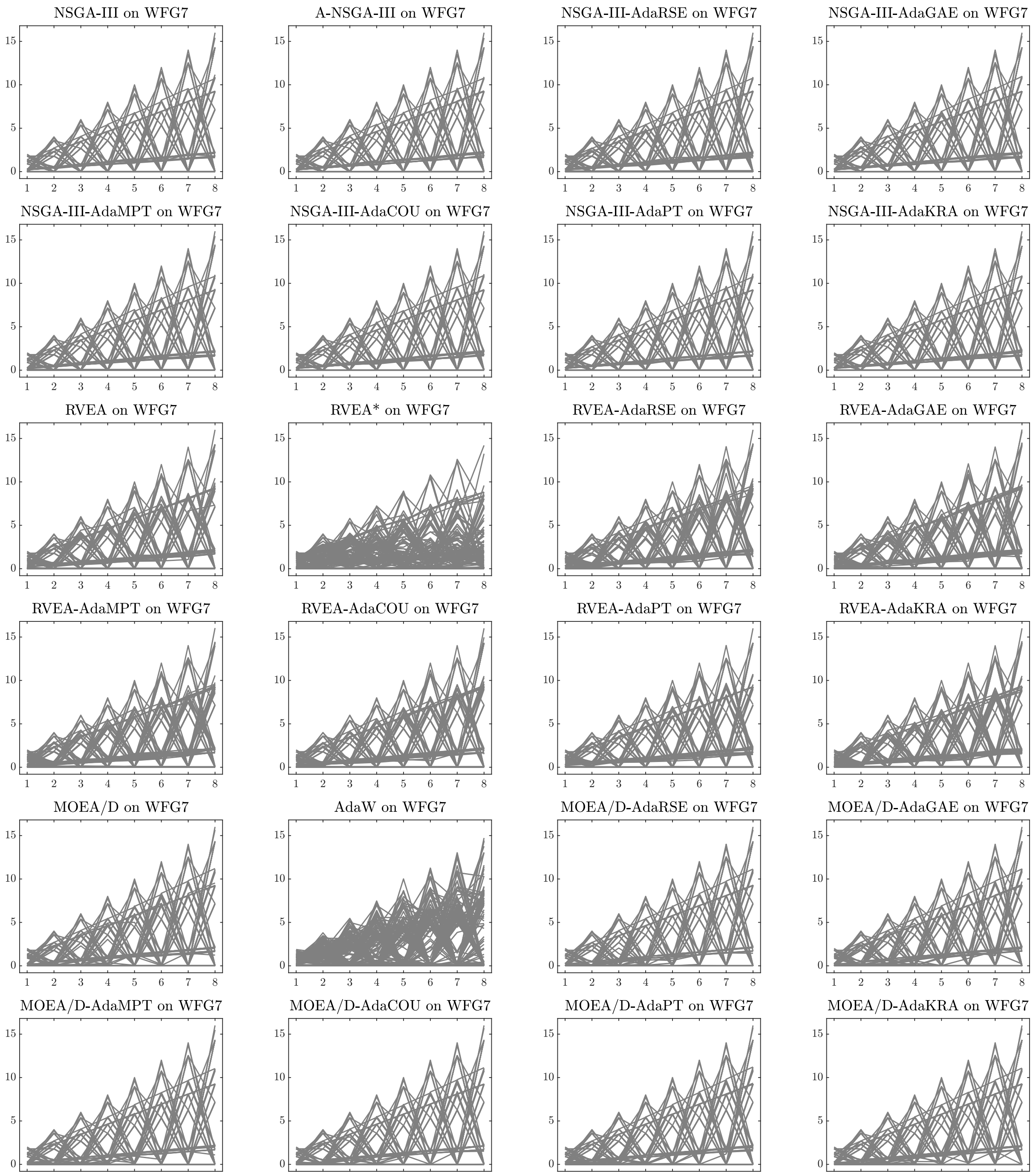

Figure 35: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7 with 8 objective functions.

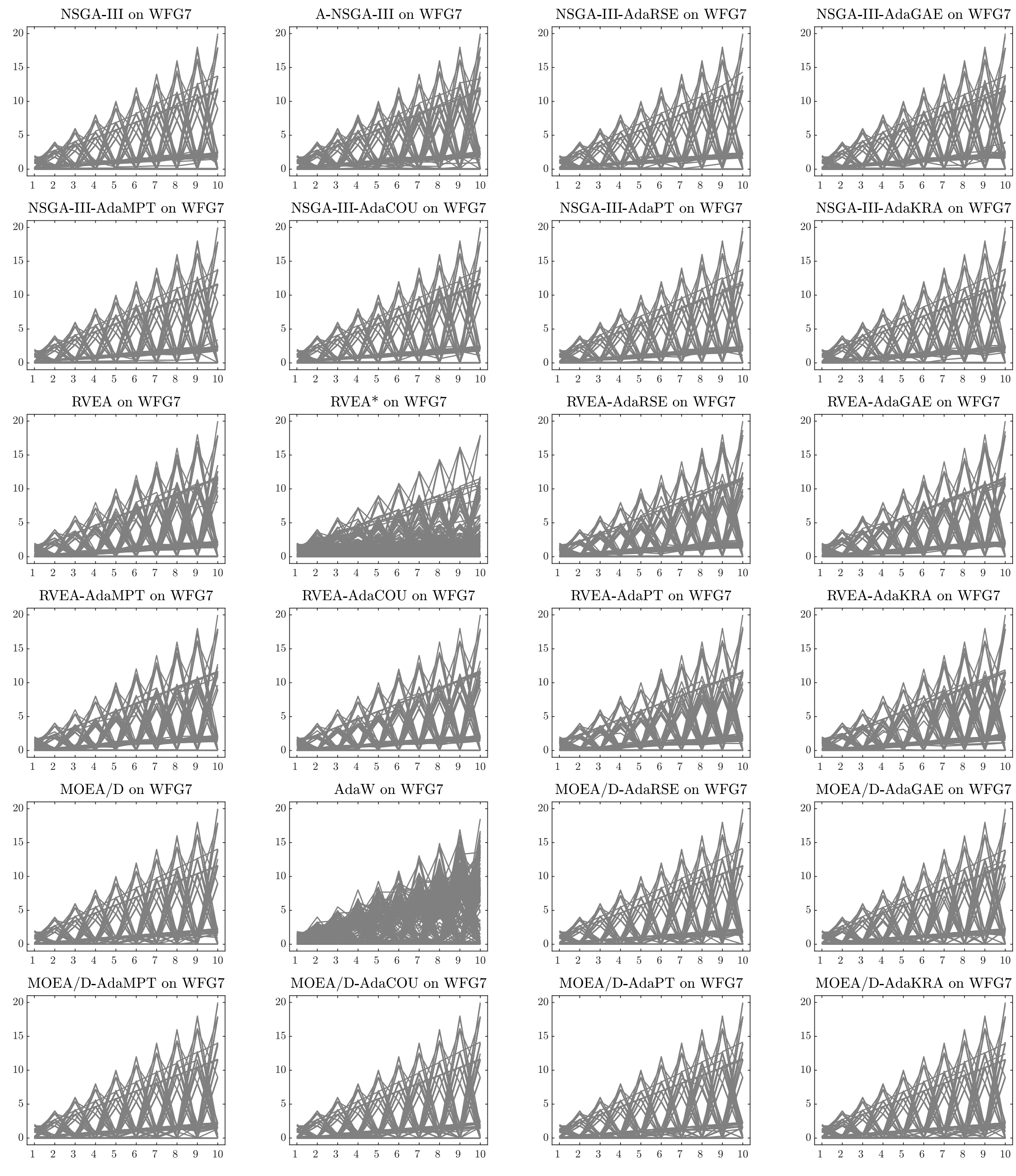

Figure 36: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7 with 10 objective functions.

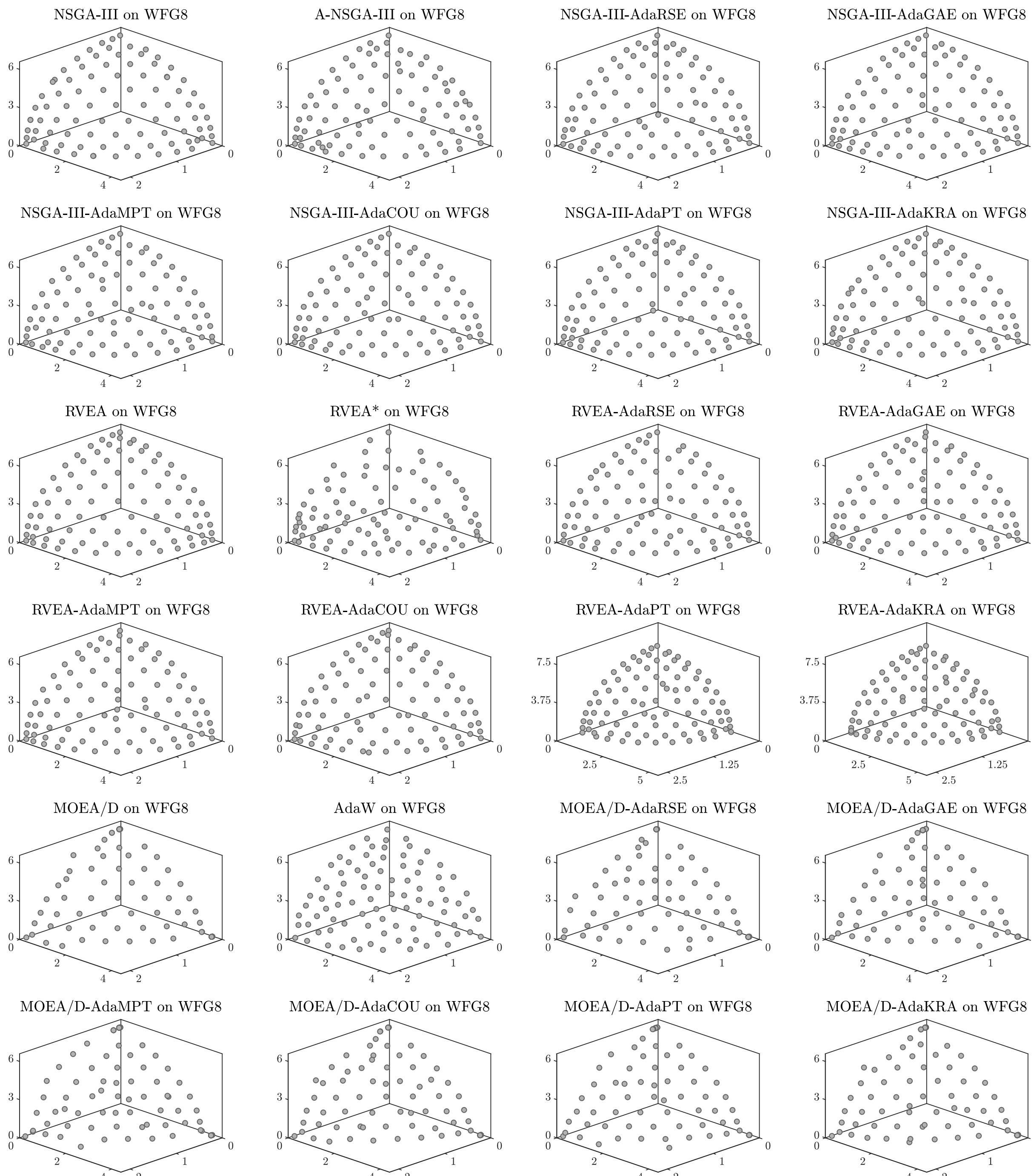

Figure 37: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8 with 3 objective functions.

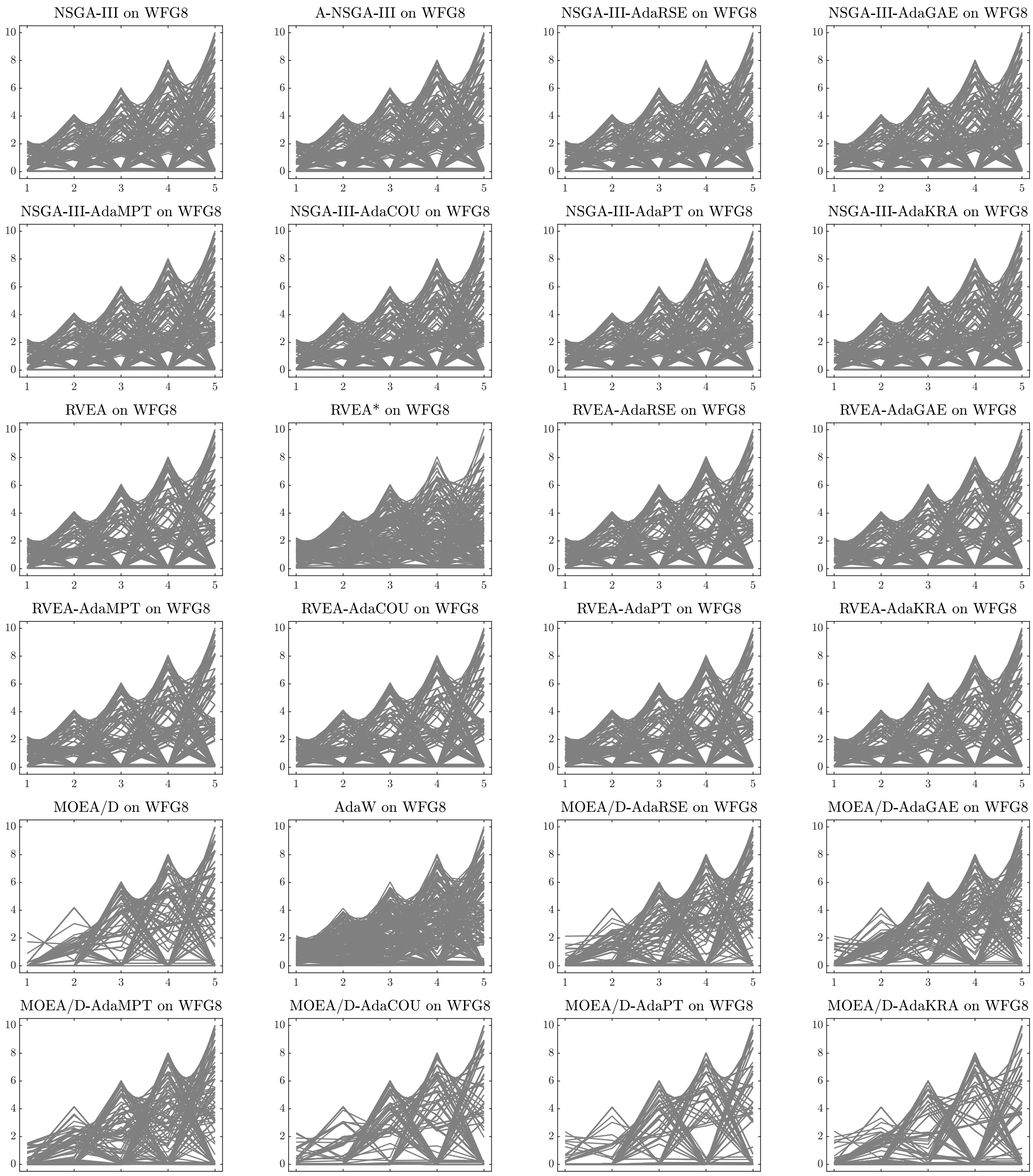

Figure 38: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8 with 5 objective functions.

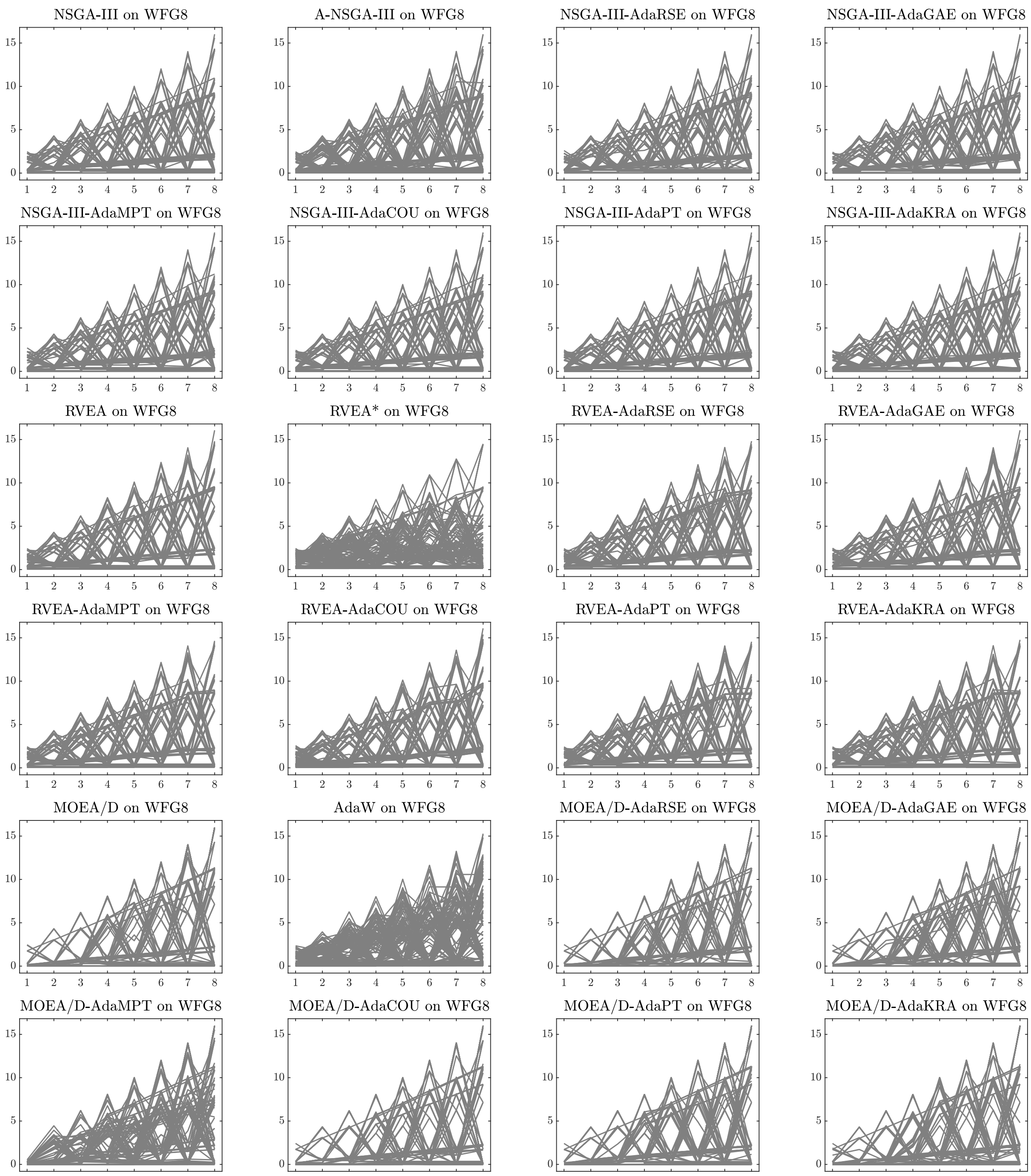

Figure 39: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8 with 8 objective functions.

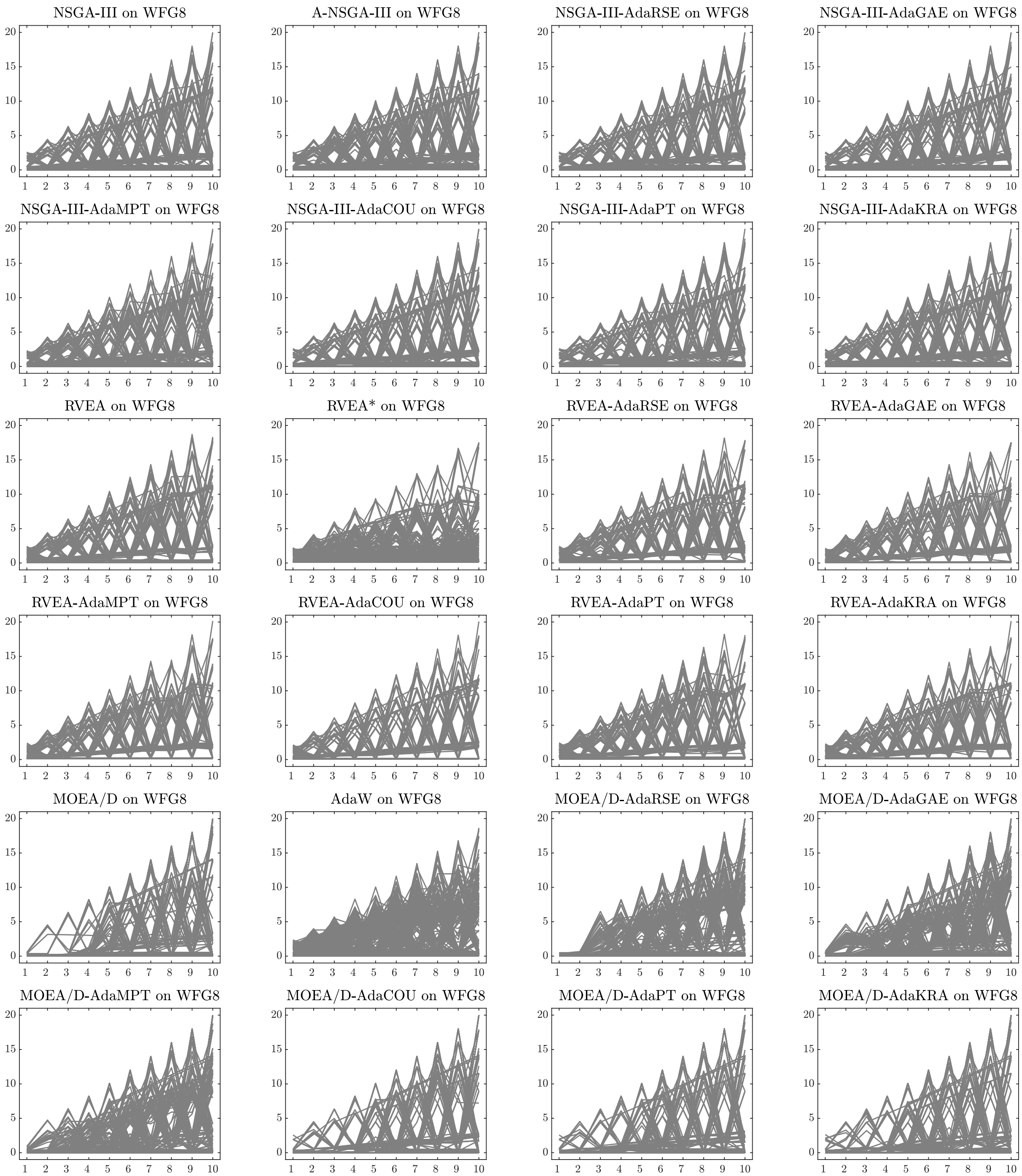

Figure 40: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8 with 10 objective functions.

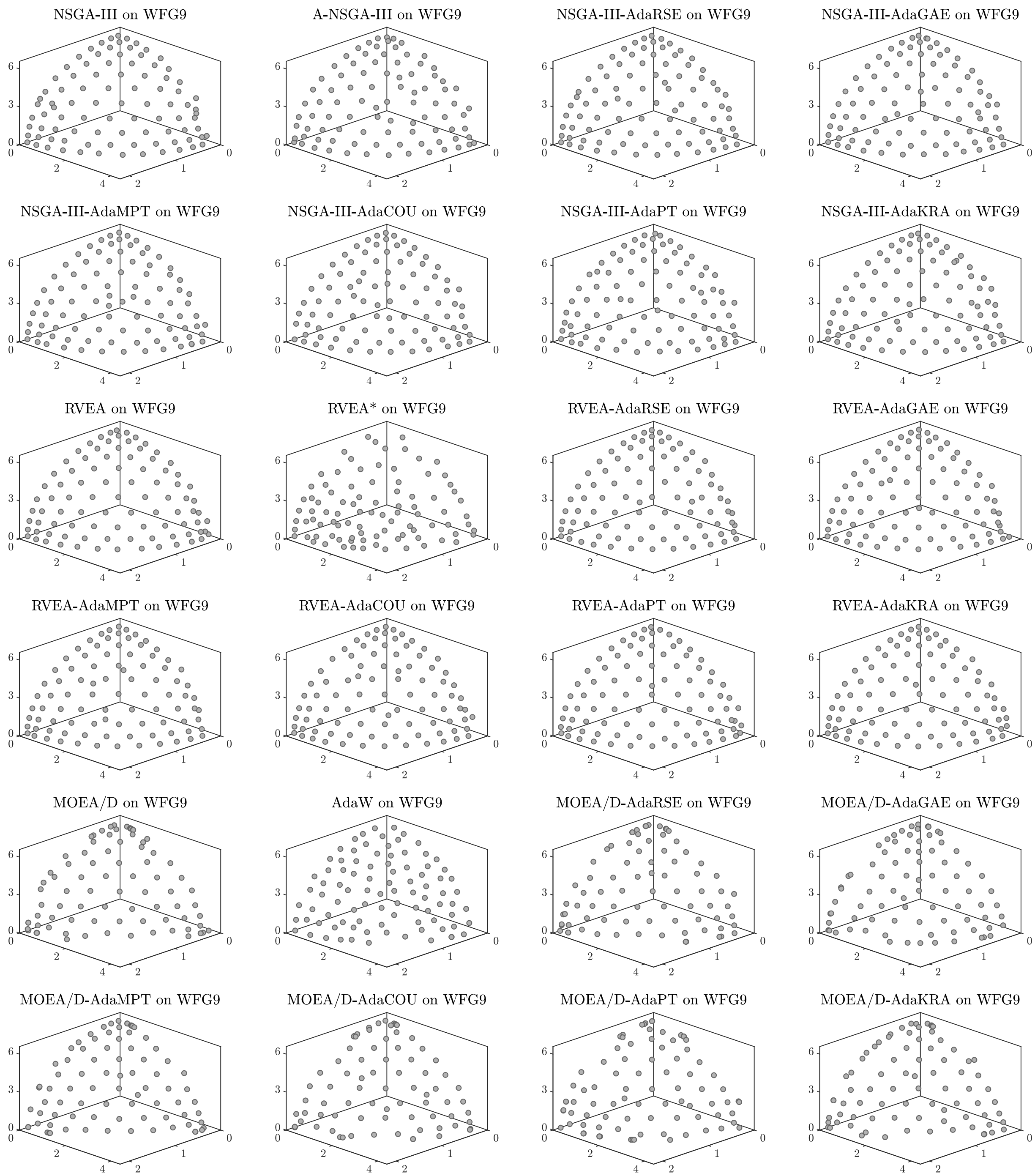

Figure 41: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9 with 3 objective functions.

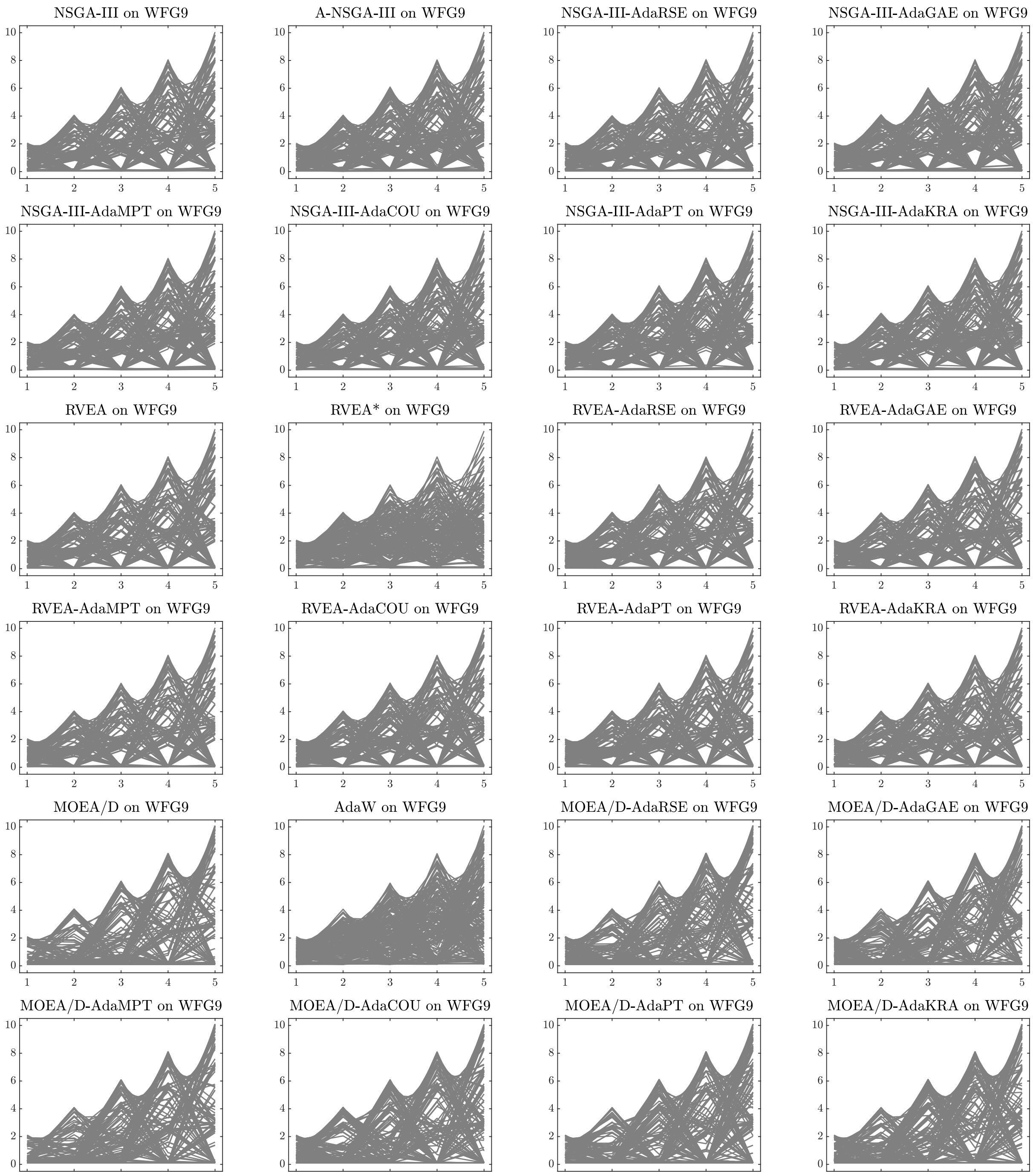

Figure 42: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9 with 5 objective functions.

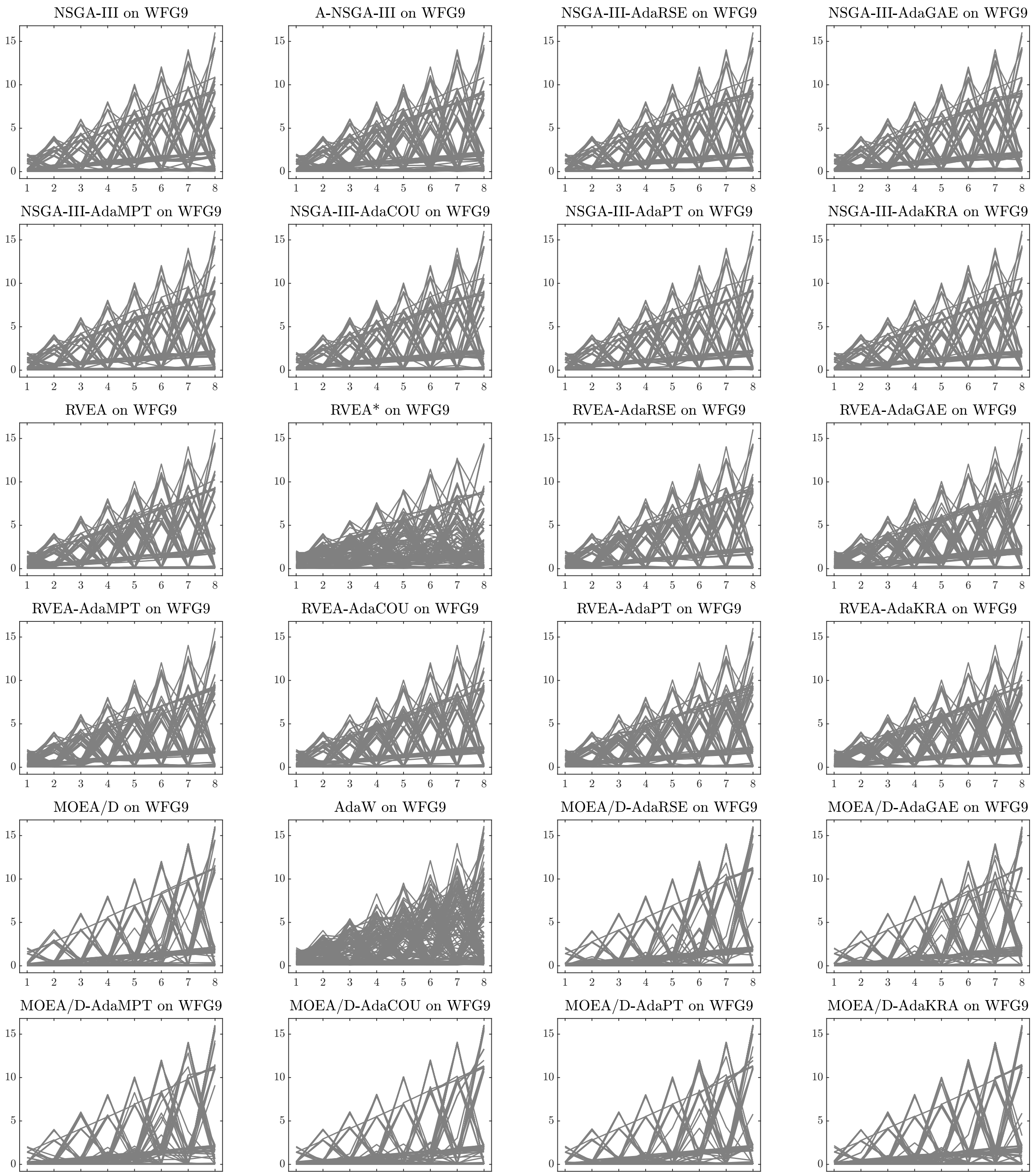

Figure 43: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9 with 8 objective functions.

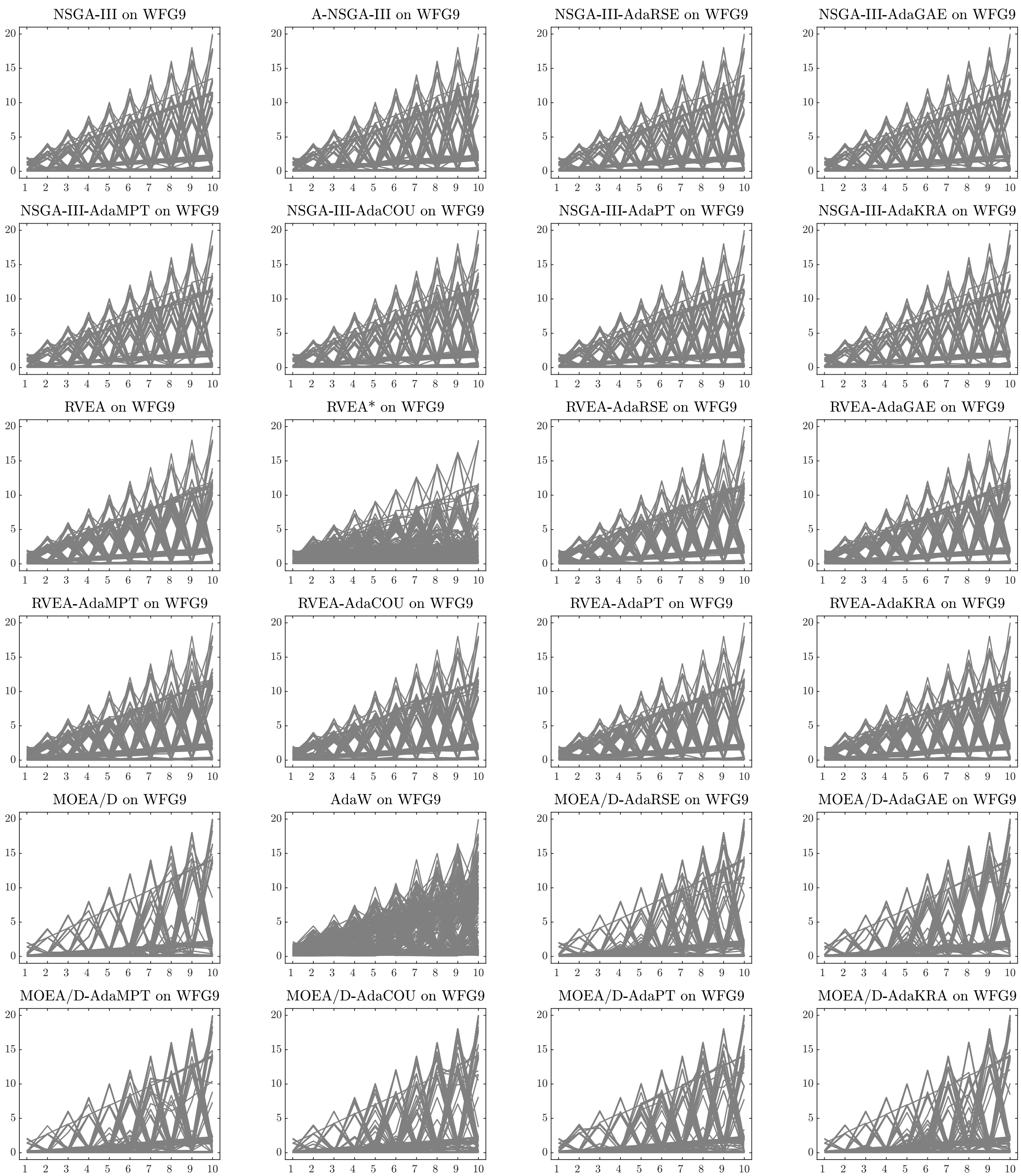

Figure 44: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9 with 10 objective functions.

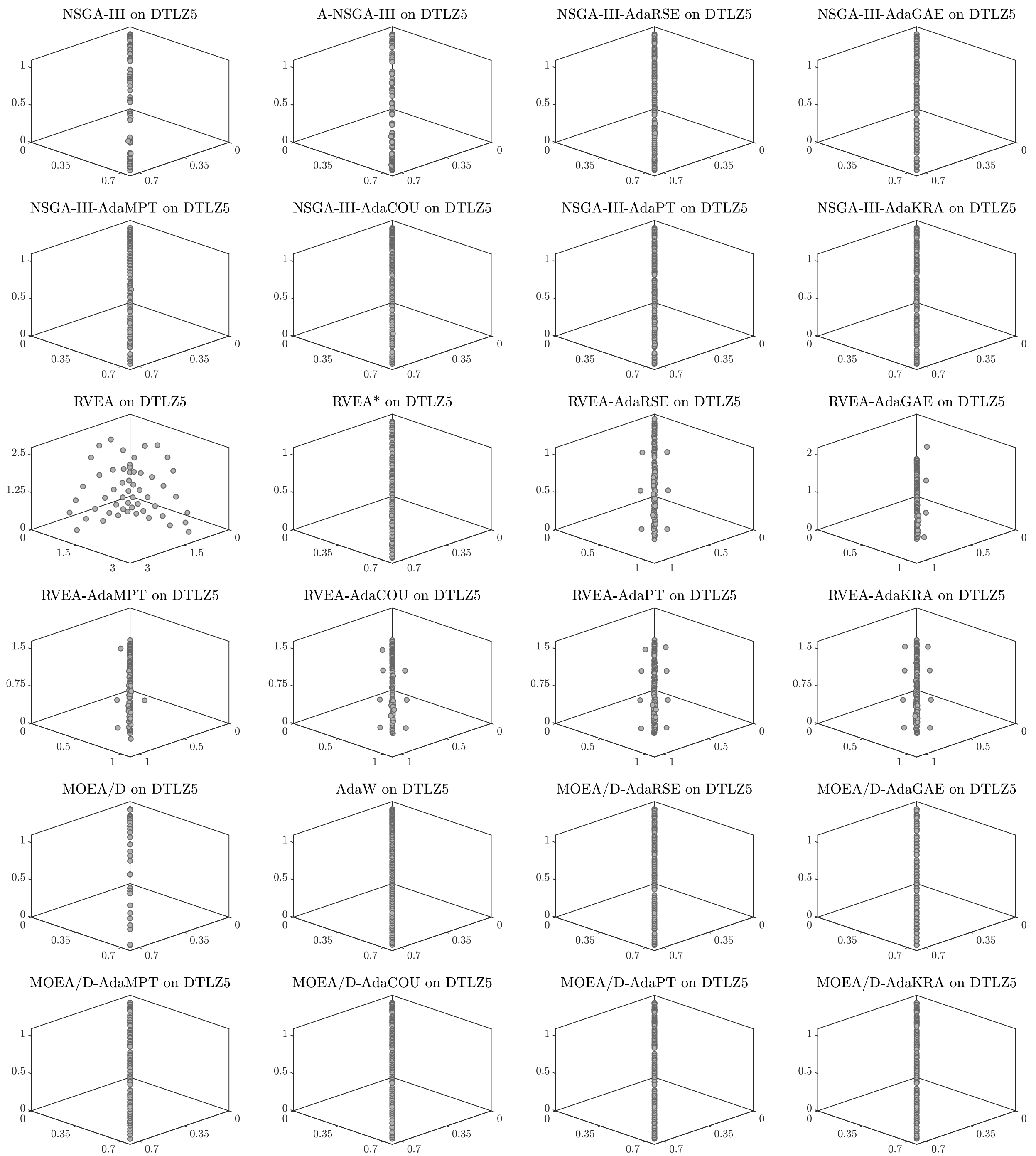

Figure 45: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5 with 3 objective functions.

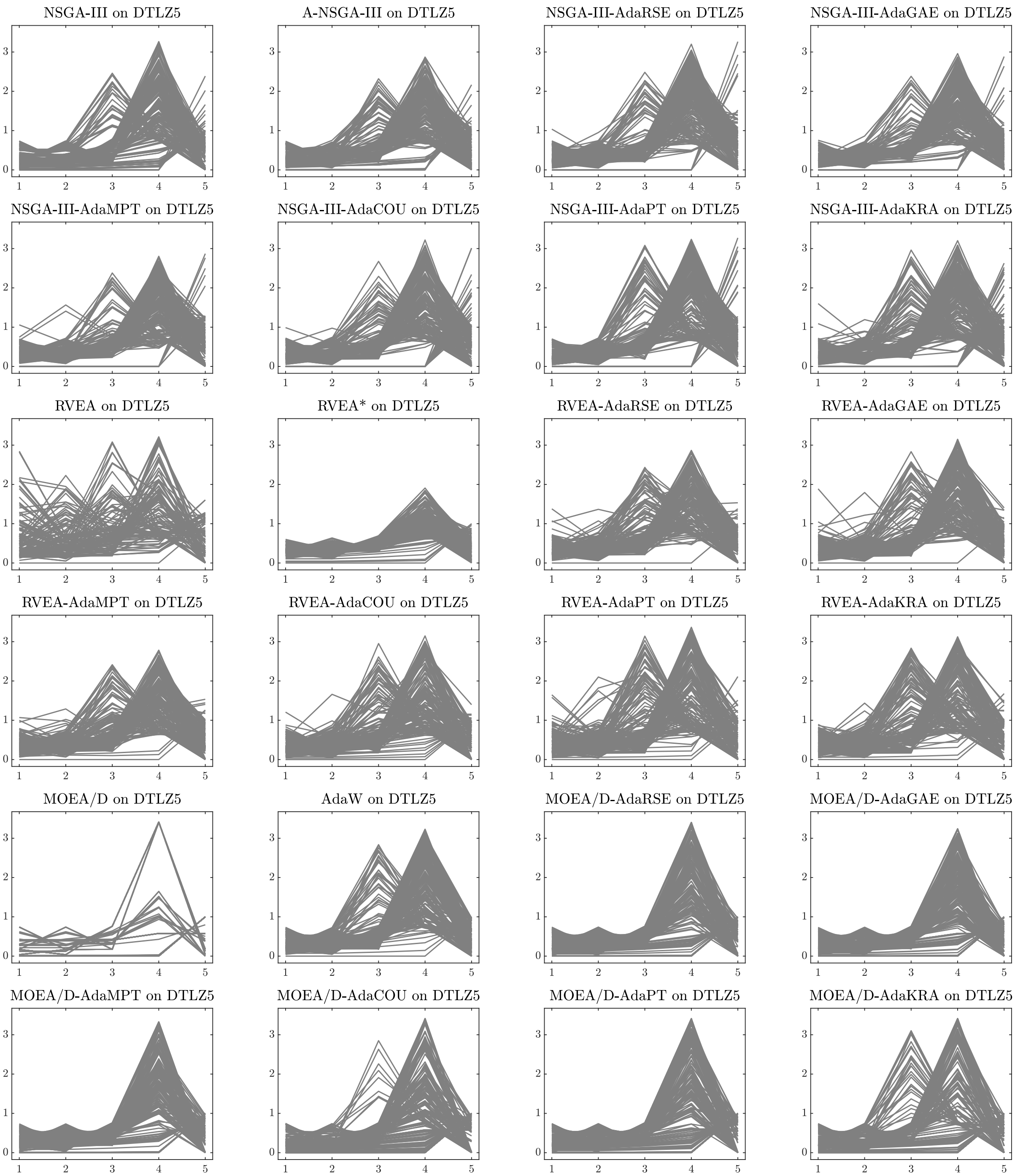

Figure 46: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5 with 5 objective functions.

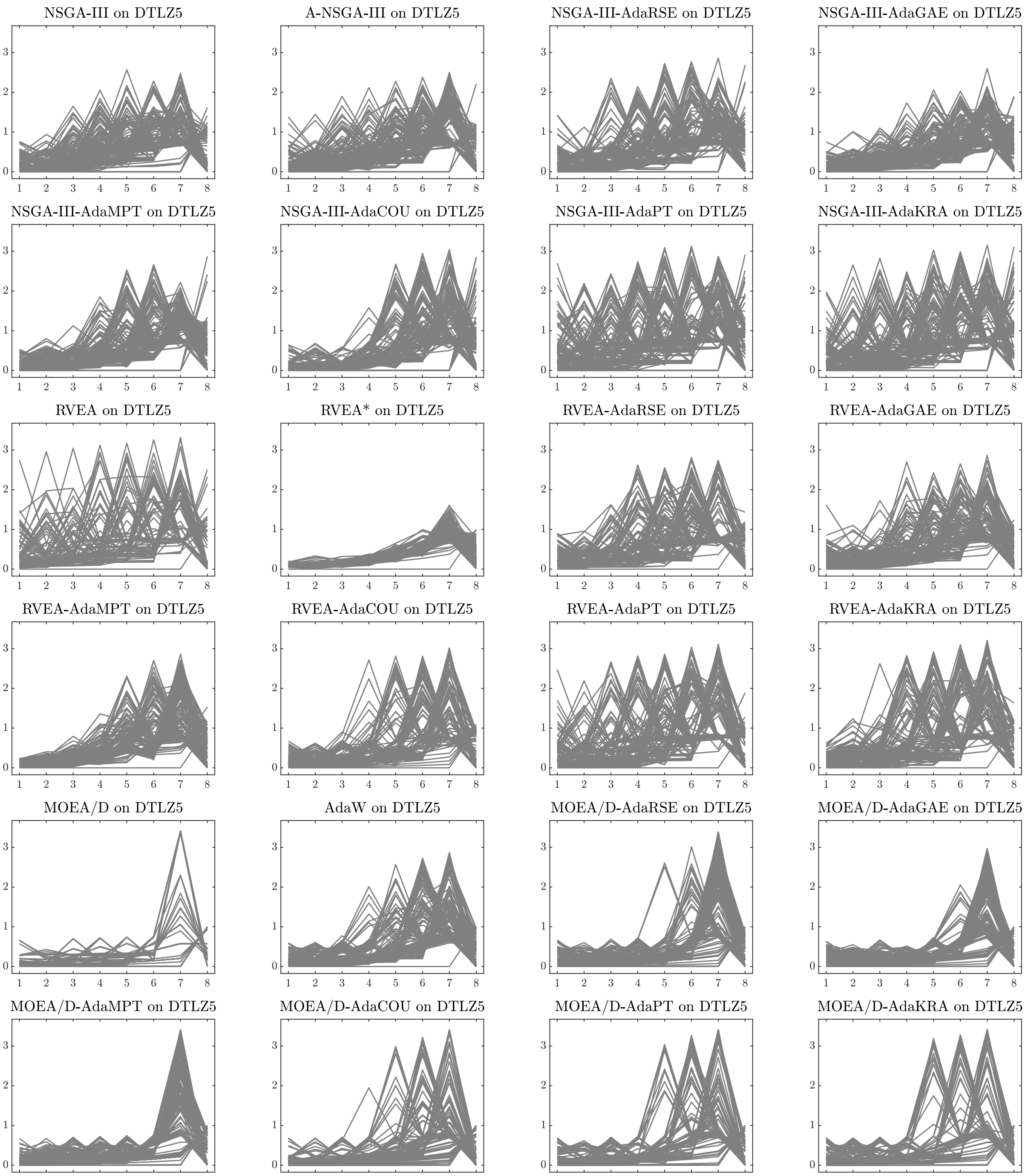

Figure 47: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5 with 8 objective functions.

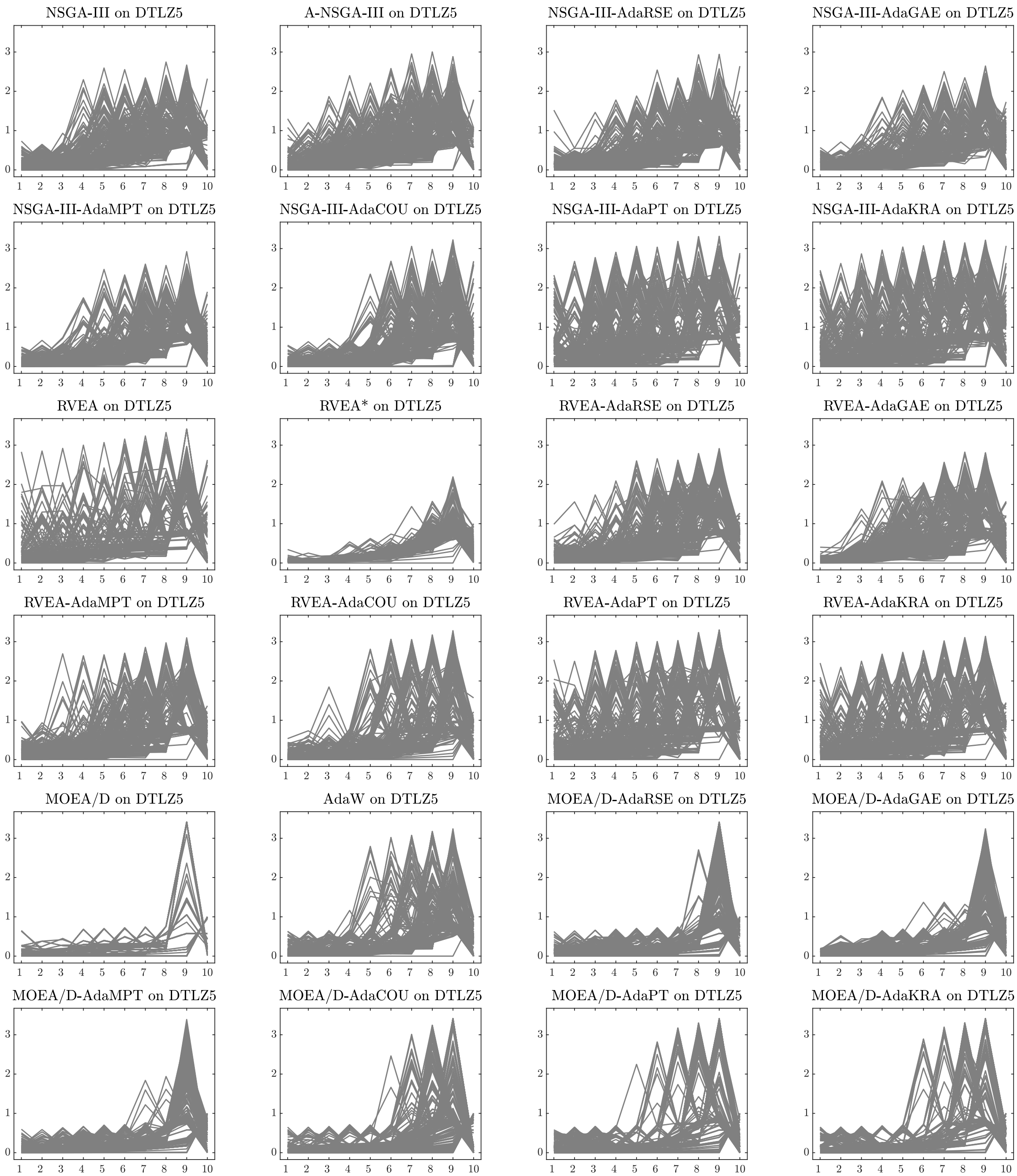

Figure 48: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5 with 10 objective functions.

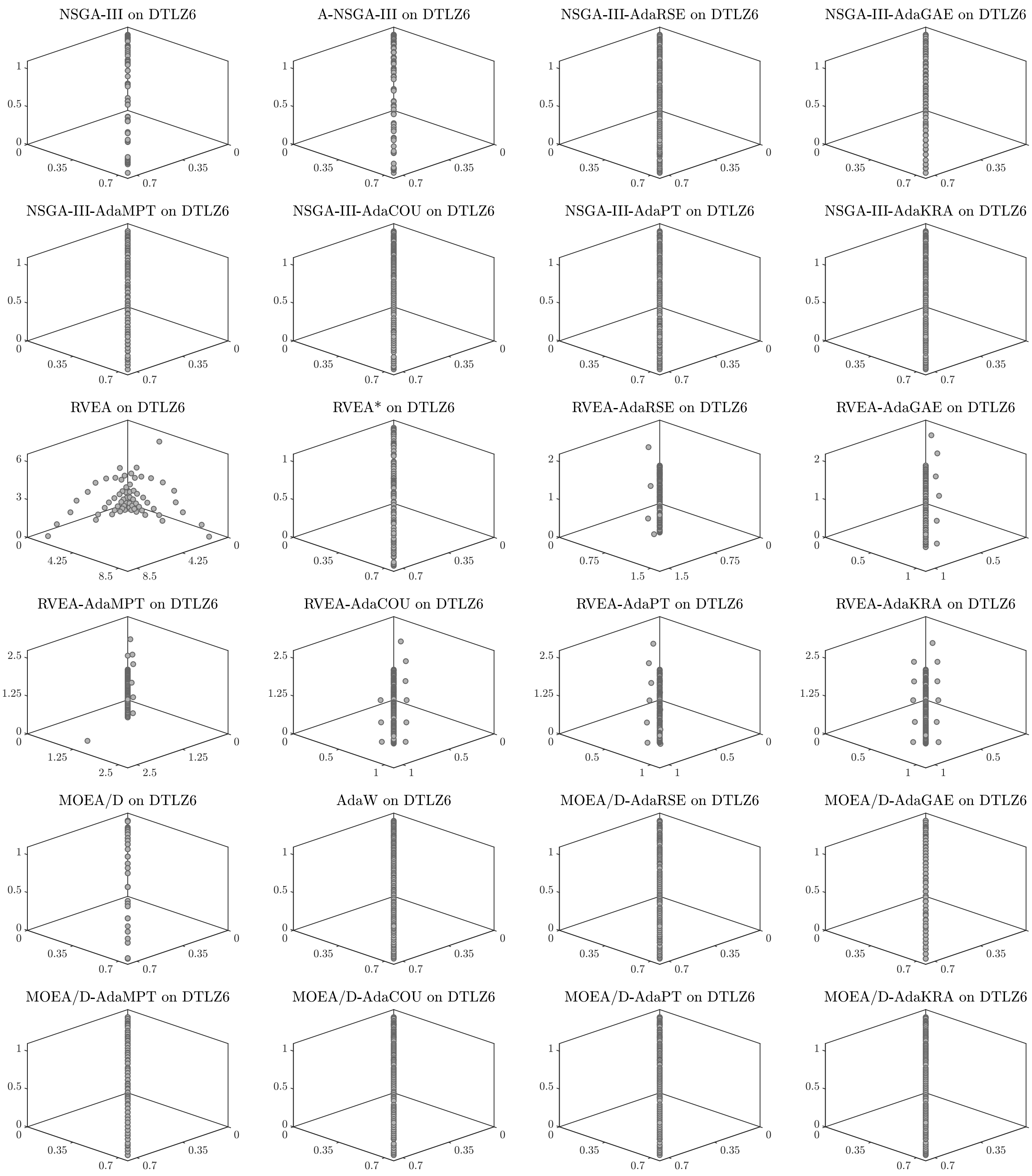

Figure 49: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6 with 3 objective functions.

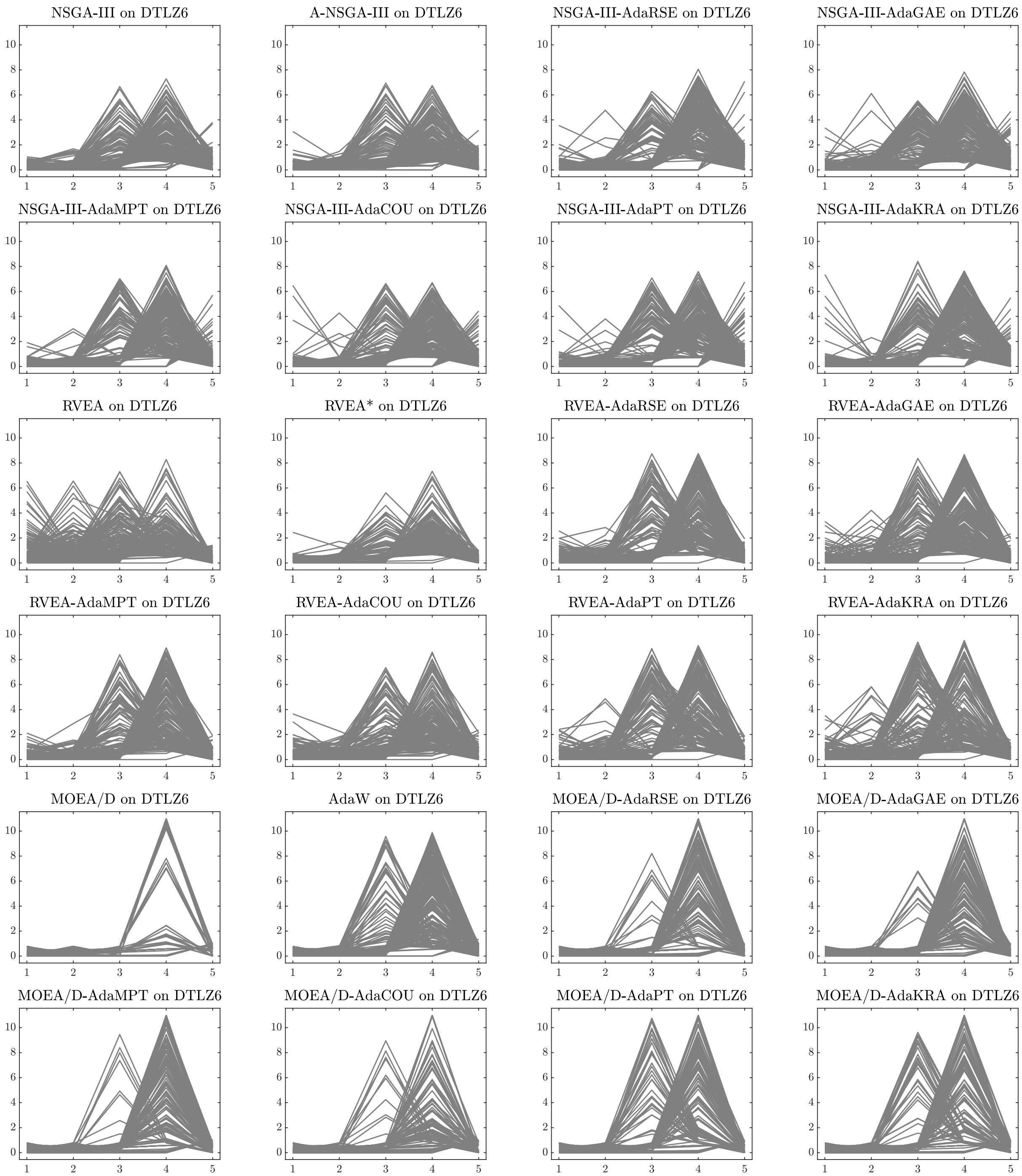

Figure 50: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6 with 5 objective functions.

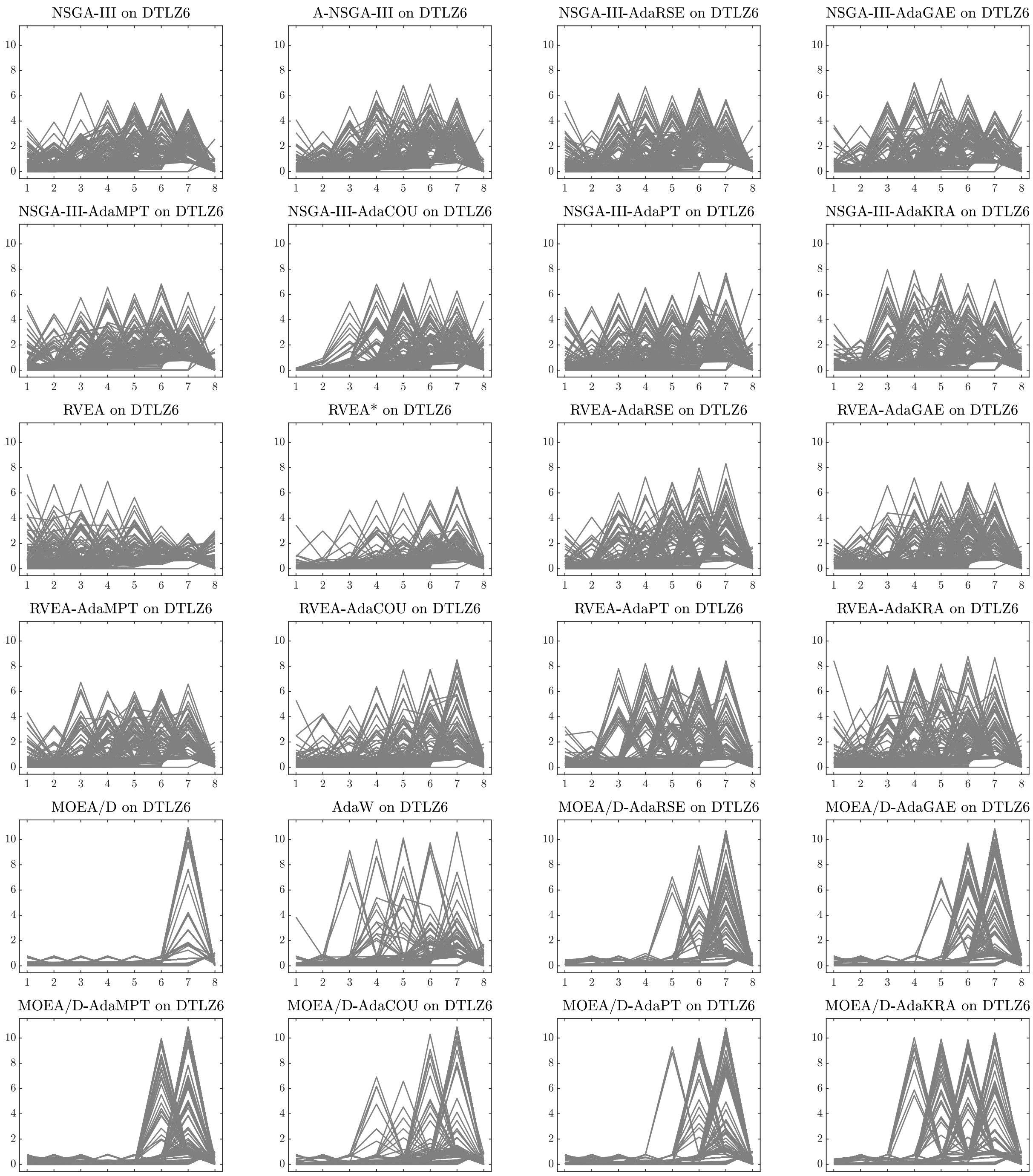

Figure 51: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6 with 8 objective functions.

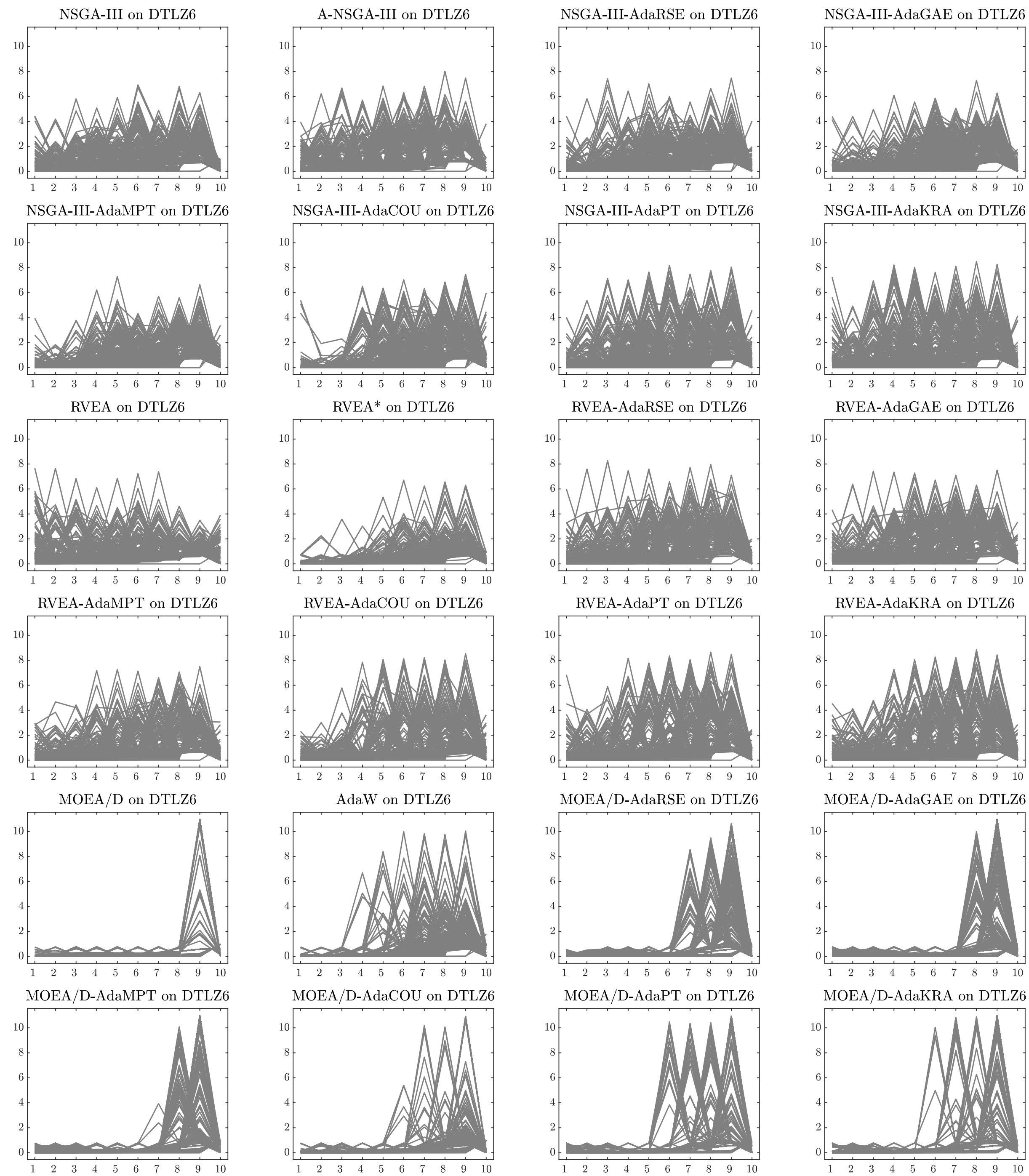

Figure 52: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6 with 10 objective functions.

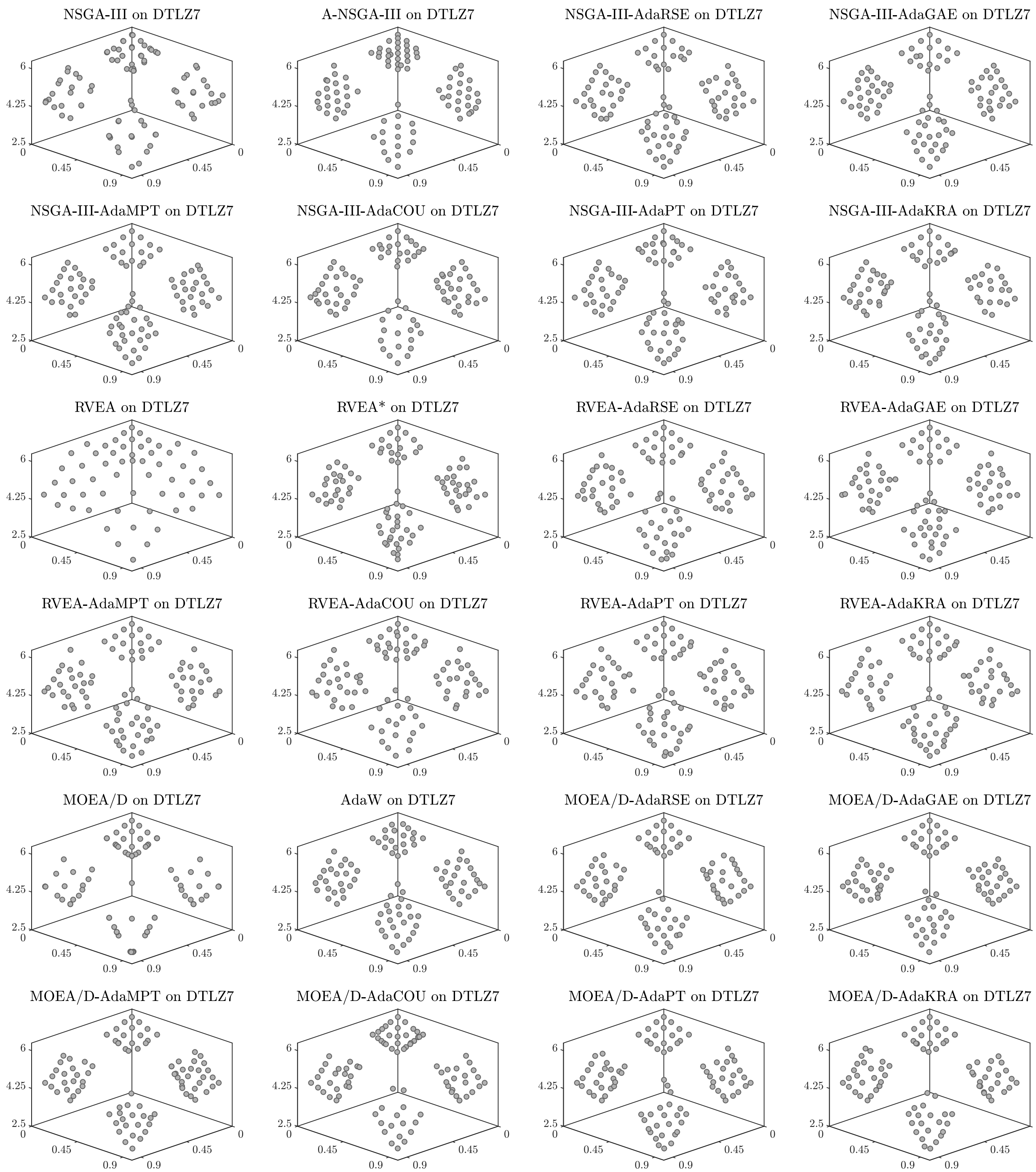

Figure 53: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7 with 3 objective functions.

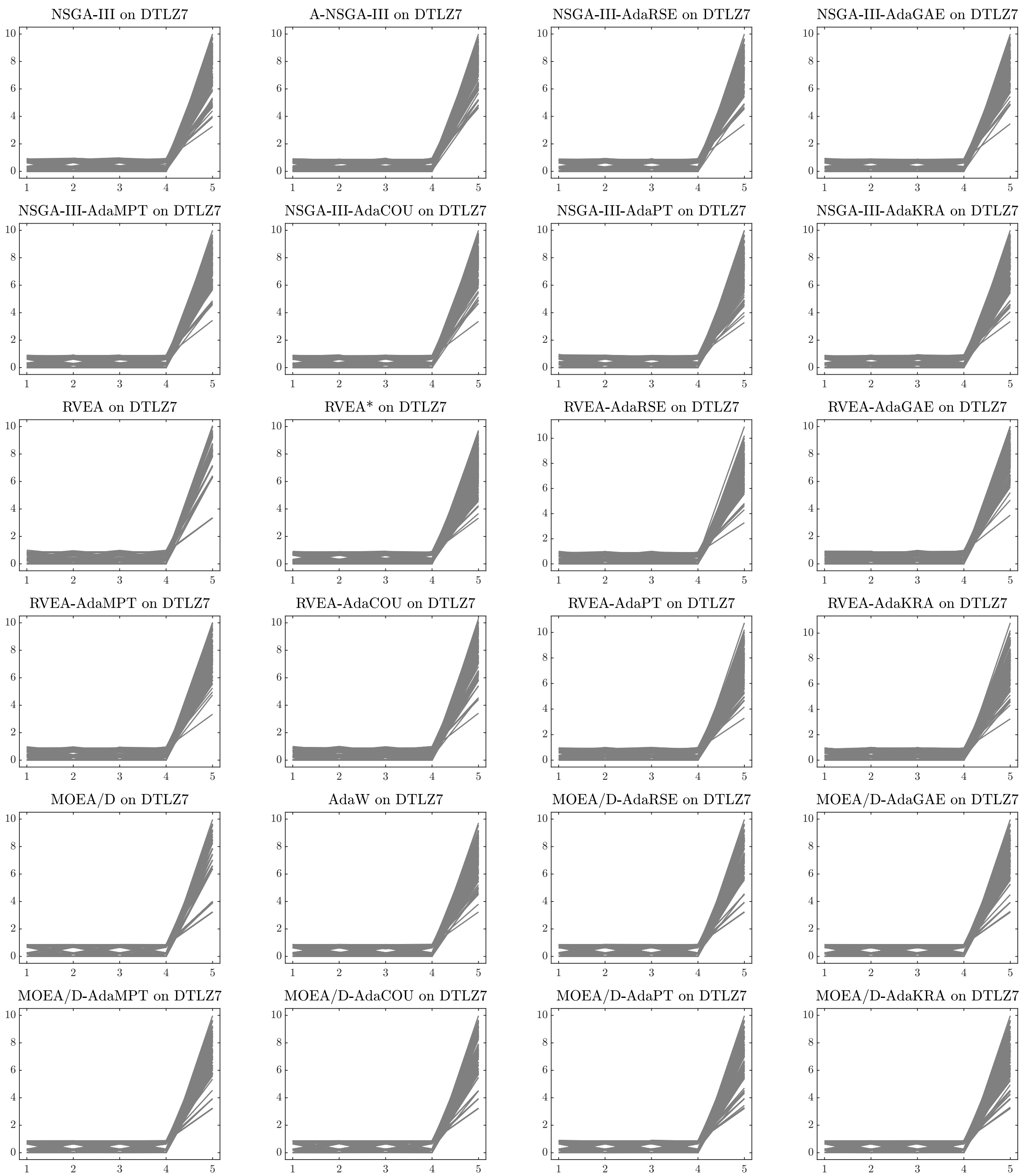

Figure 54: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7 with 5 objective functions.

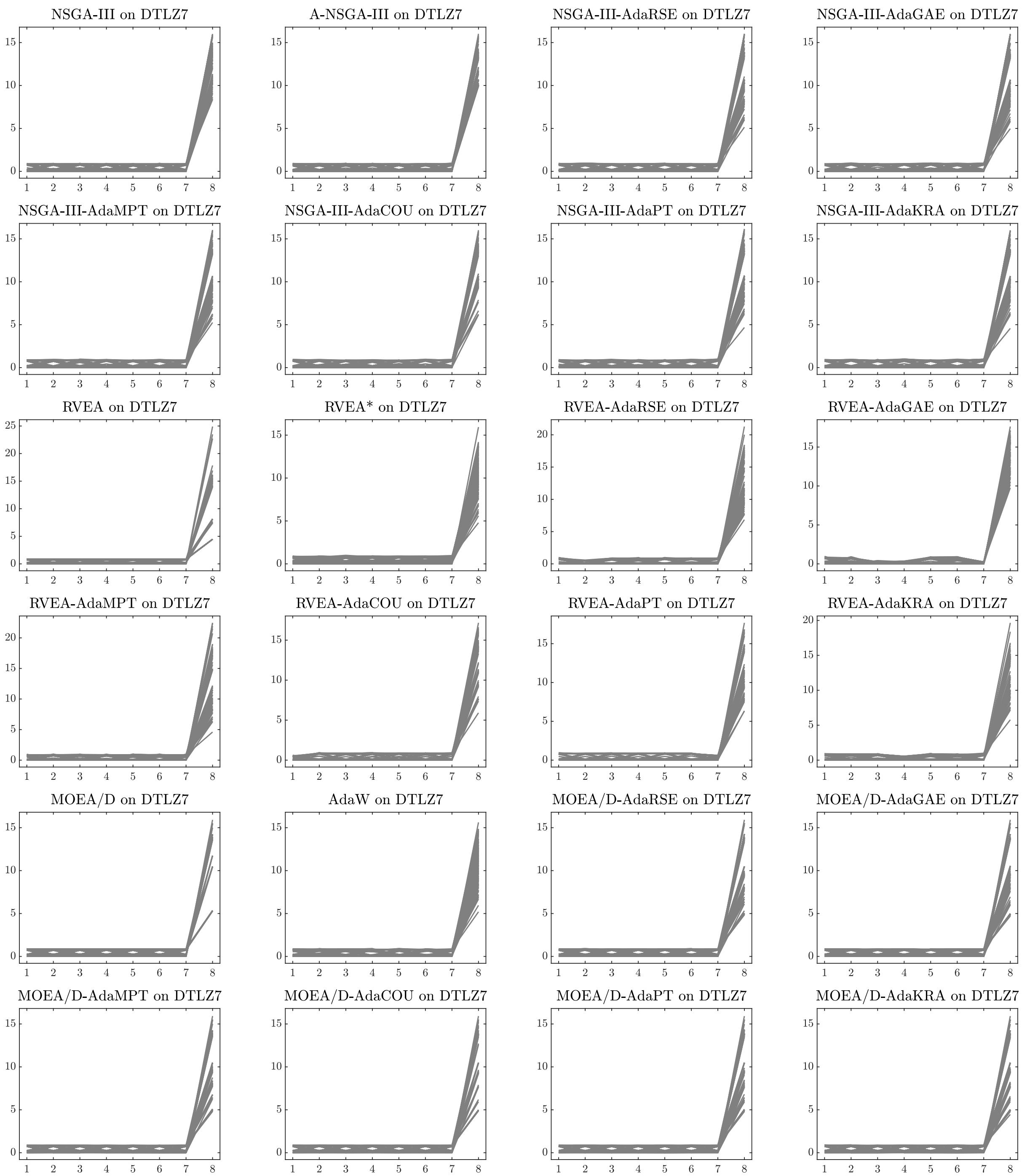

Figure 55: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7 with 8 objective functions.

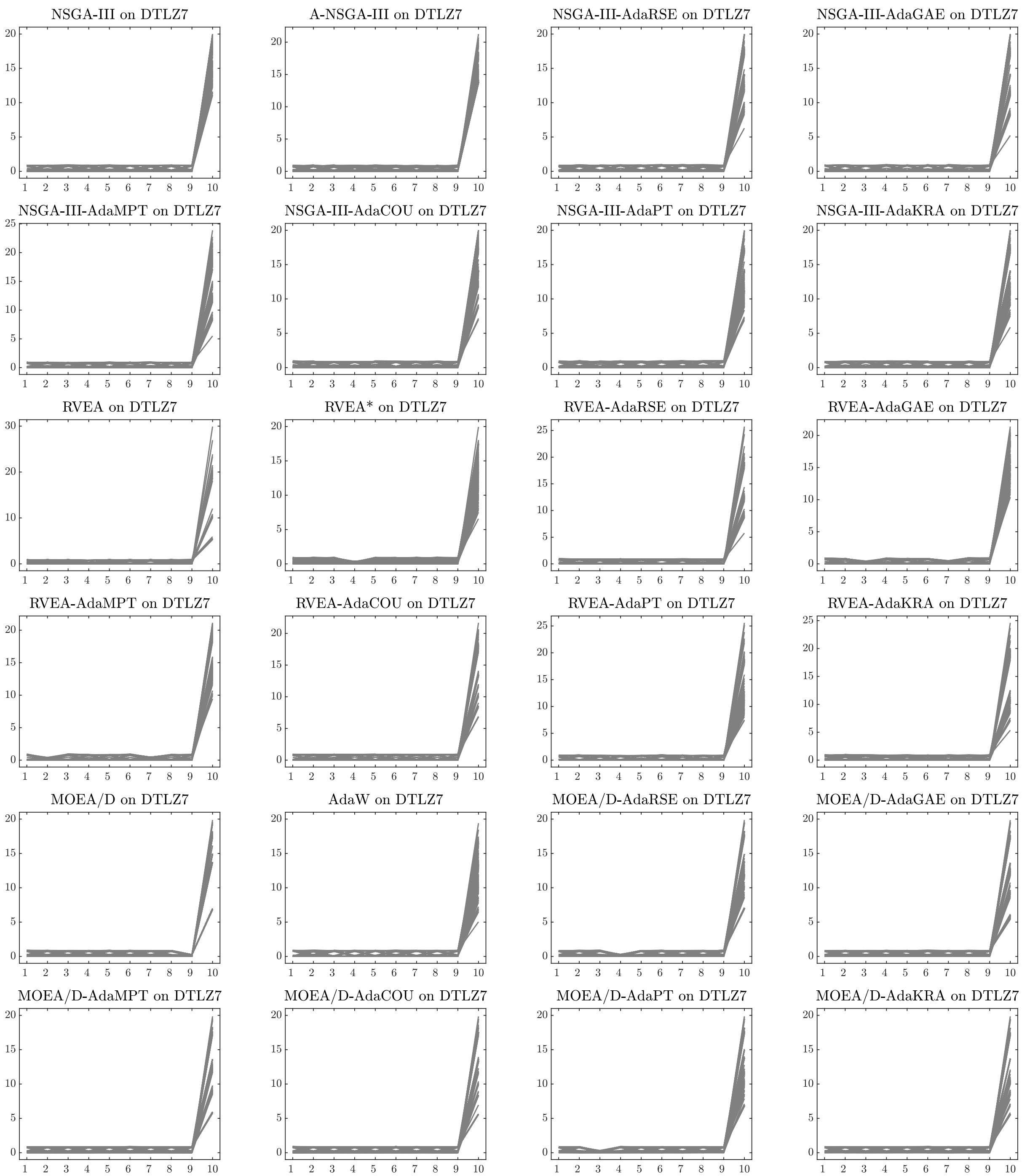

Figure 56: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7 with 10 objective functions.

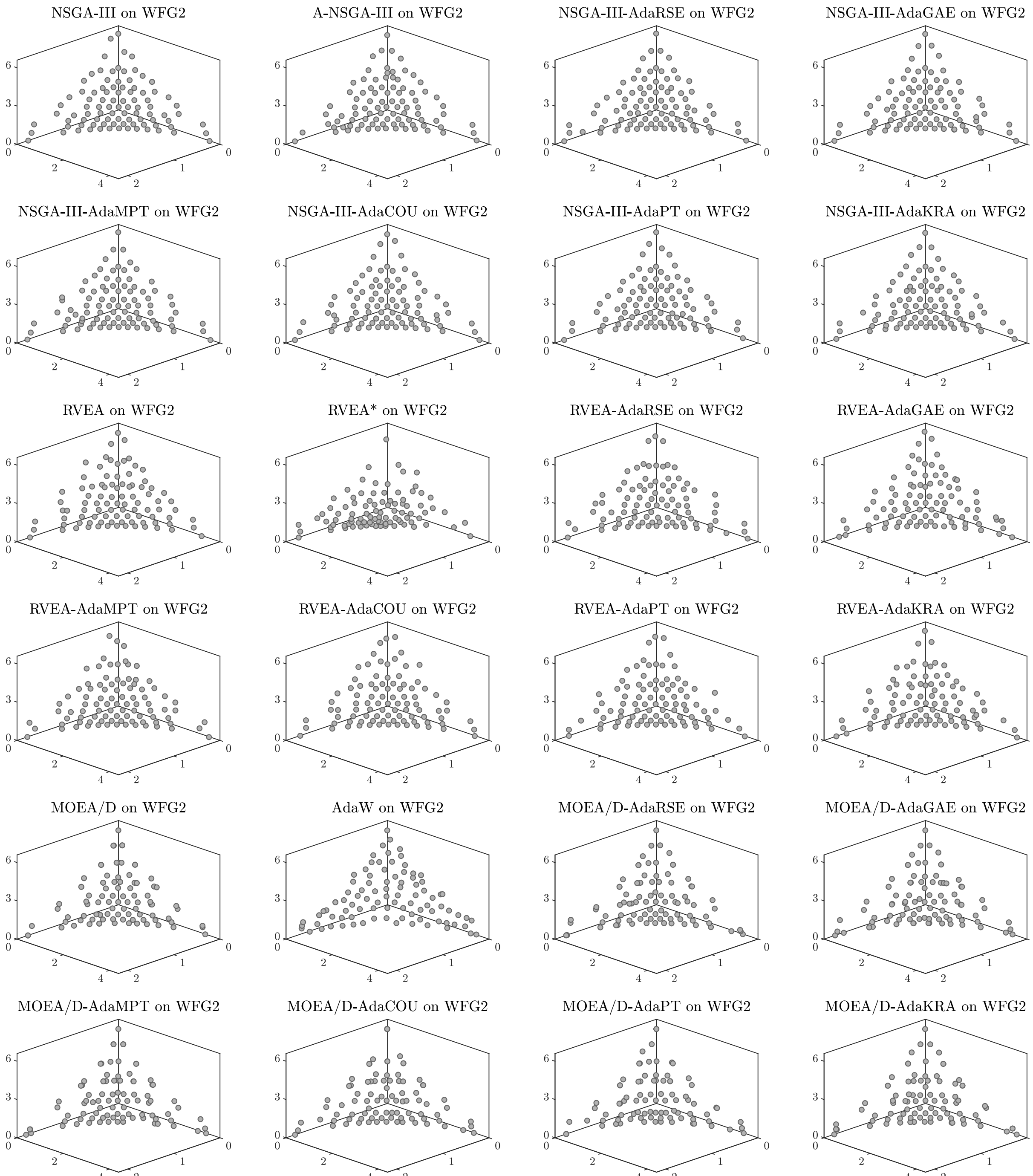

Figure 57: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2 with 3 objective functions.

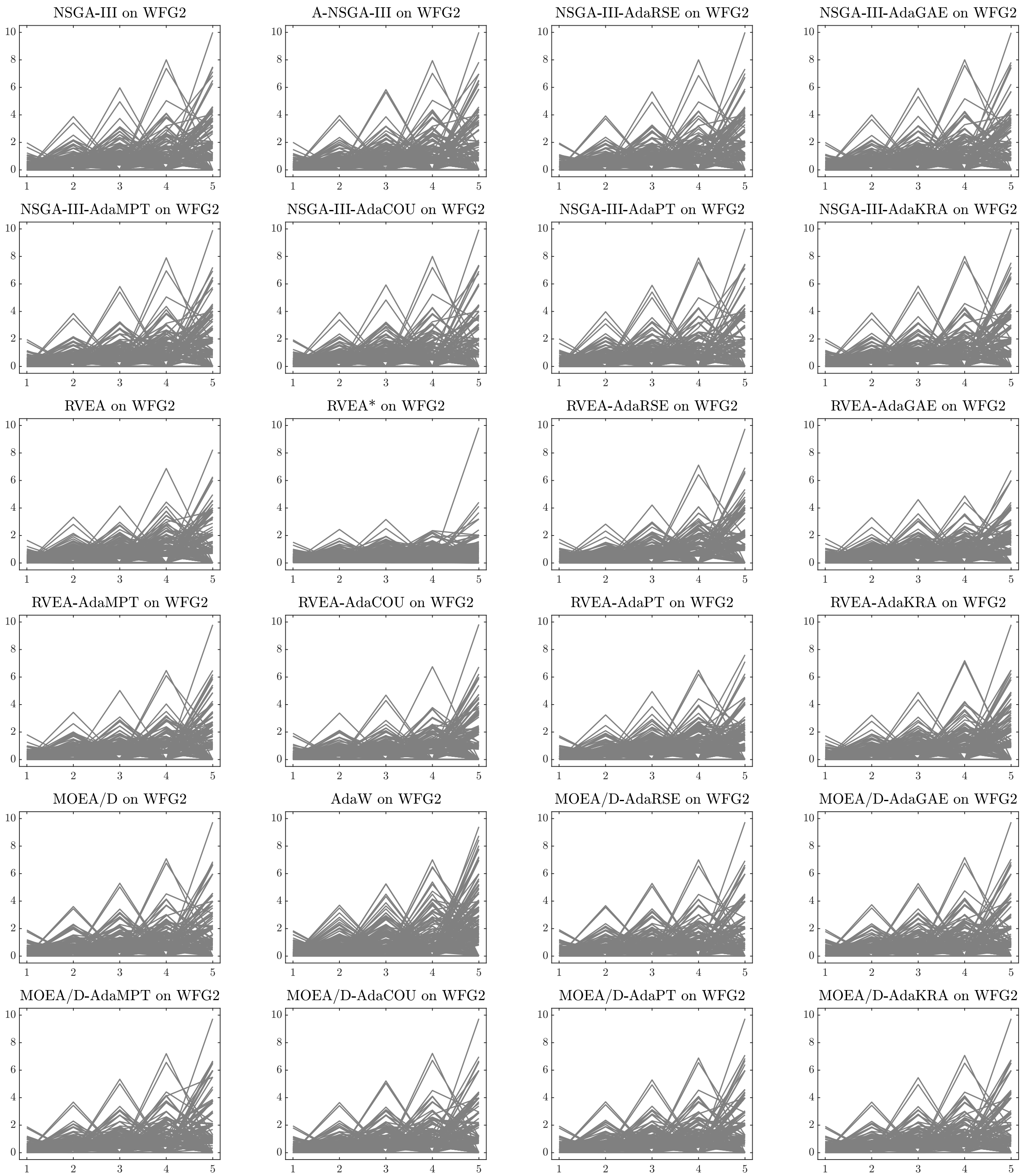

Figure 58: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2 with 5 objective functions.

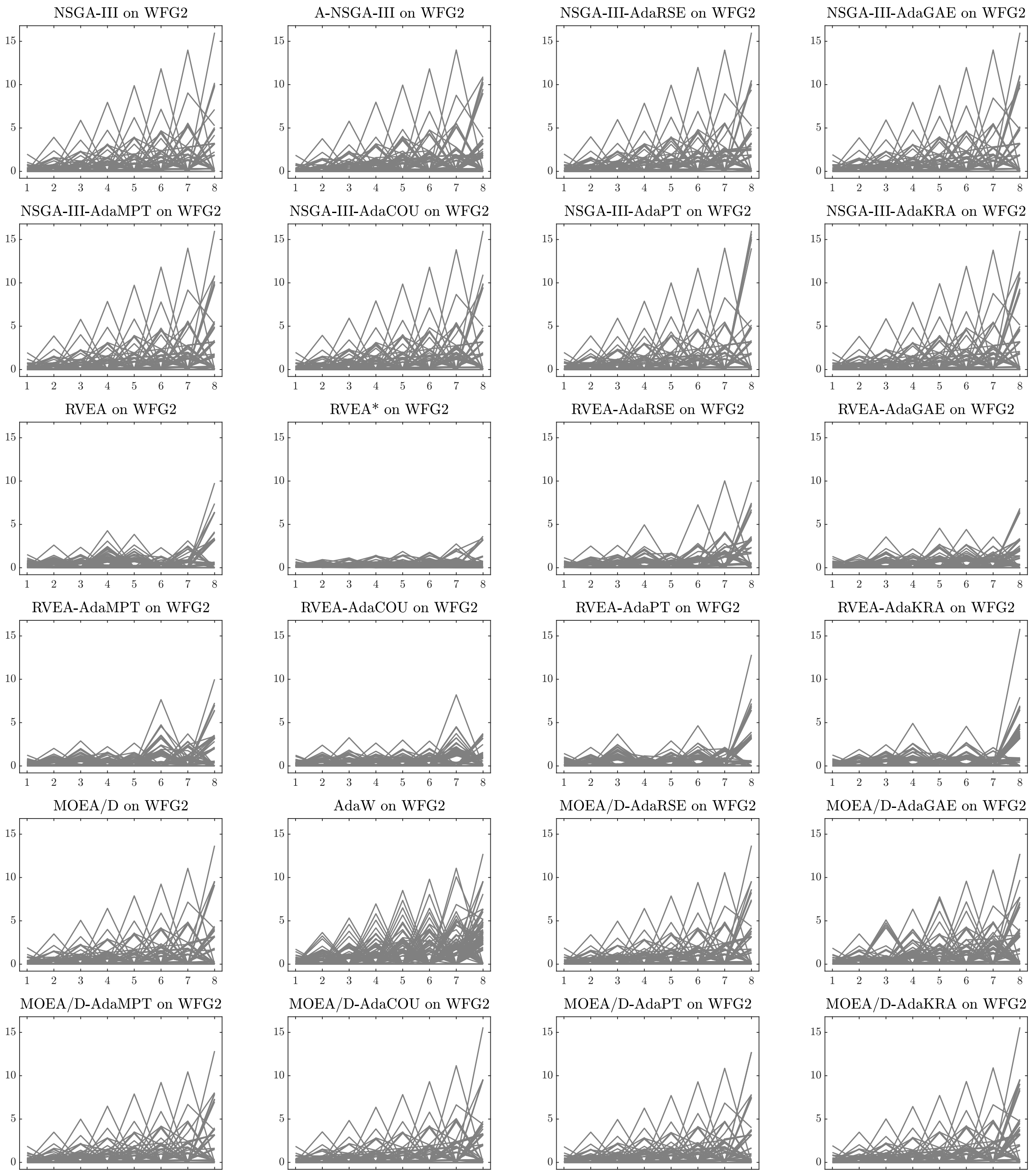

Figure 59: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2 with 8 objective functions.

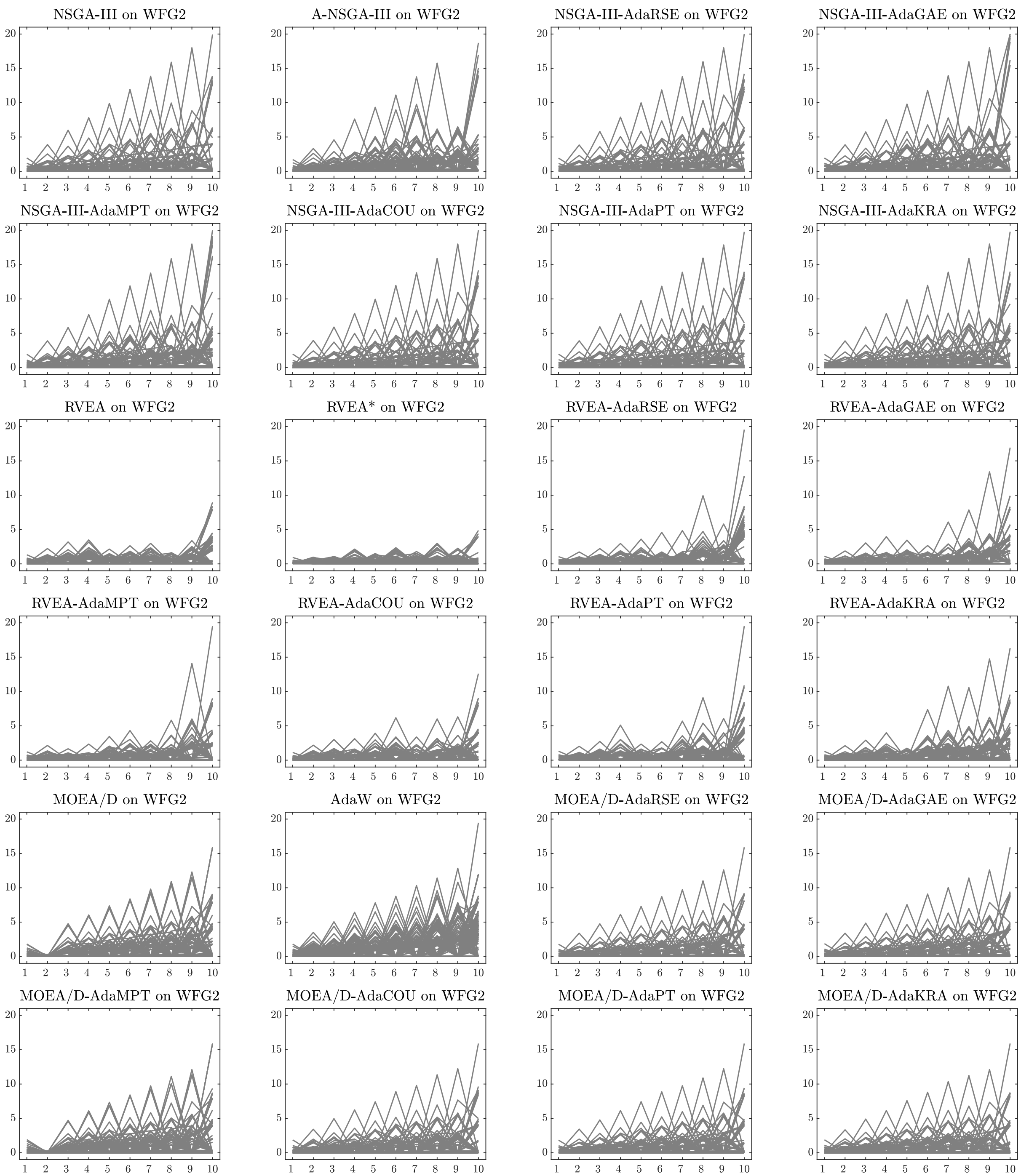

Figure 60: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2 with 10 objective functions.

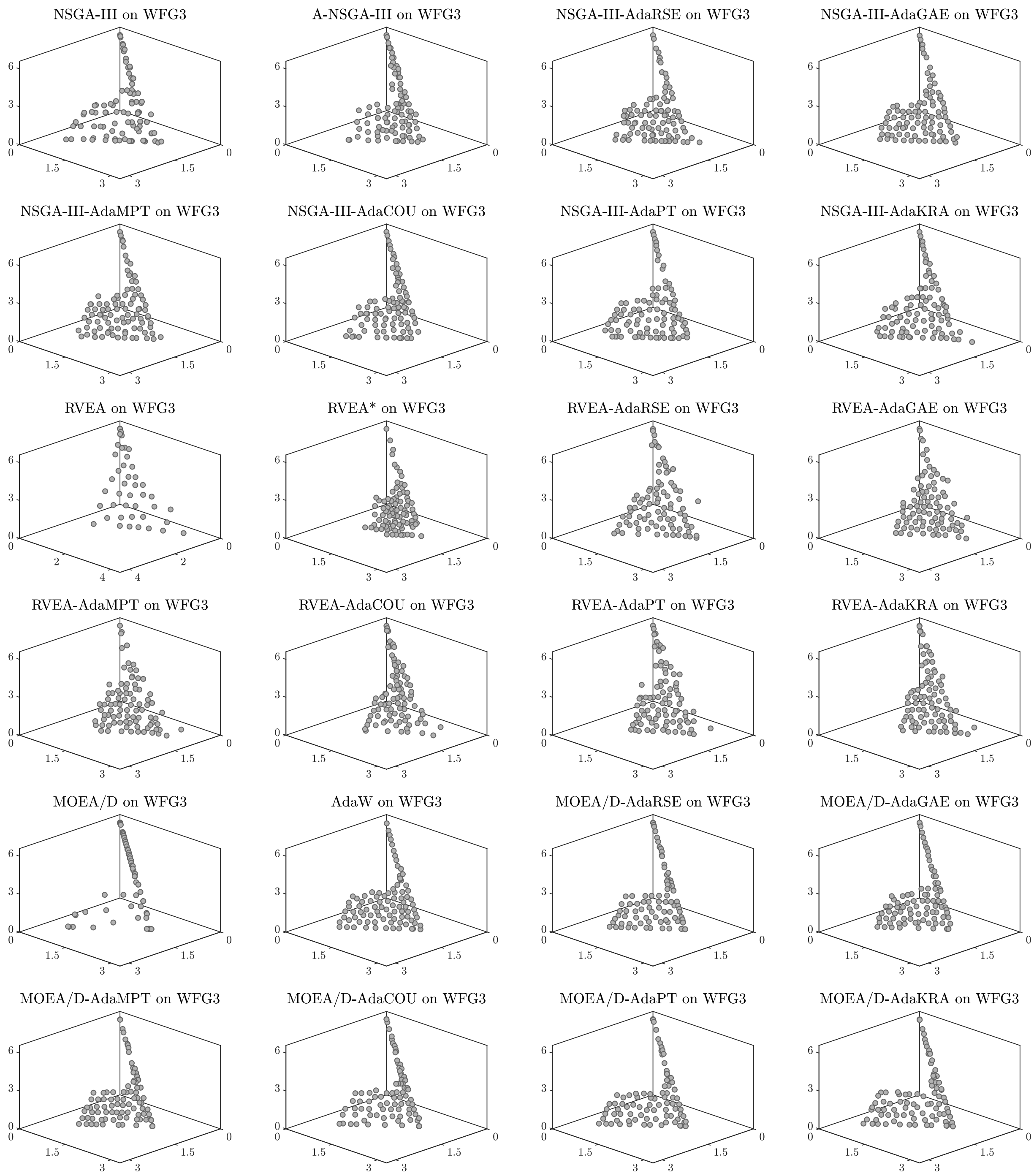

Figure 61: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3 with 3 objective functions.

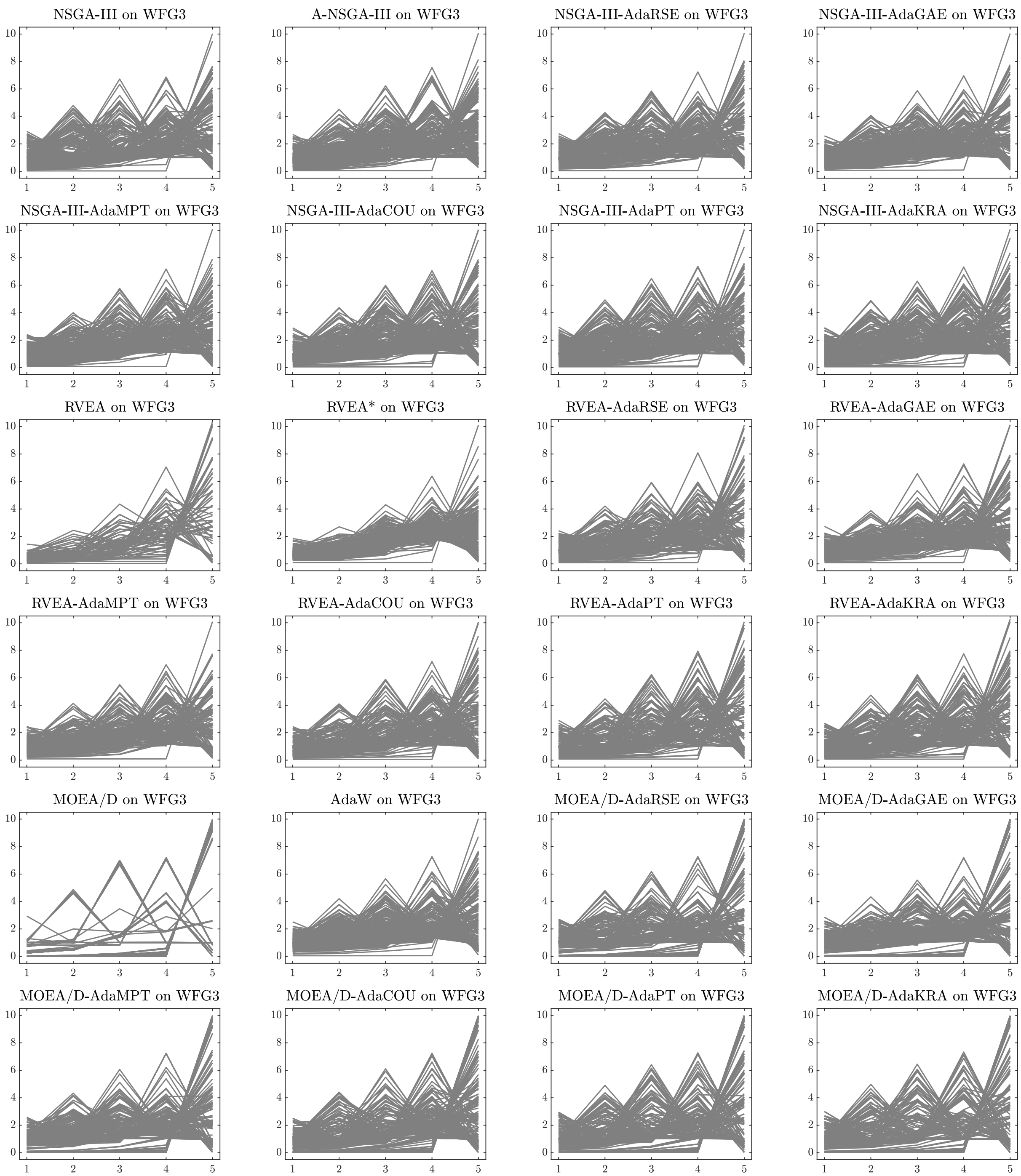

Figure 62: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3 with 5 objective functions.

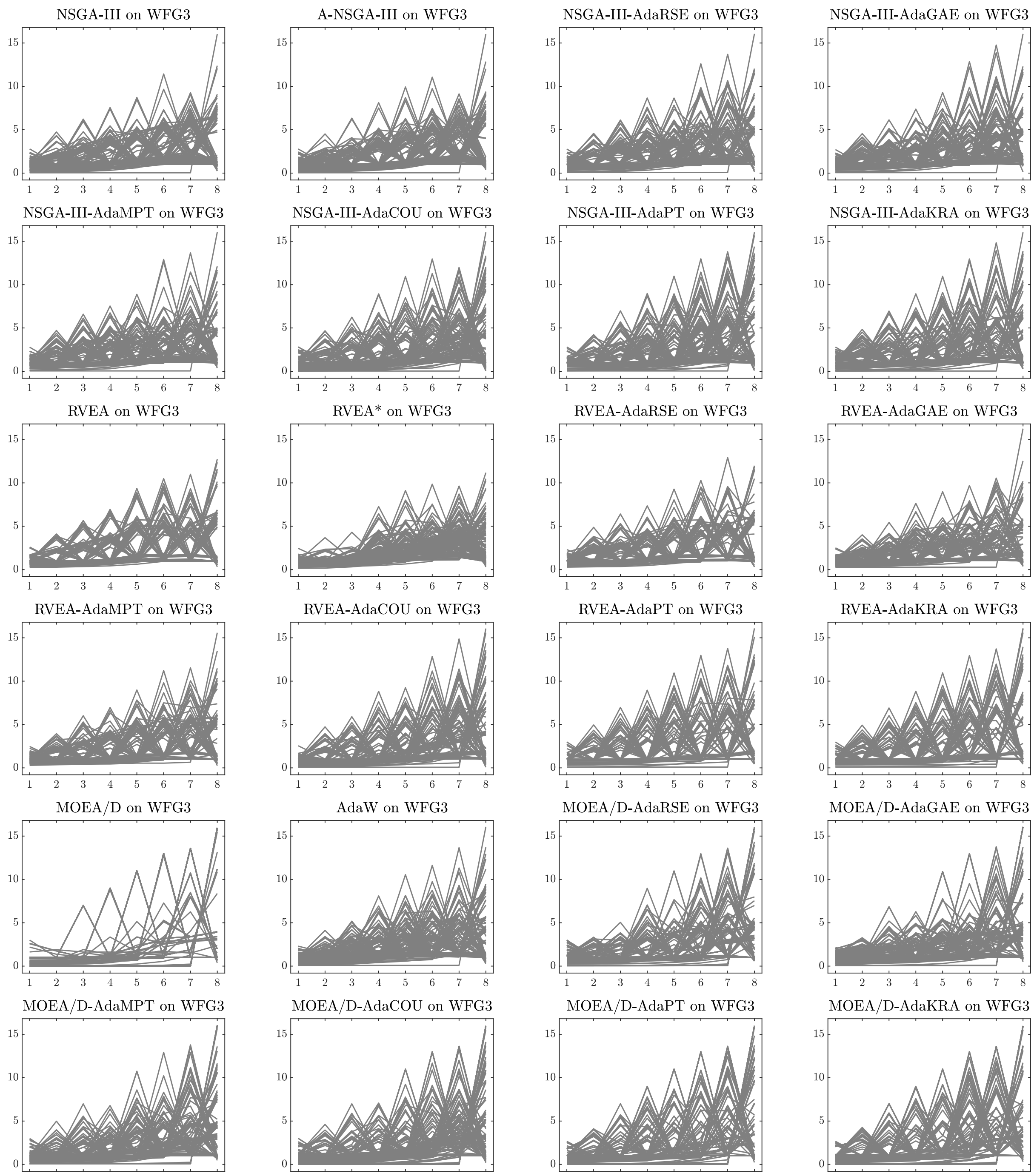

Figure 63: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3 with 8 objective functions.

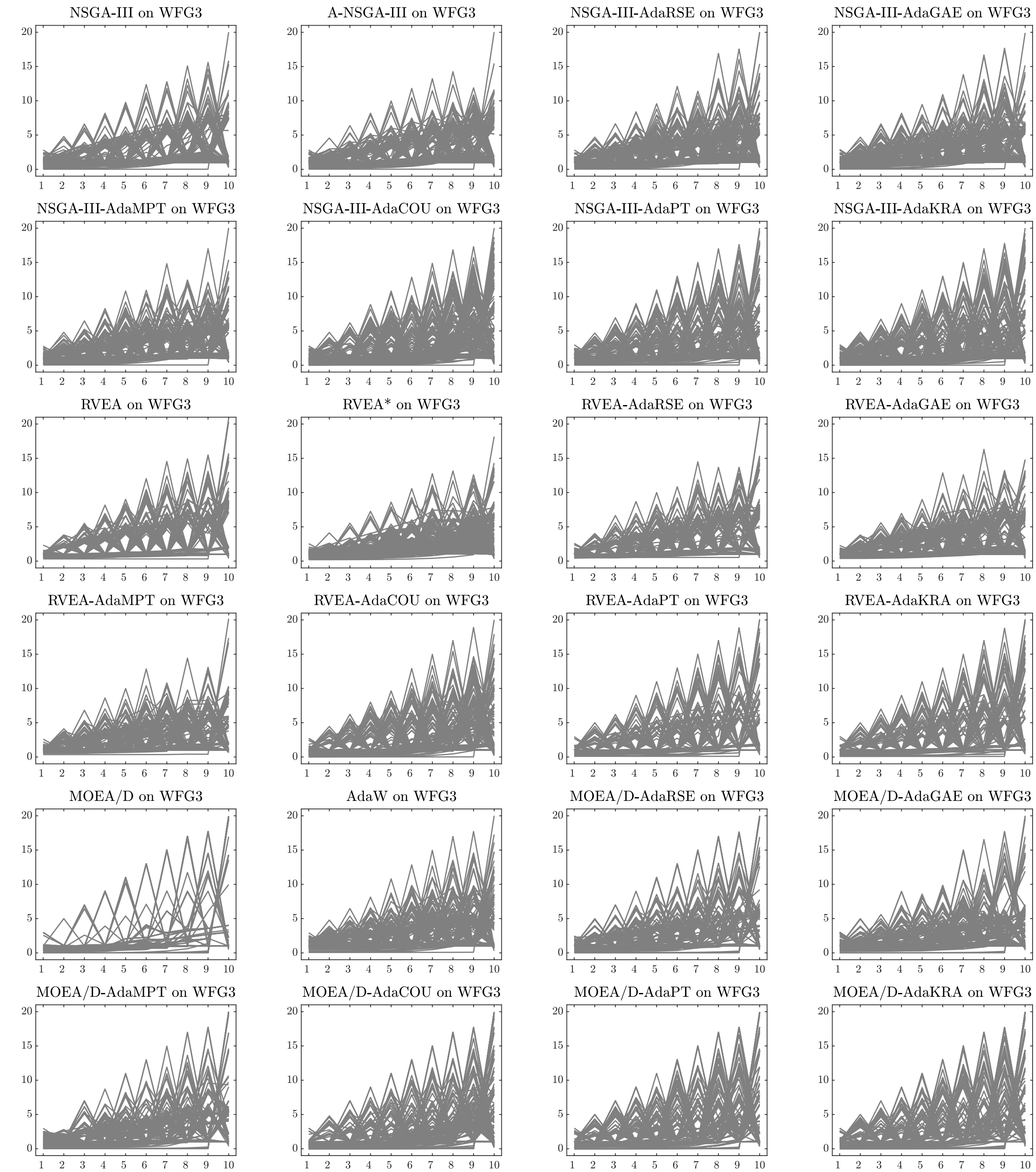

Figure 64: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3 with 10 objective functions.

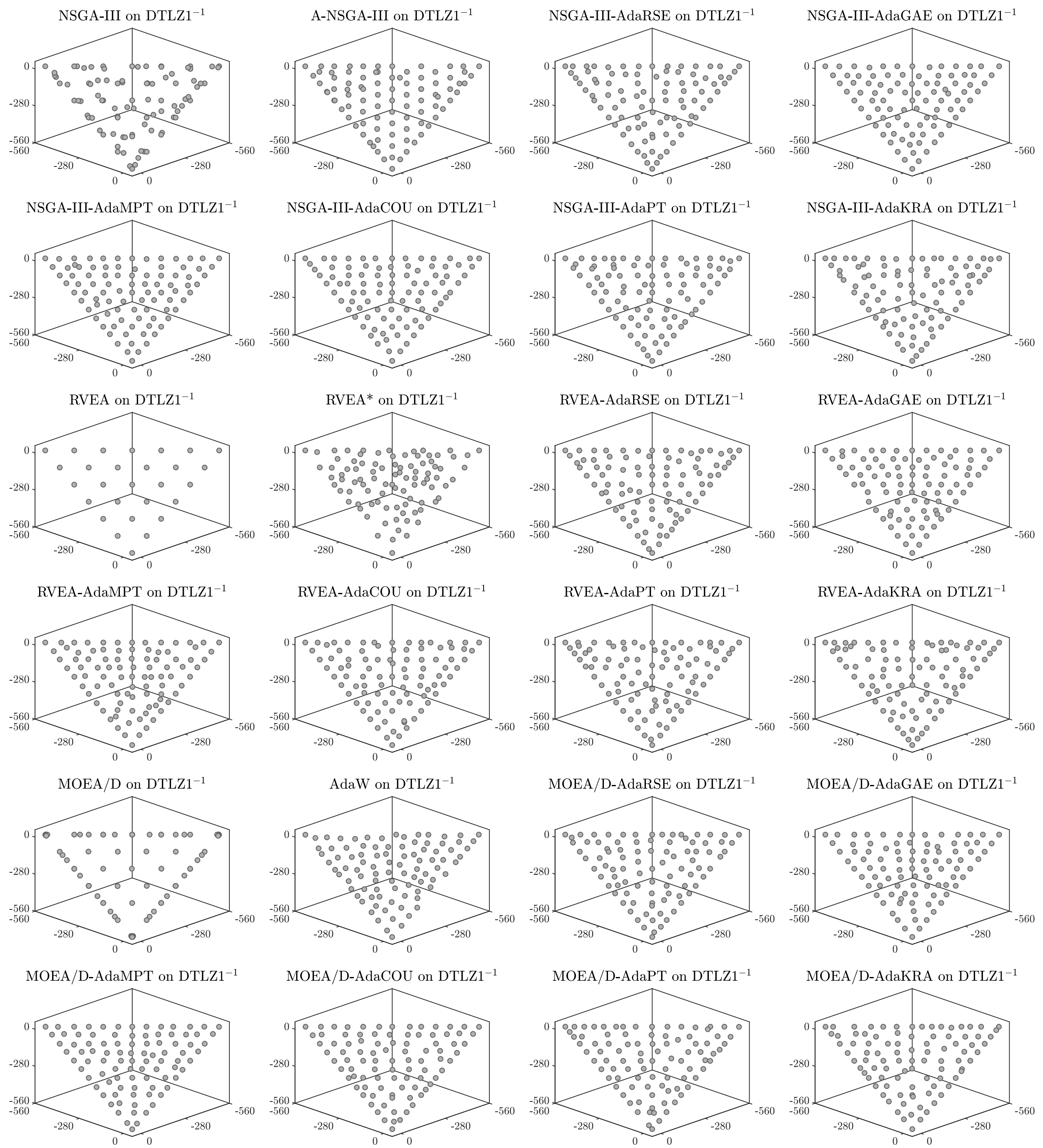

Figure 65: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 3 objective functions.

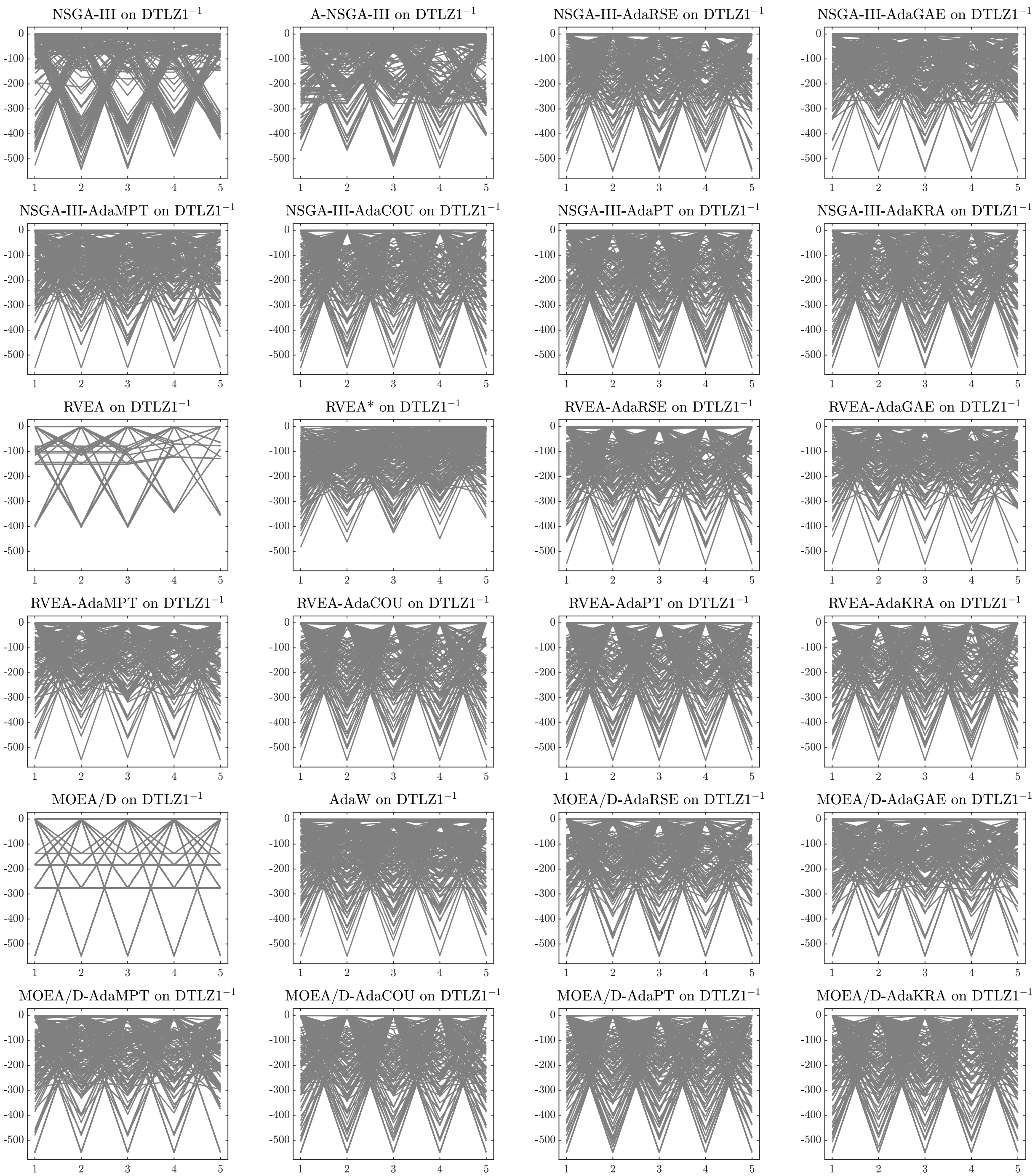

Figure 66: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 5 objective functions.

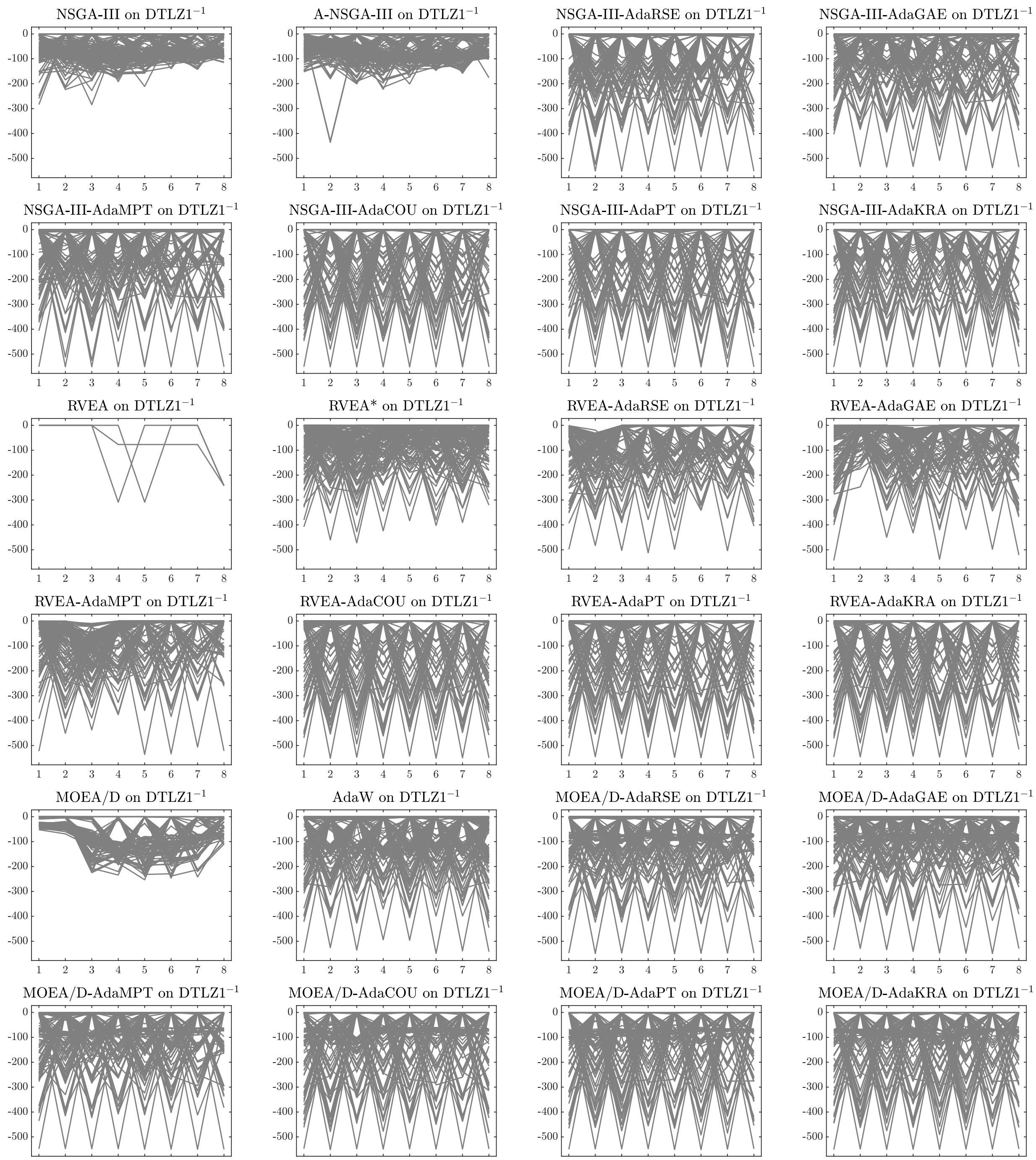

Figure 67: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 8 objective functions.

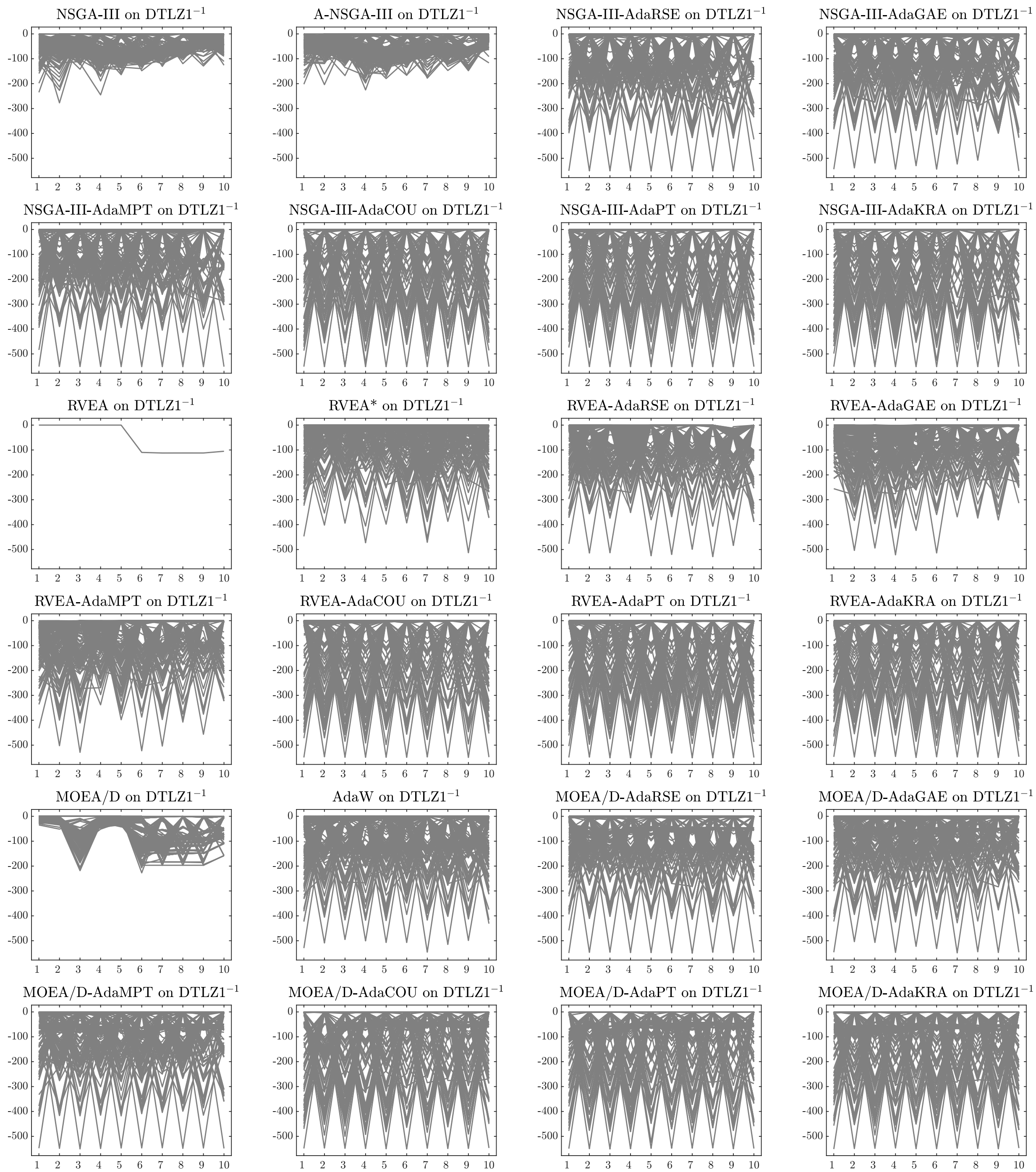

Figure 68: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 10 objective functions.

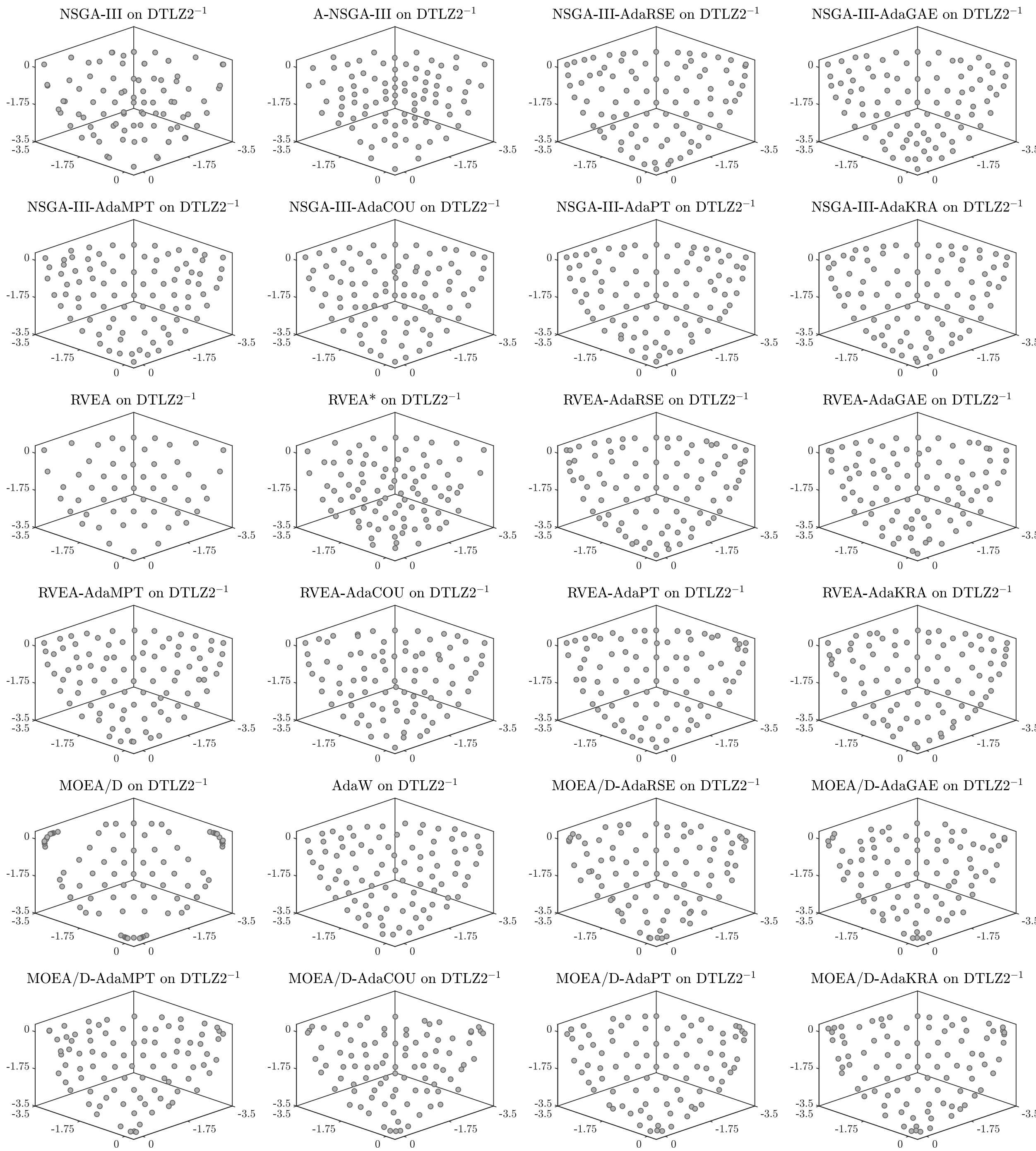

Figure 69: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2^{-1} with 3 objective functions.

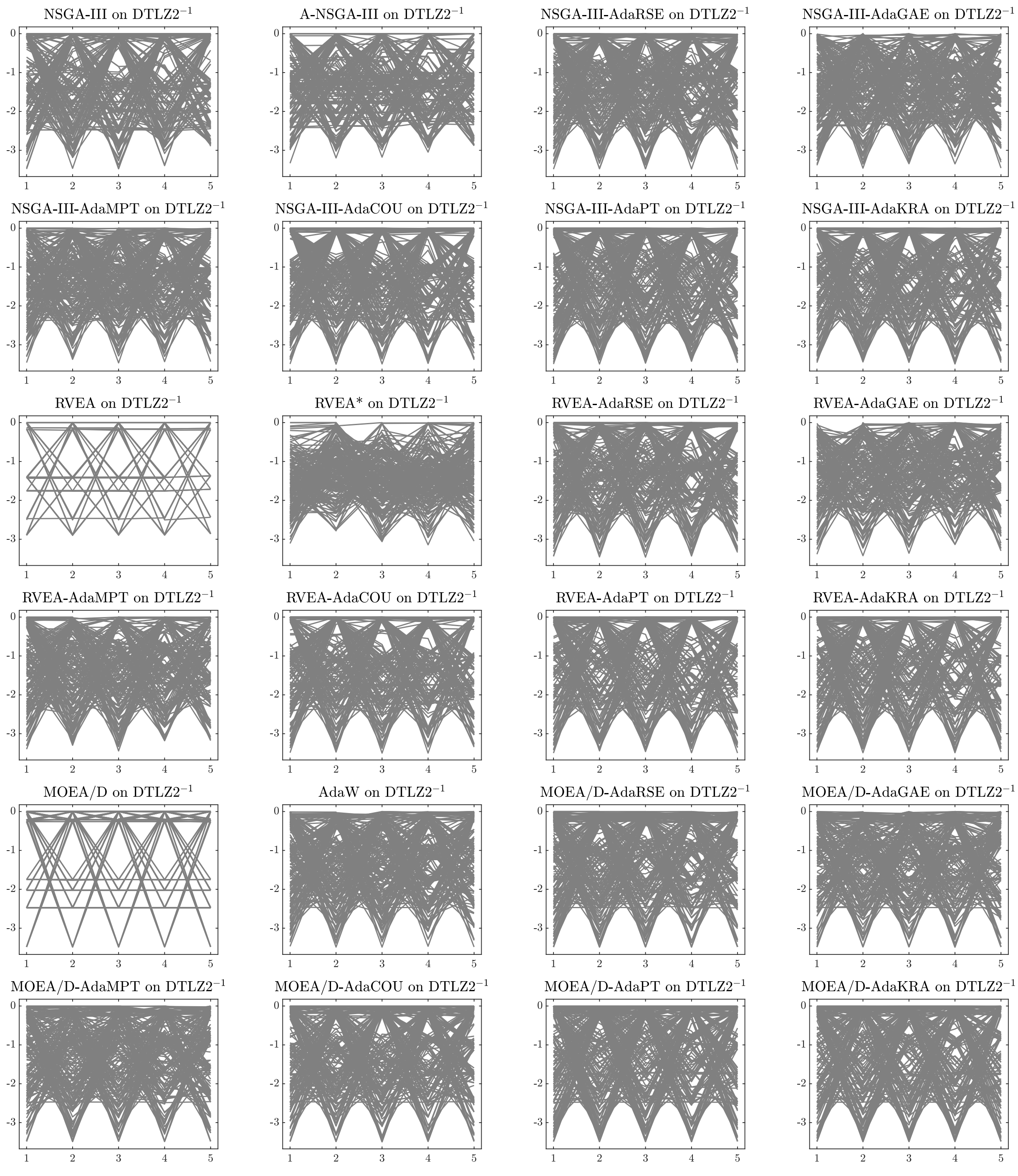

Figure 70: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2^{-1} with 5 objective functions.

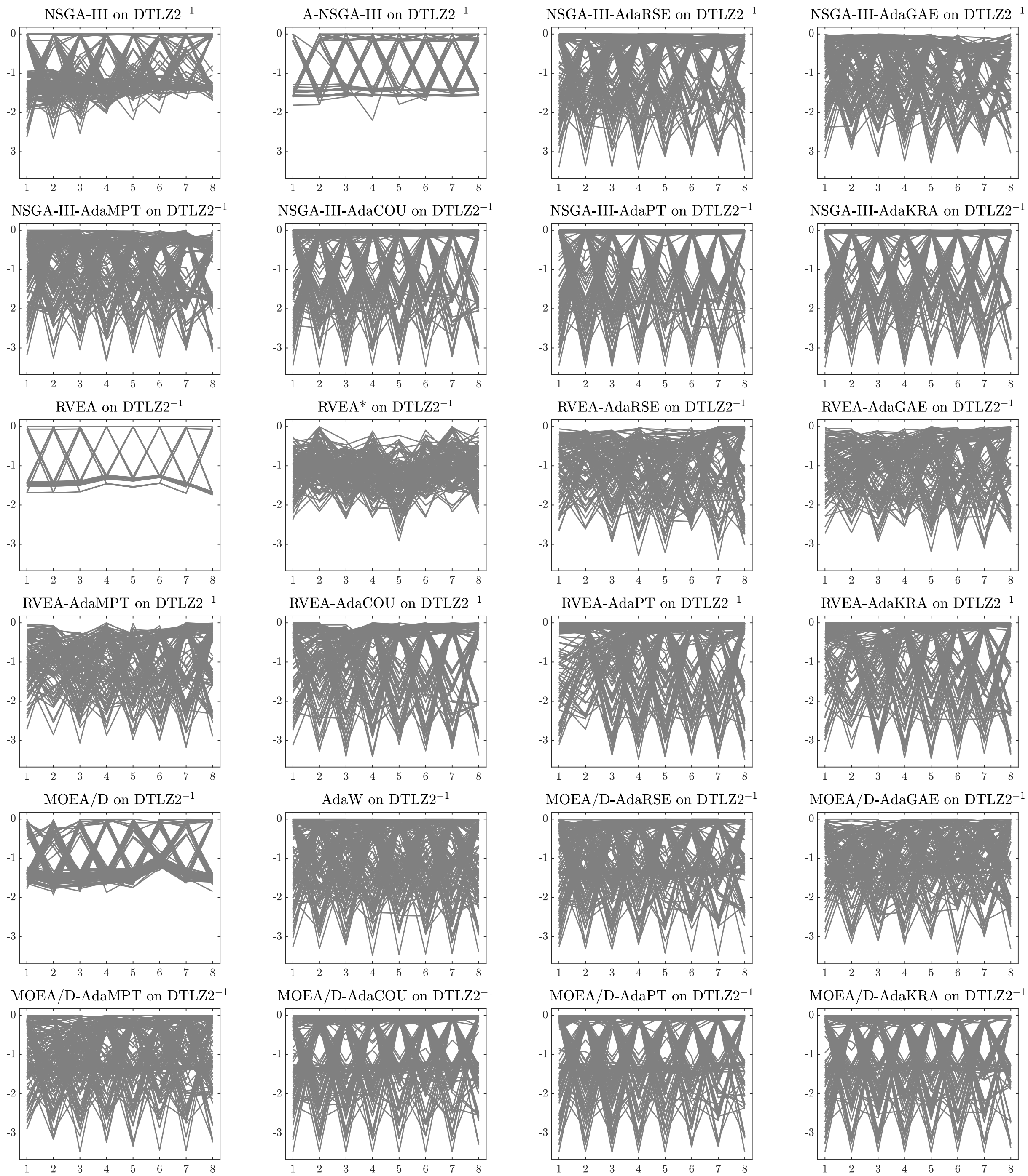

Figure 71: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2^{-1} with 8 objective functions.

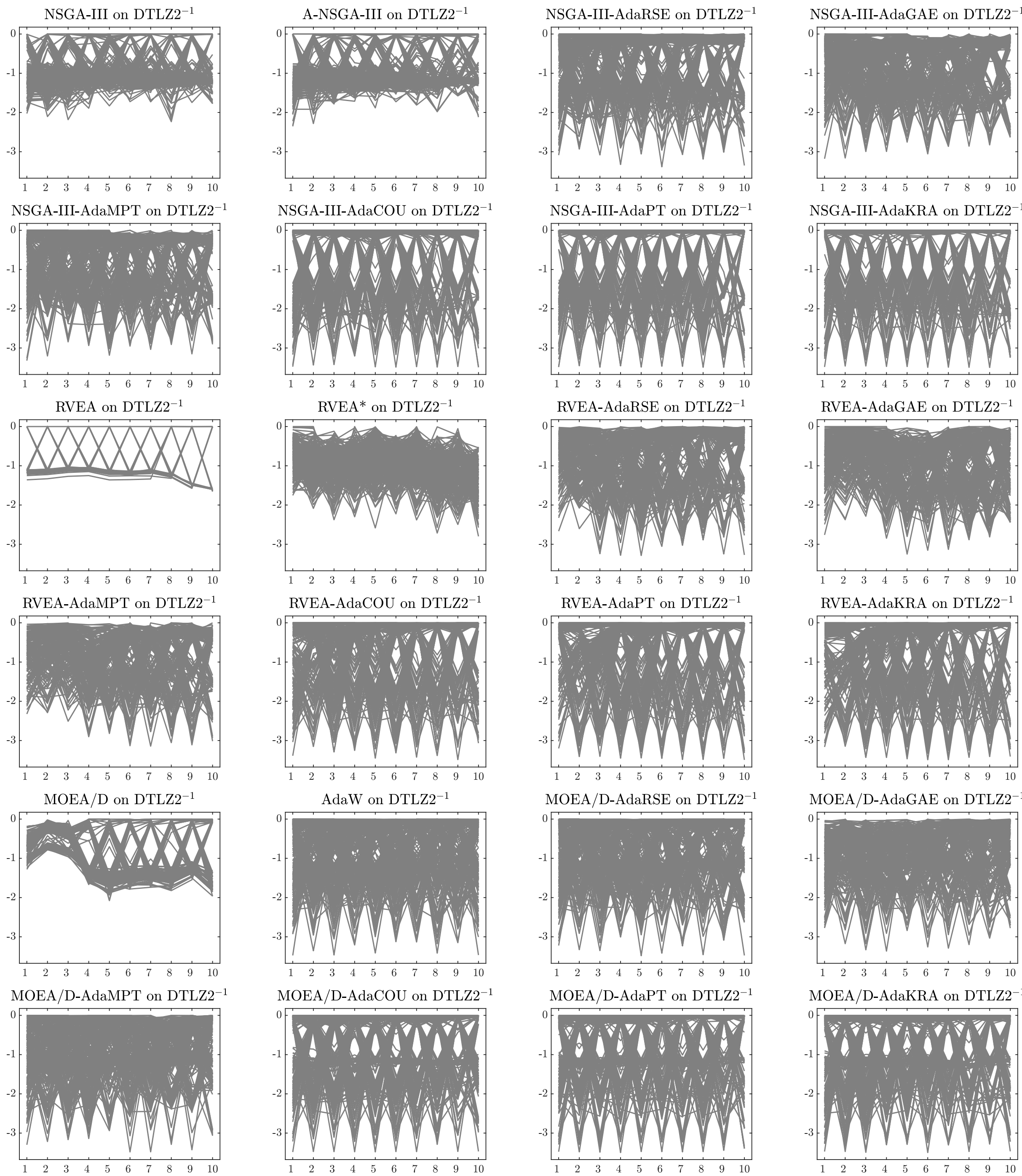

Figure 72: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ2^{-1} with 10 objective functions.

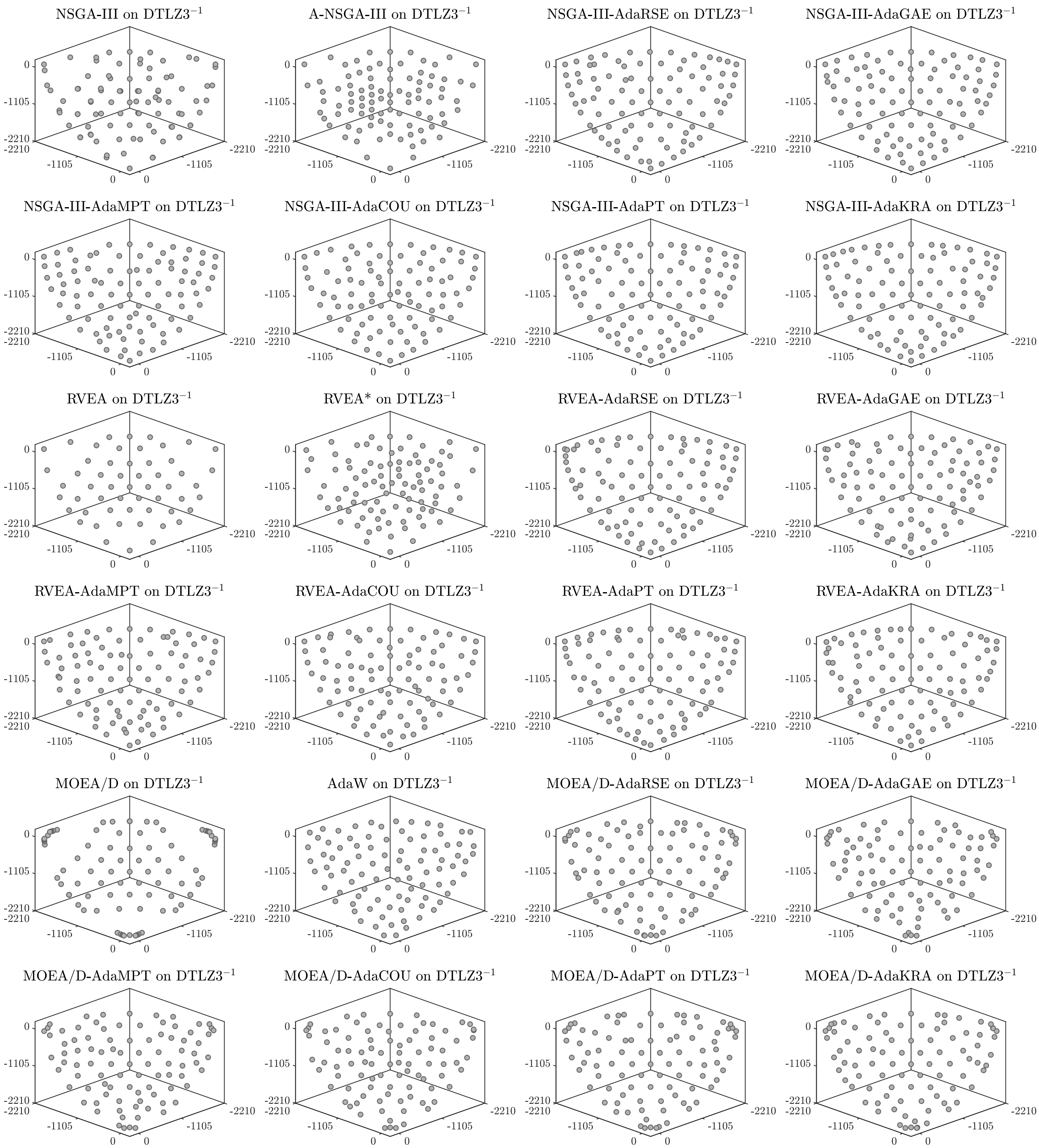

Figure 73: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3^{-1} with 3 objective functions.

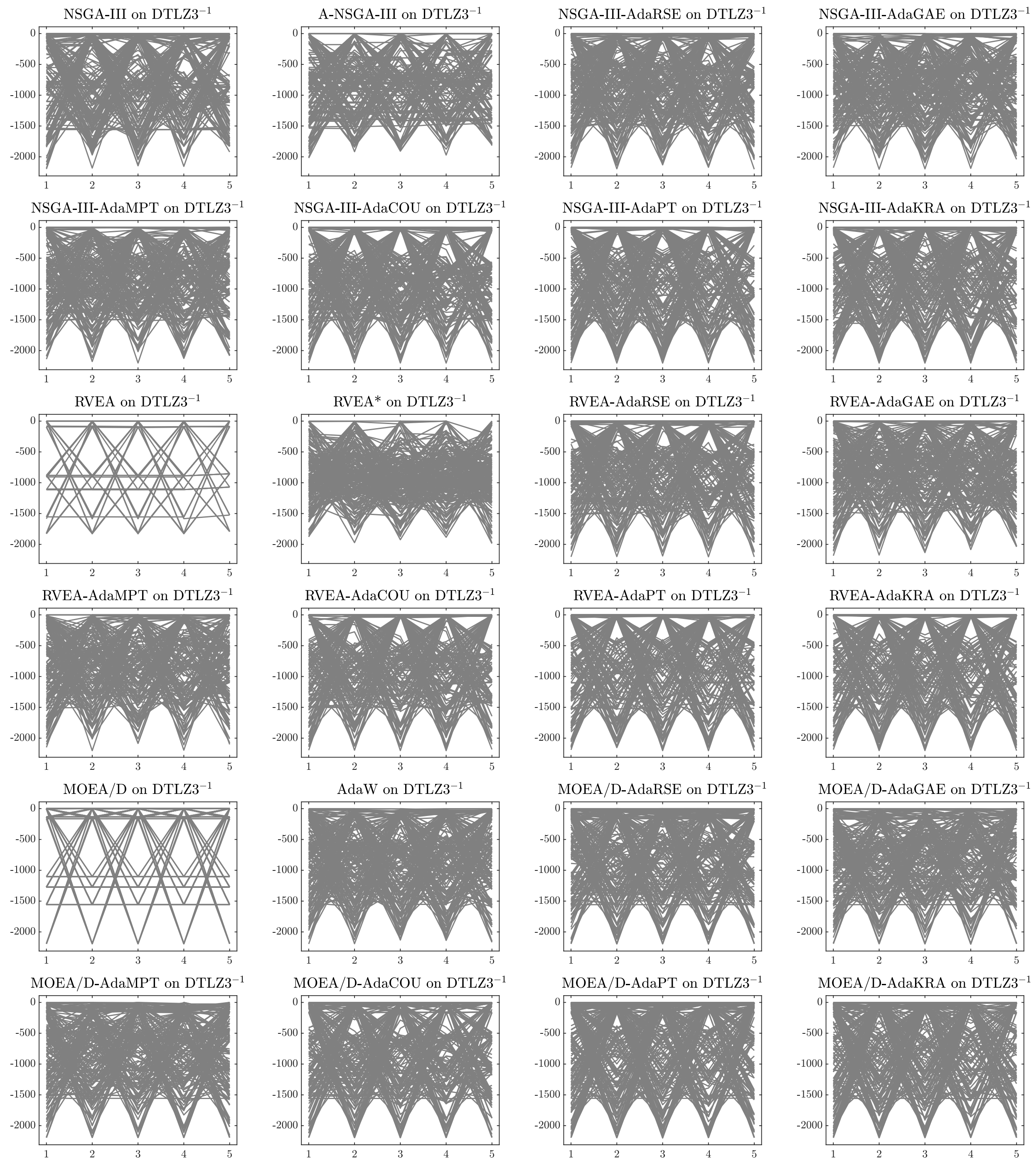

Figure 74: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3^{-1} with 5 objective functions.

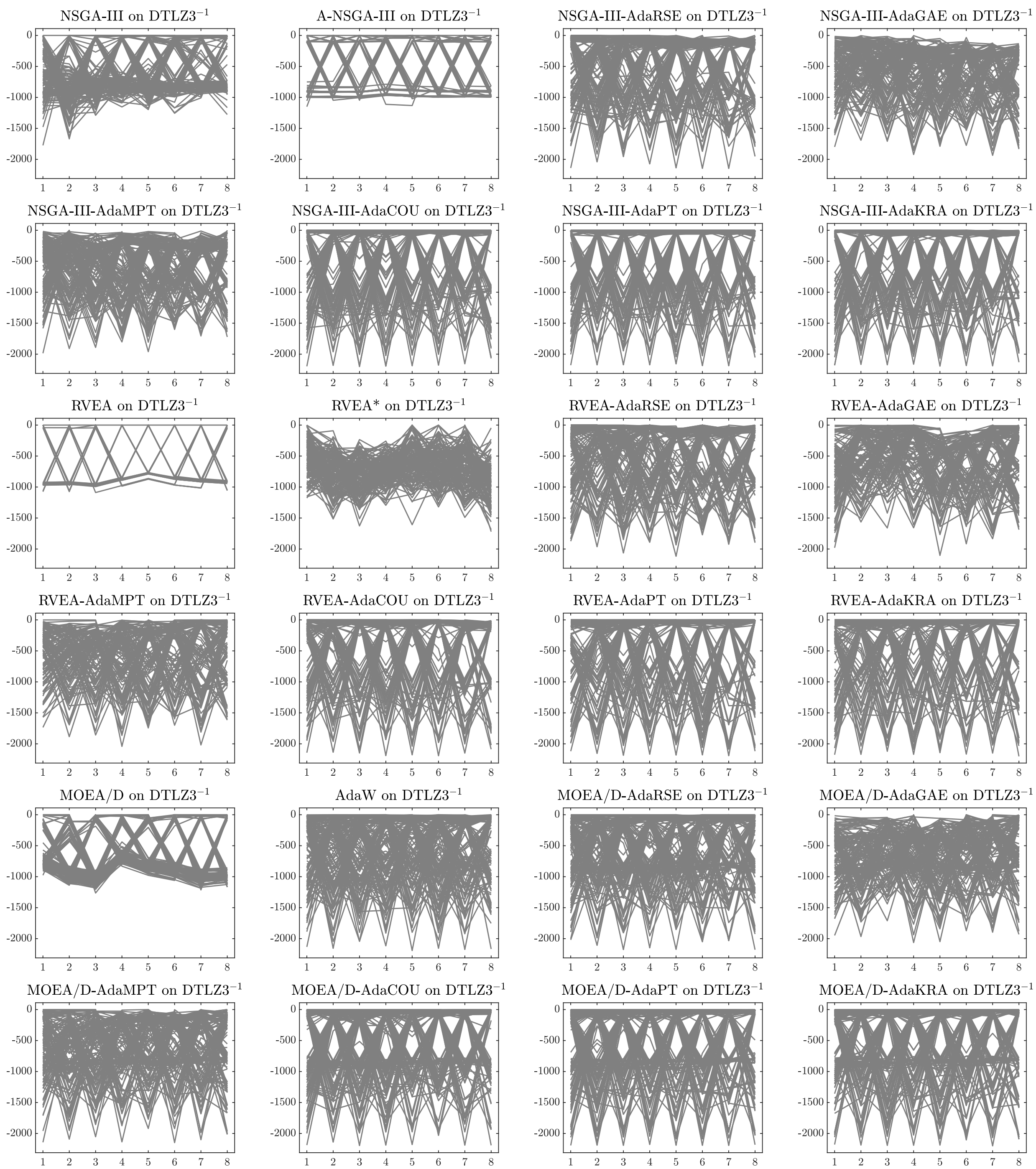

Figure 75: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3^{-1} with 8 objective functions.

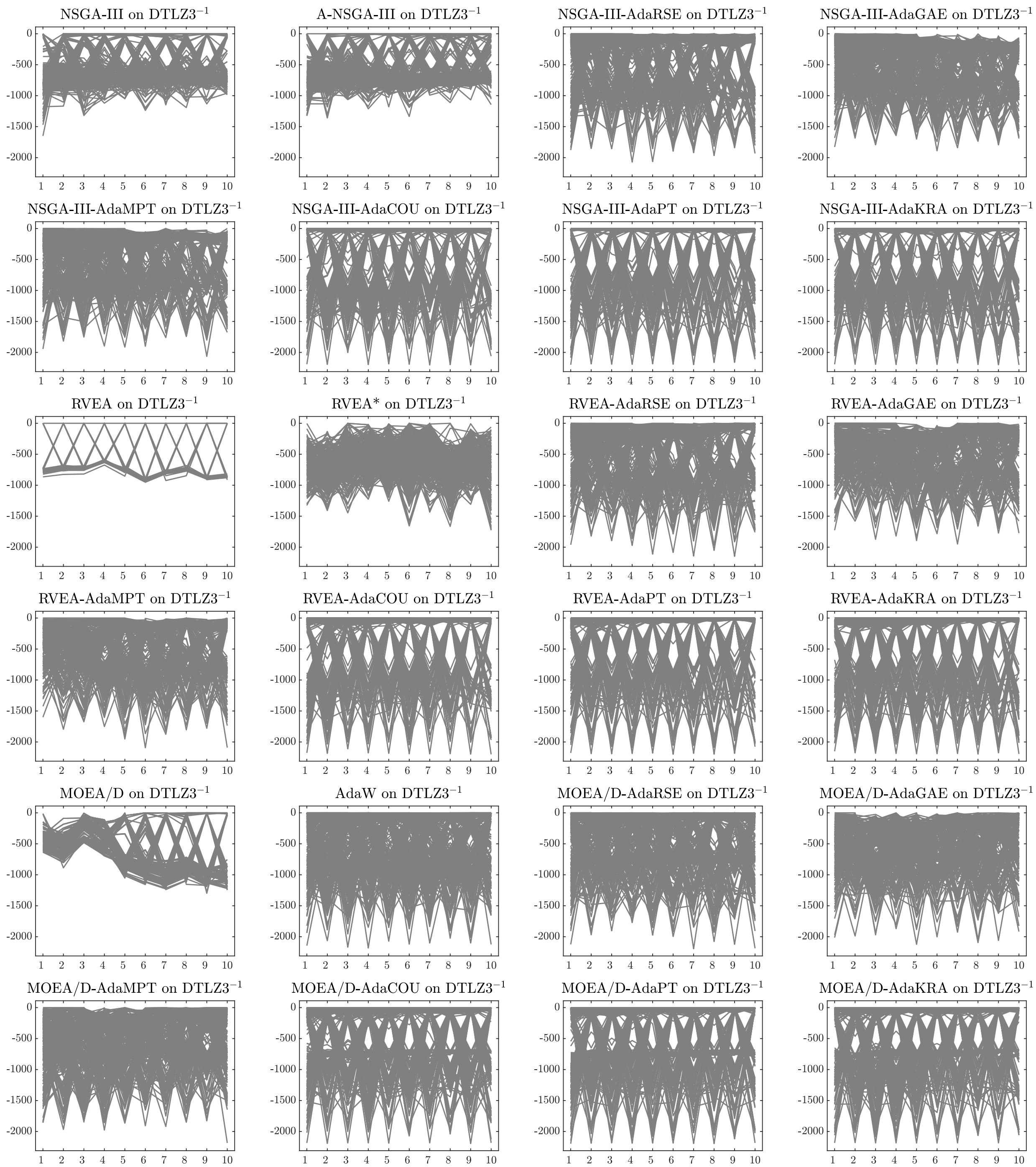

Figure 76: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ3^{-1} with 10 objective functions.

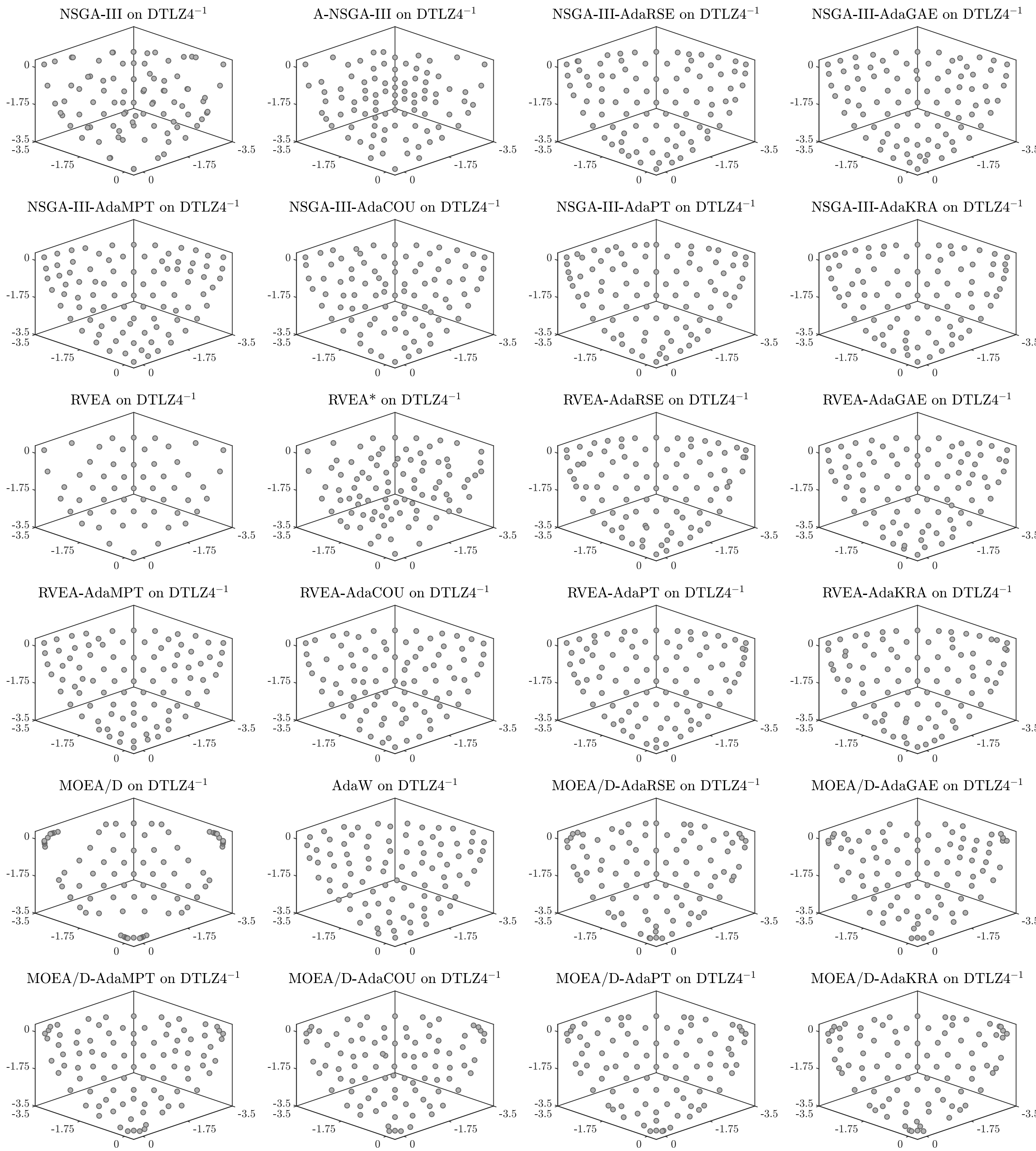

Figure 77: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4^{-1} with 3 objective functions.

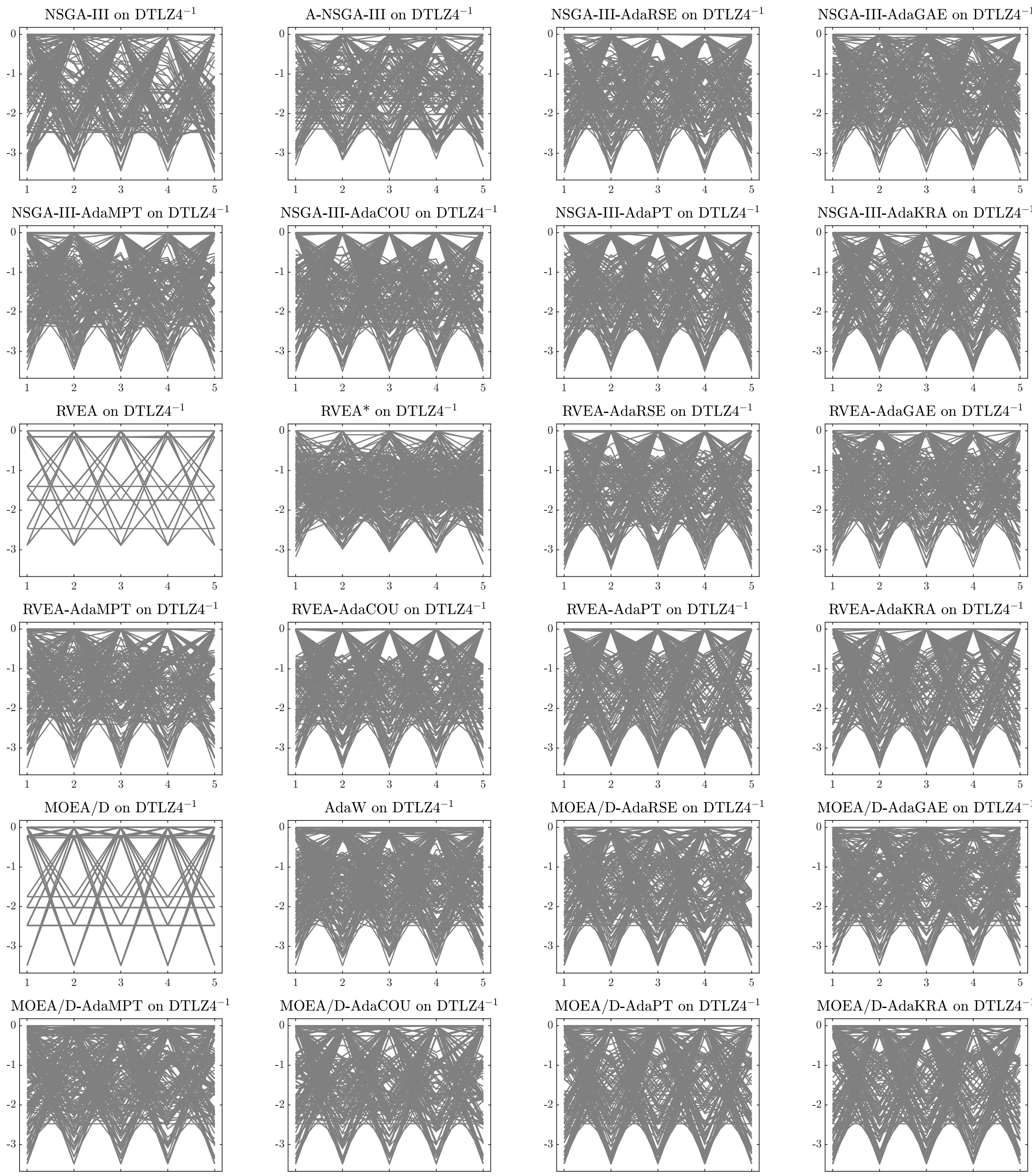

Figure 78: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4^{-1} with 5 objective functions.

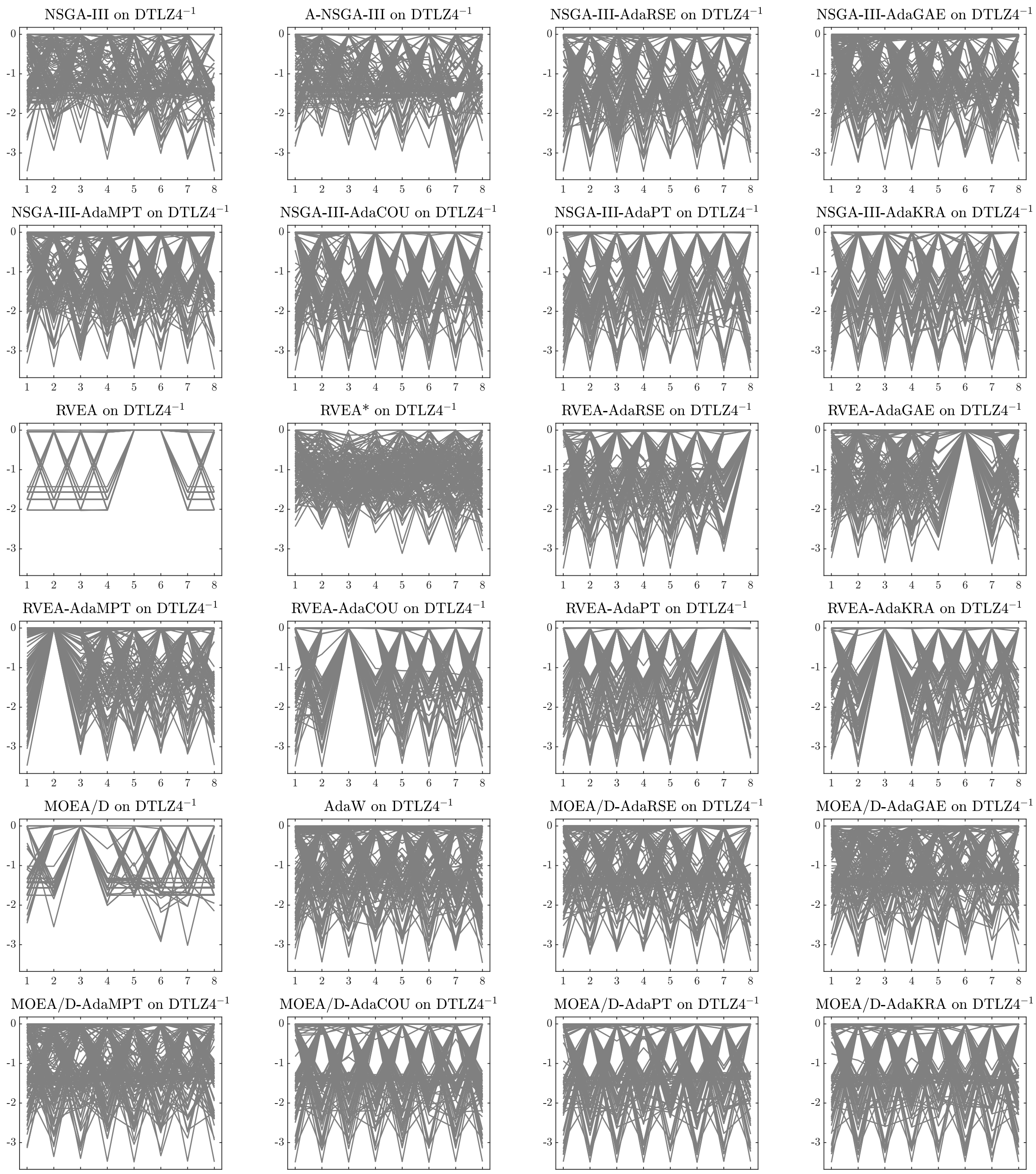

Figure 79: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4^{-1} with 8 objective functions.

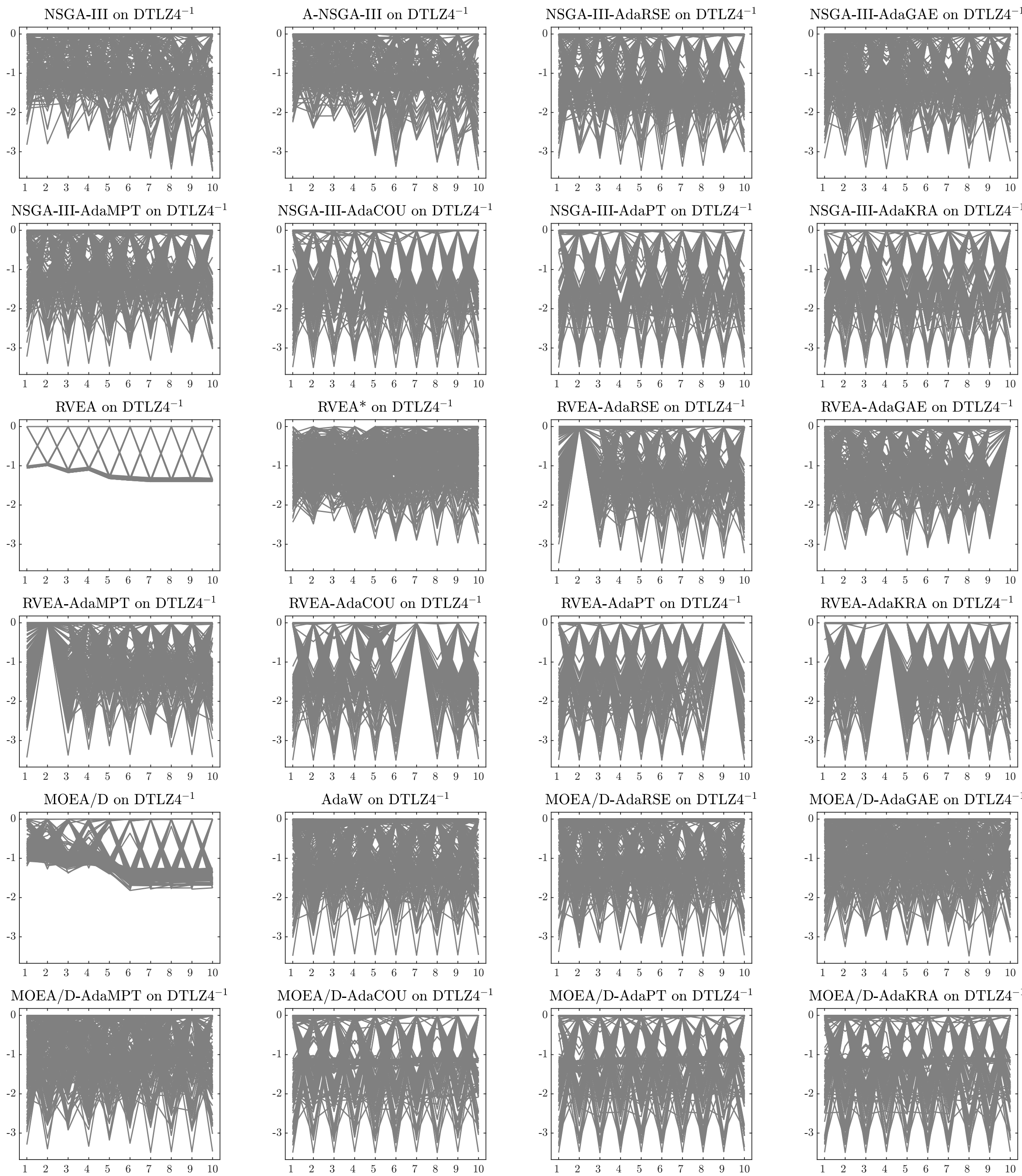

Figure 80: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ4^{-1} with 10 objective functions.

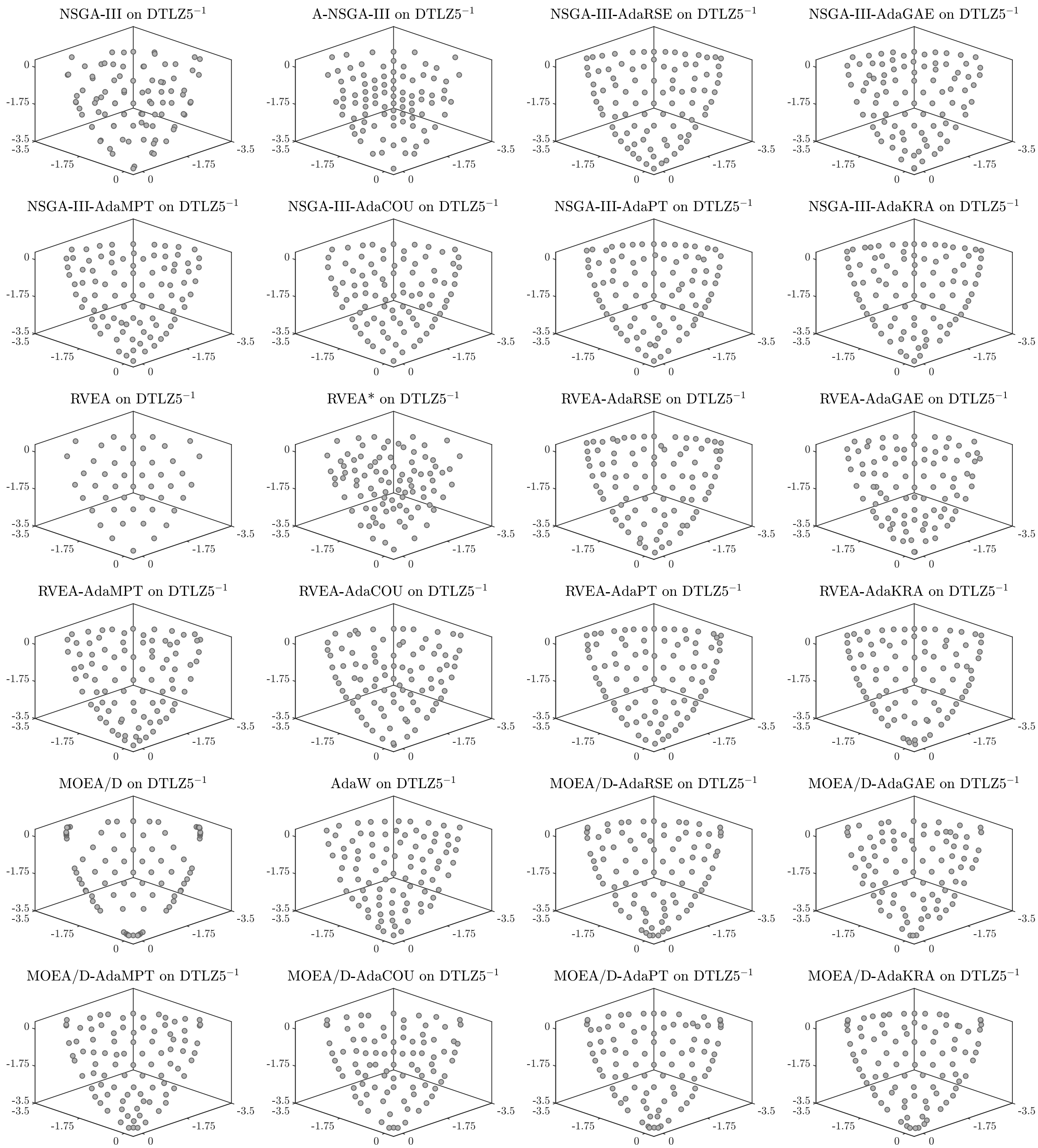

Figure 81: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5^{-1} with 3 objective functions.

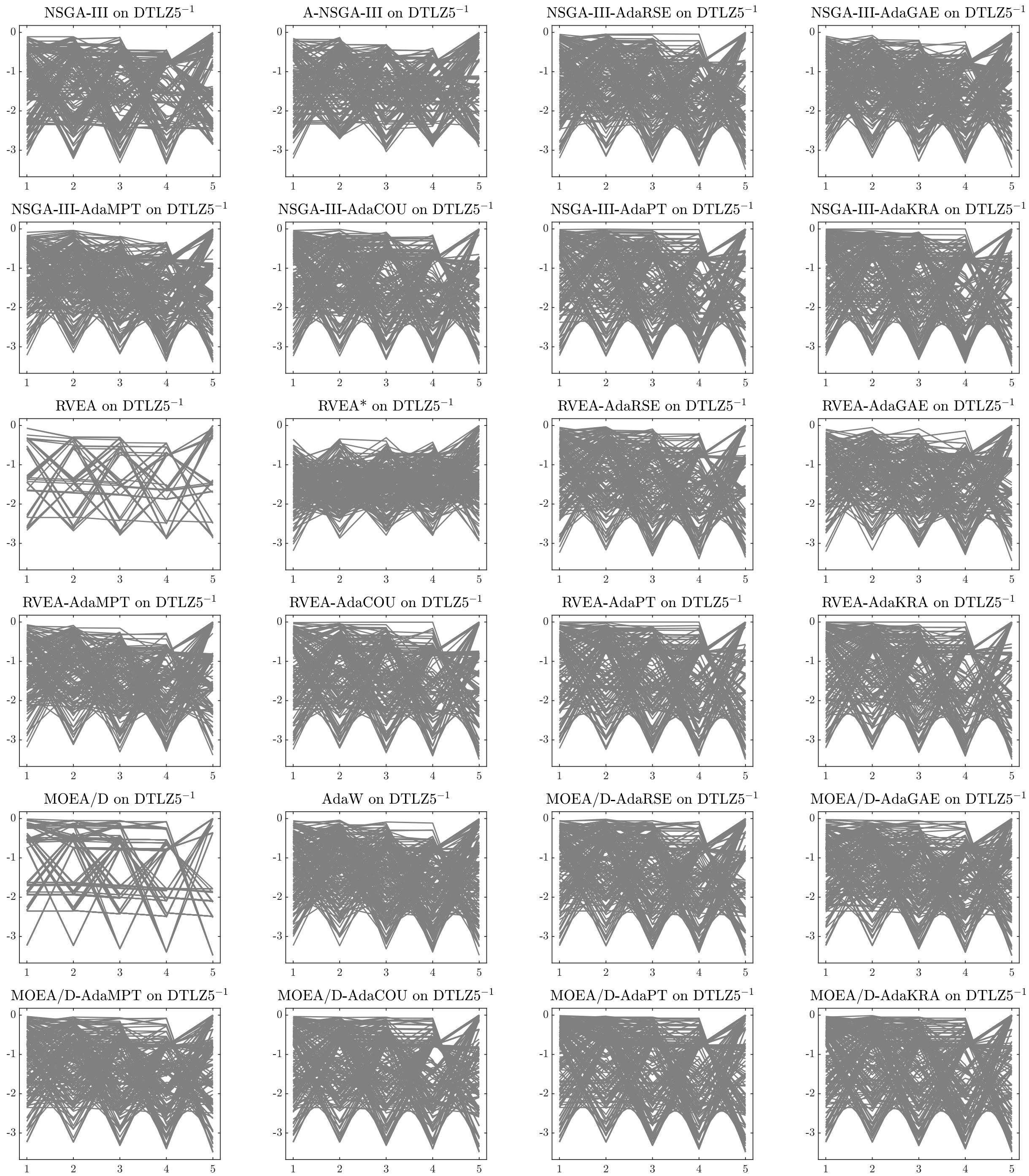

Figure 82: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5^{-1} with 5 objective functions.

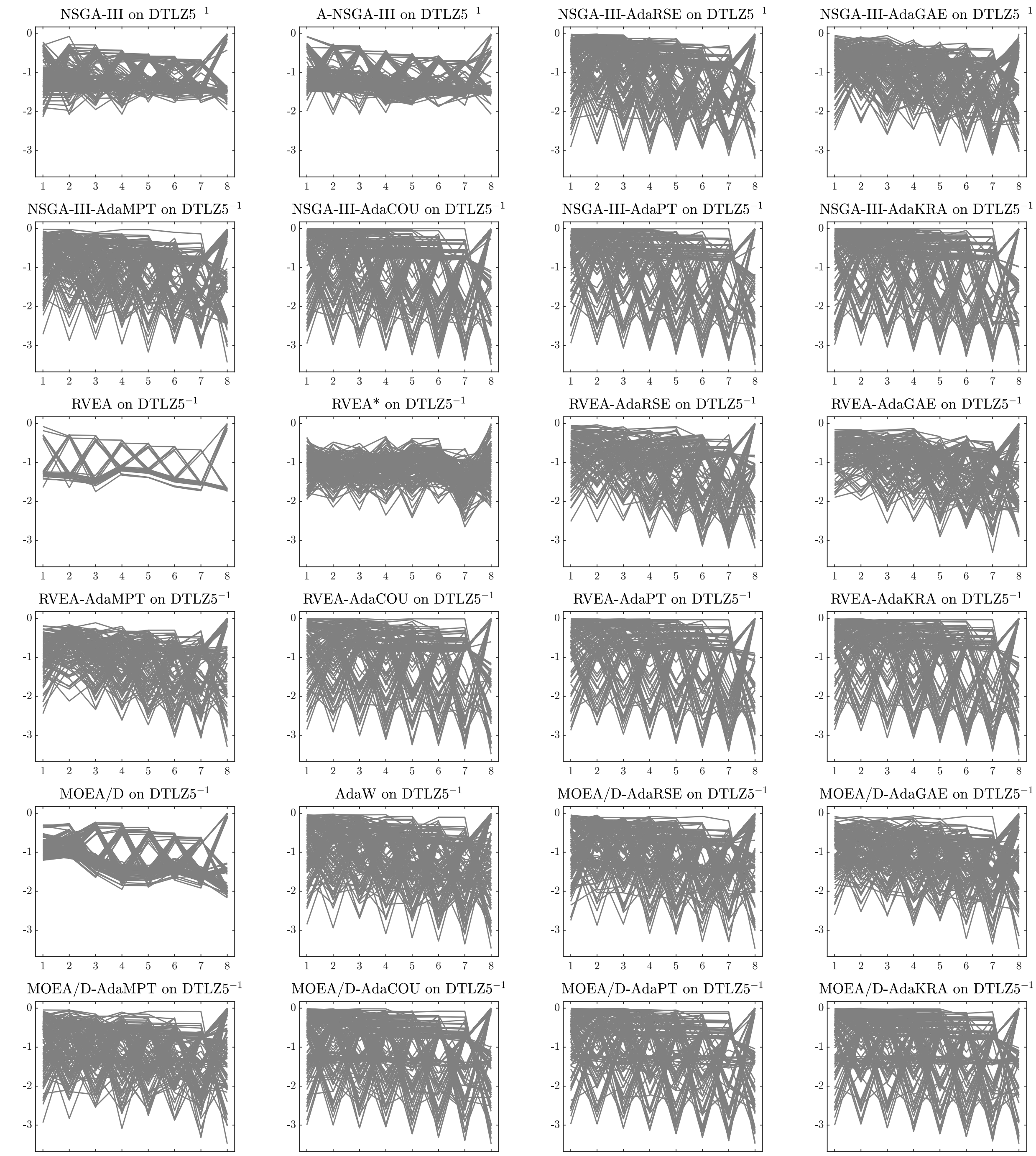

Figure 83: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5^{-1} with 8 objective functions.

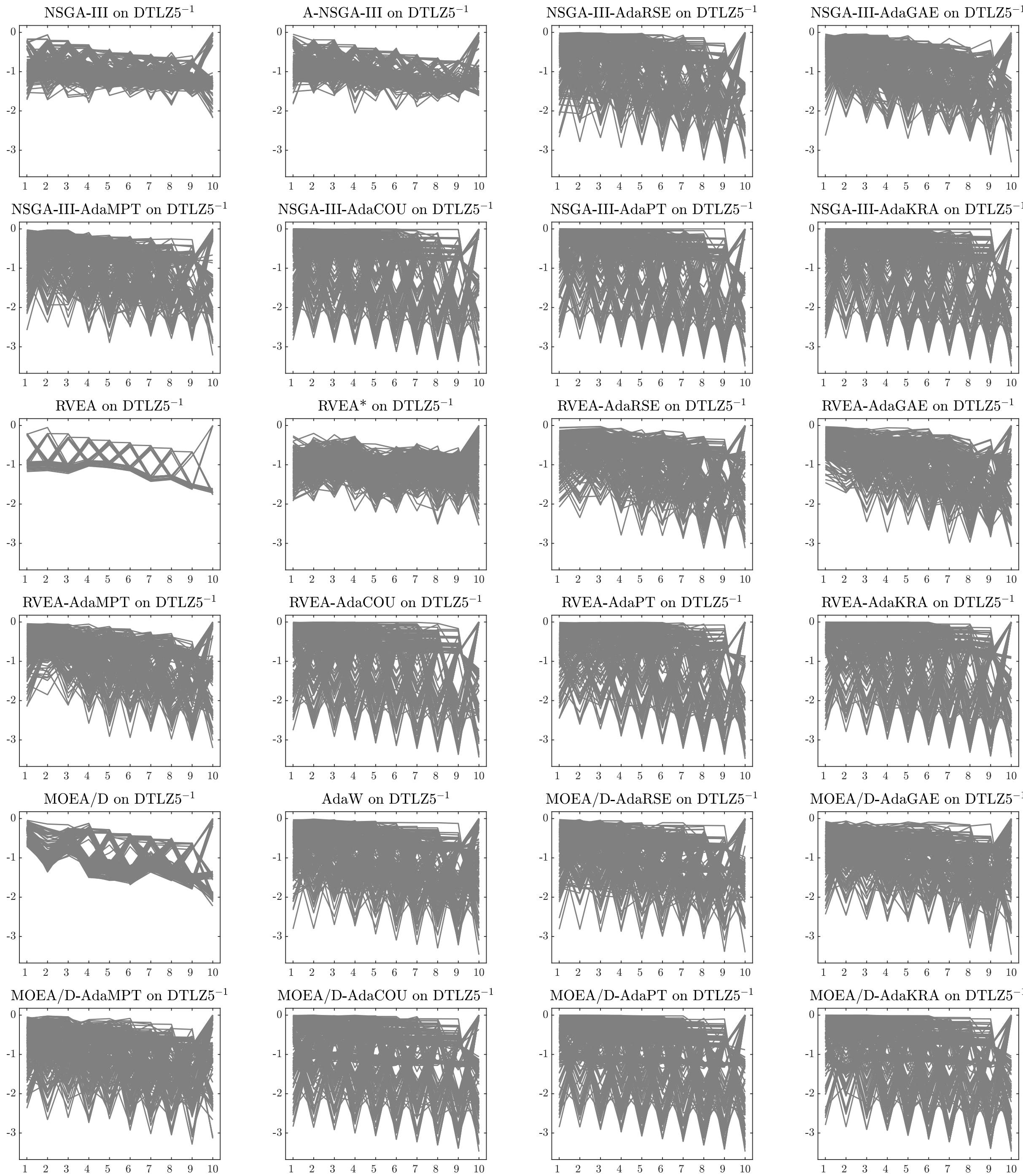

Figure 84: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ5^{-1} with 10 objective functions.

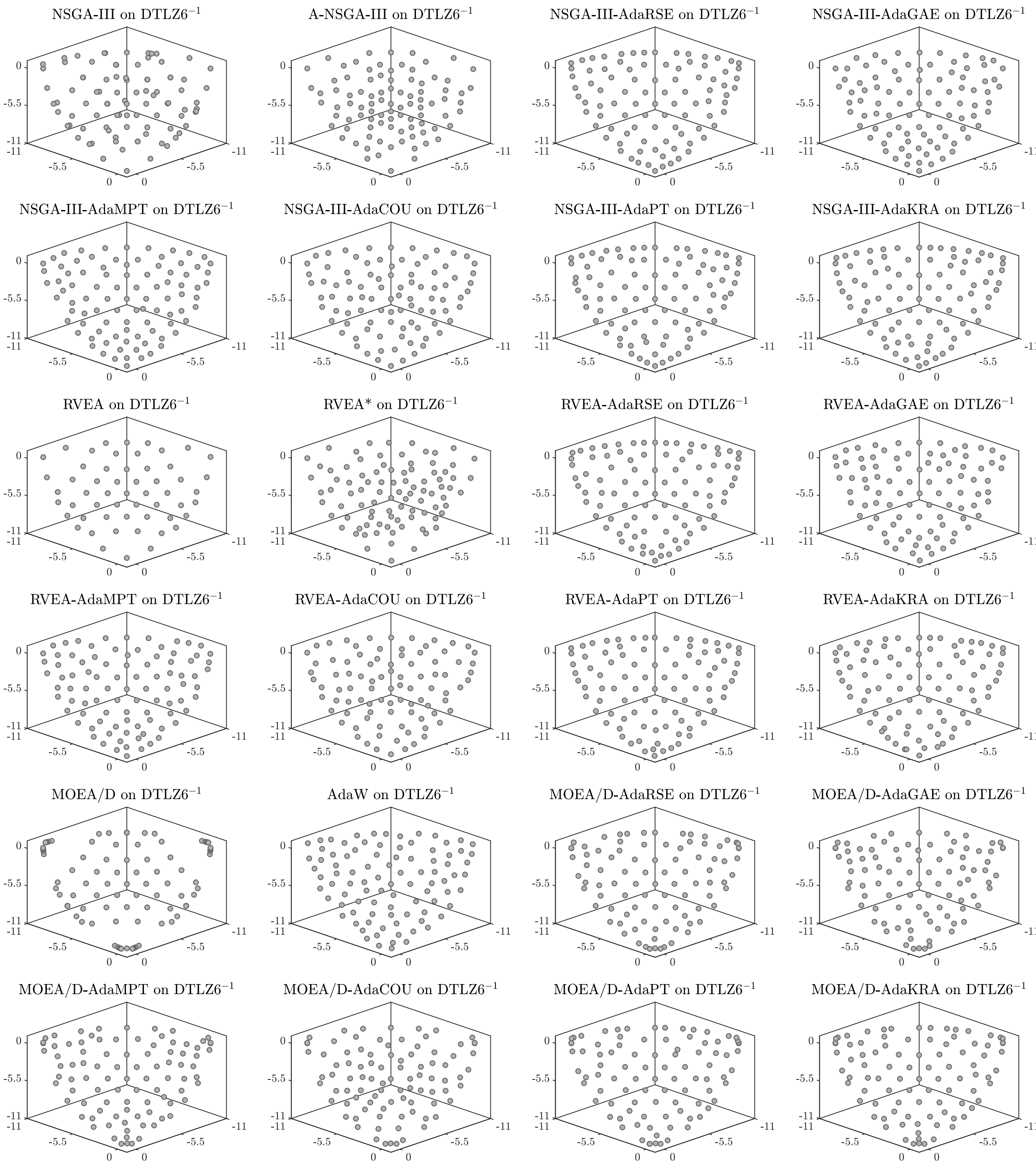

Figure 85: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6^{-1} with 3 objective functions.

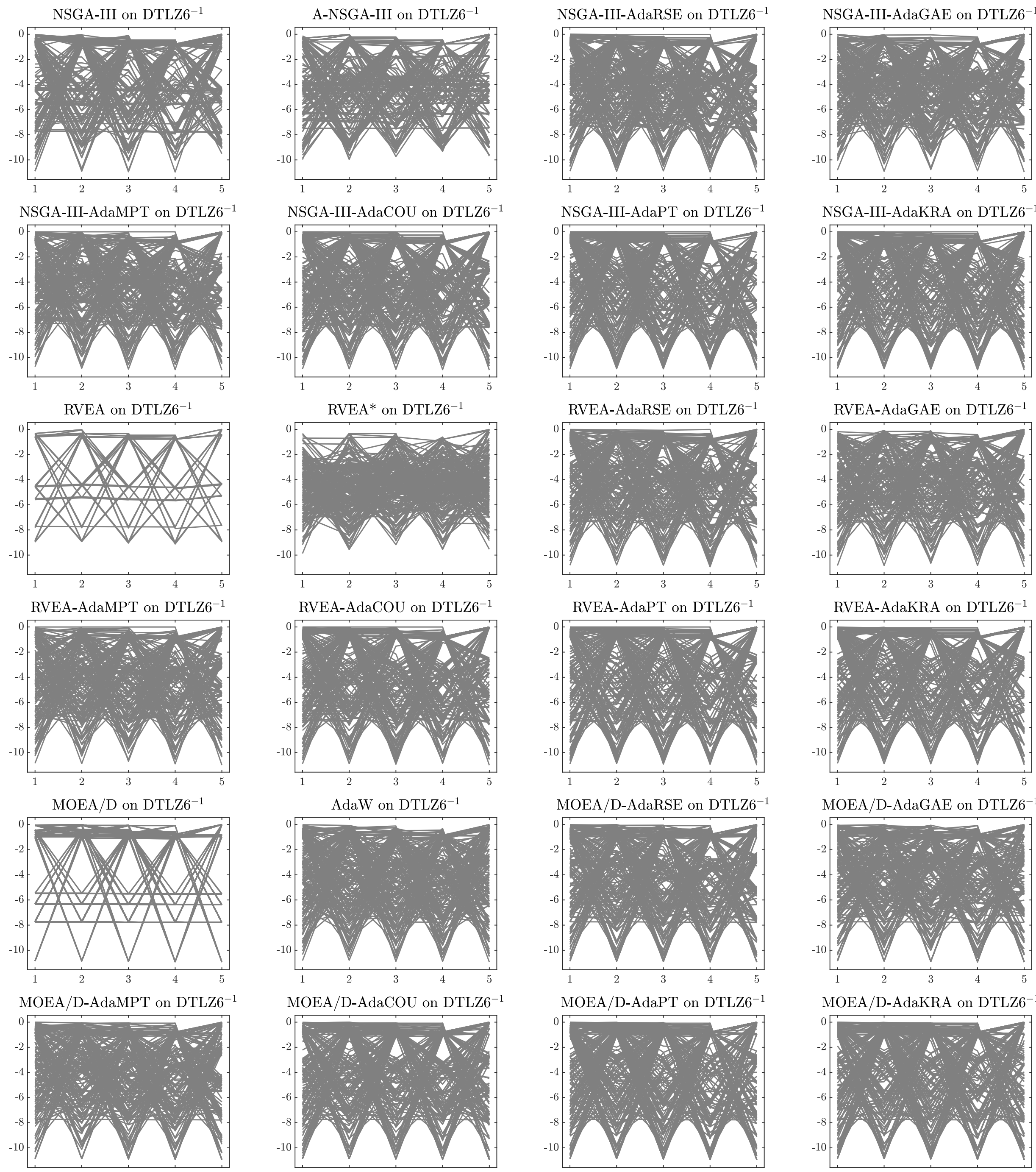

Figure 86: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6^{-1} with 5 objective functions.

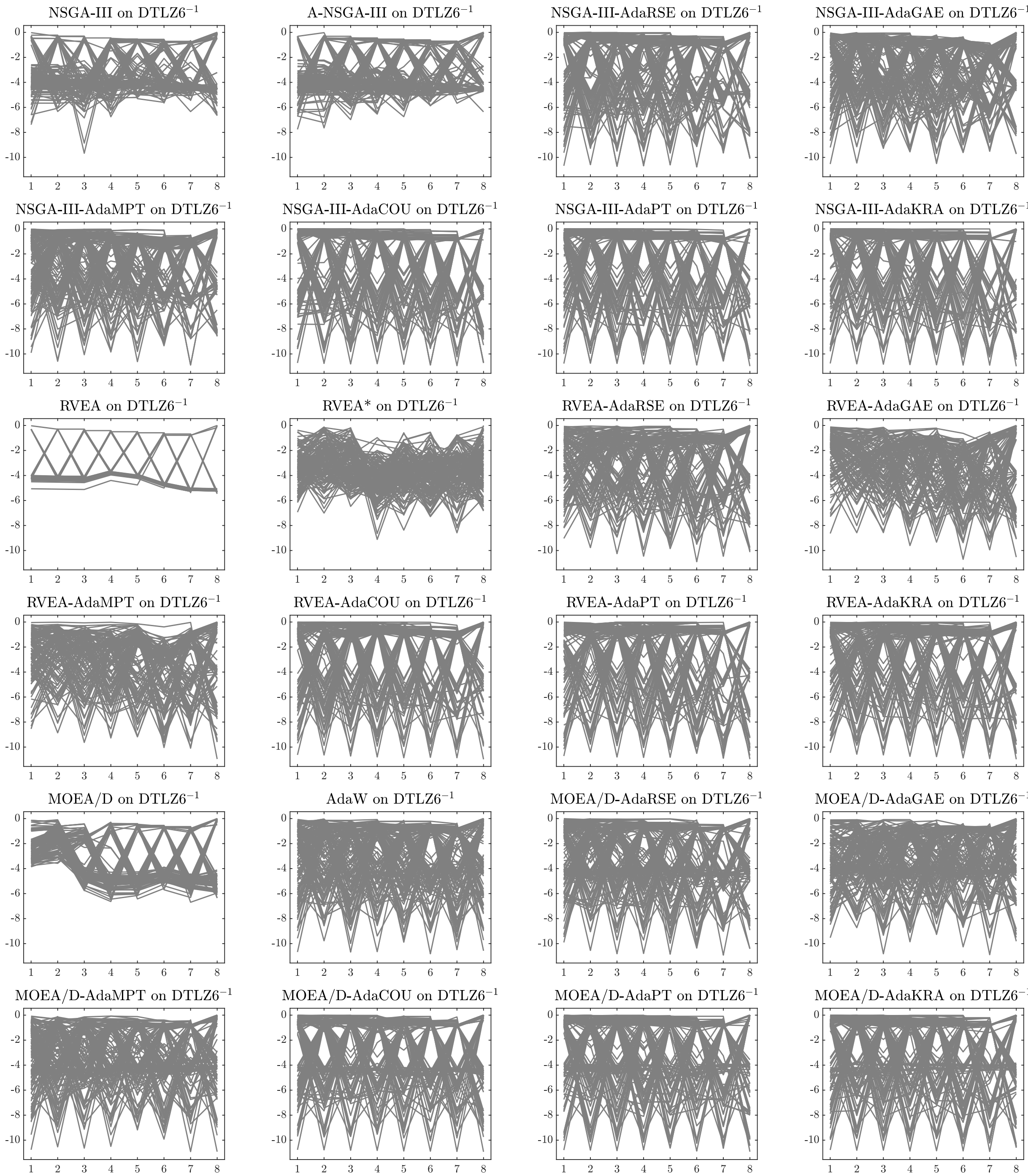

Figure 87: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6^{-1} with 8 objective functions.

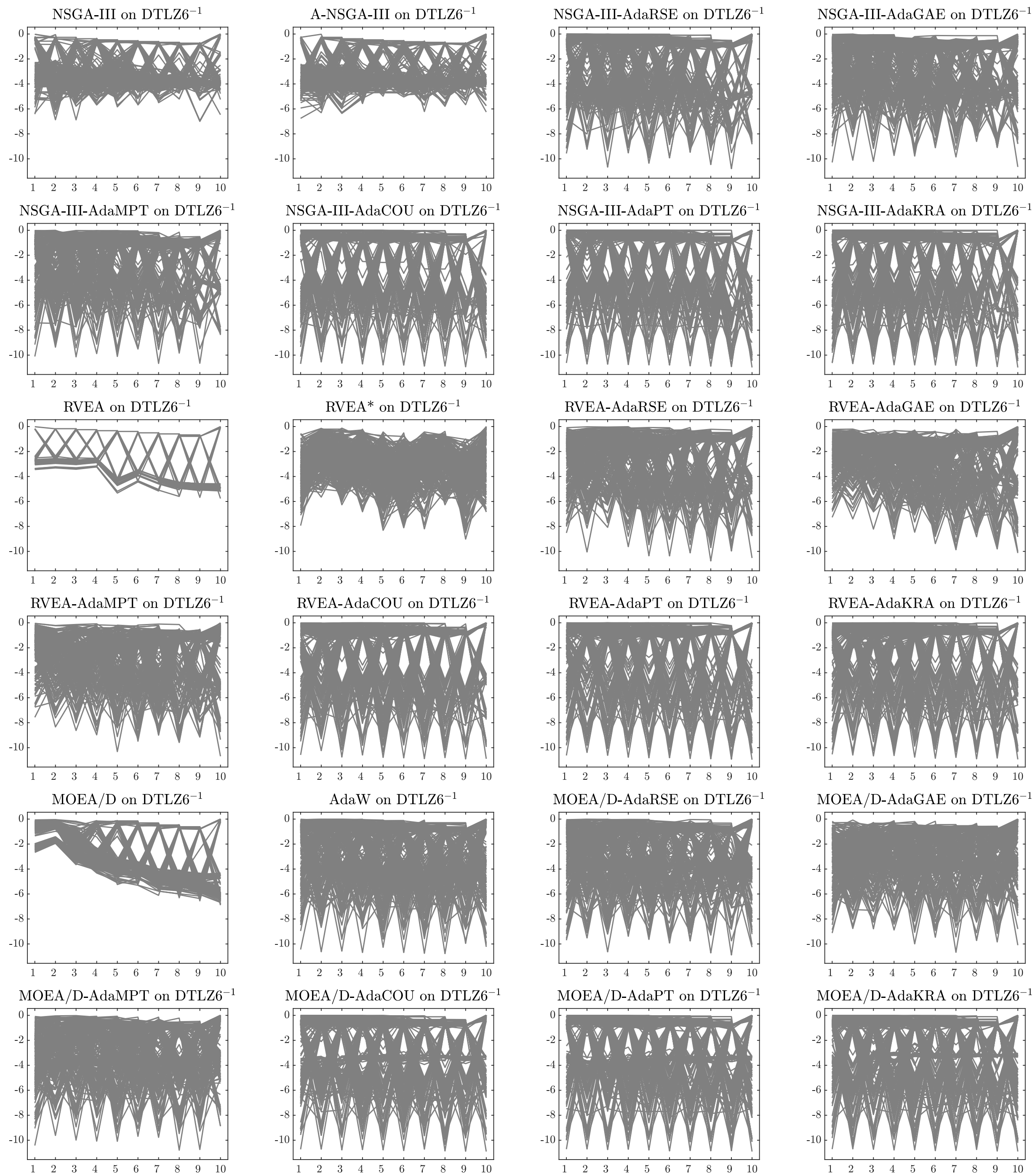

Figure 88: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ6^{-1} with 10 objective functions.

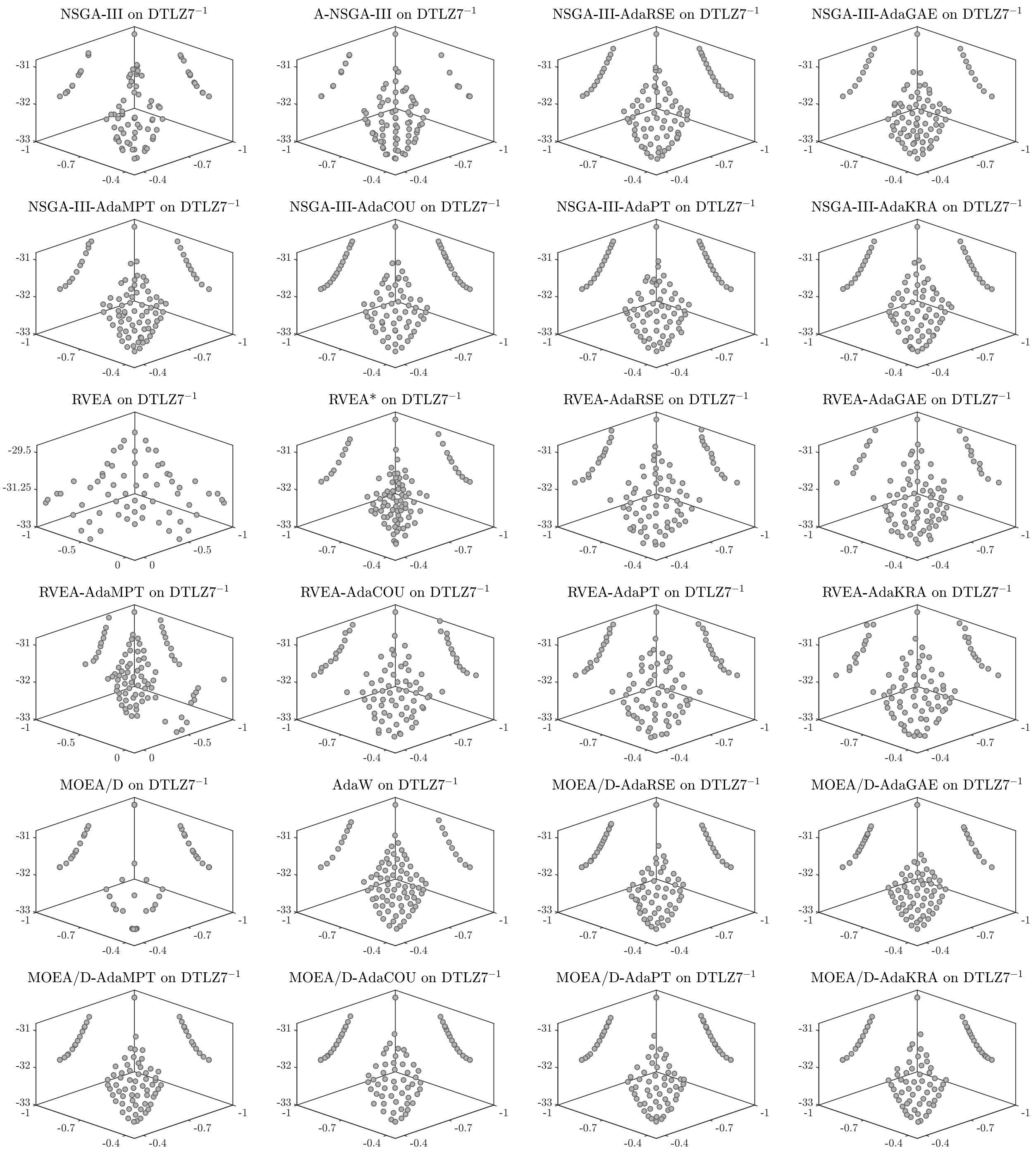

Figure 89: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7^{-1} with 3 objective functions.

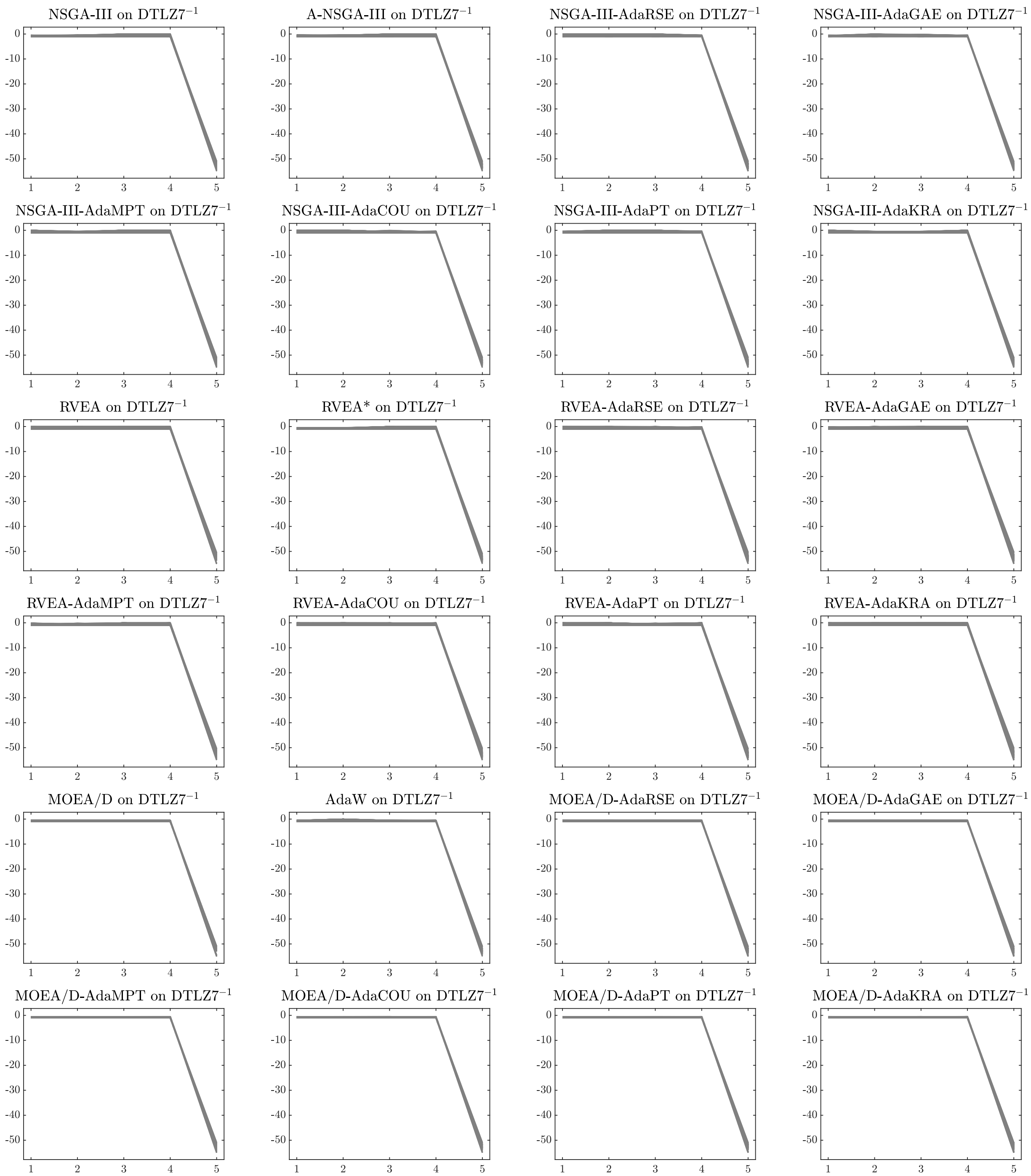

Figure 90: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7^{-1} with 5 objective functions.

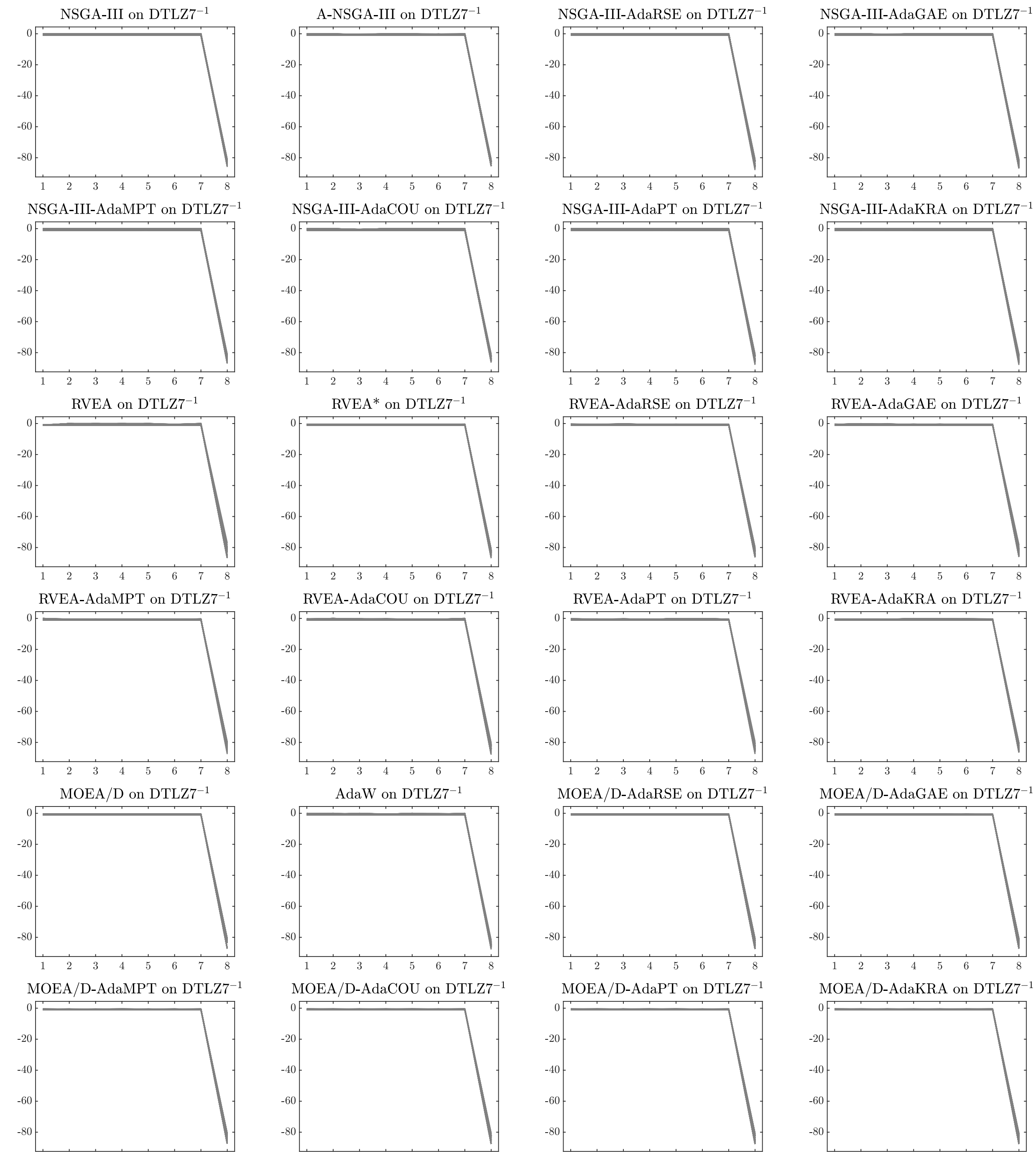

Figure 91: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7^{-1} with 8 objective functions.

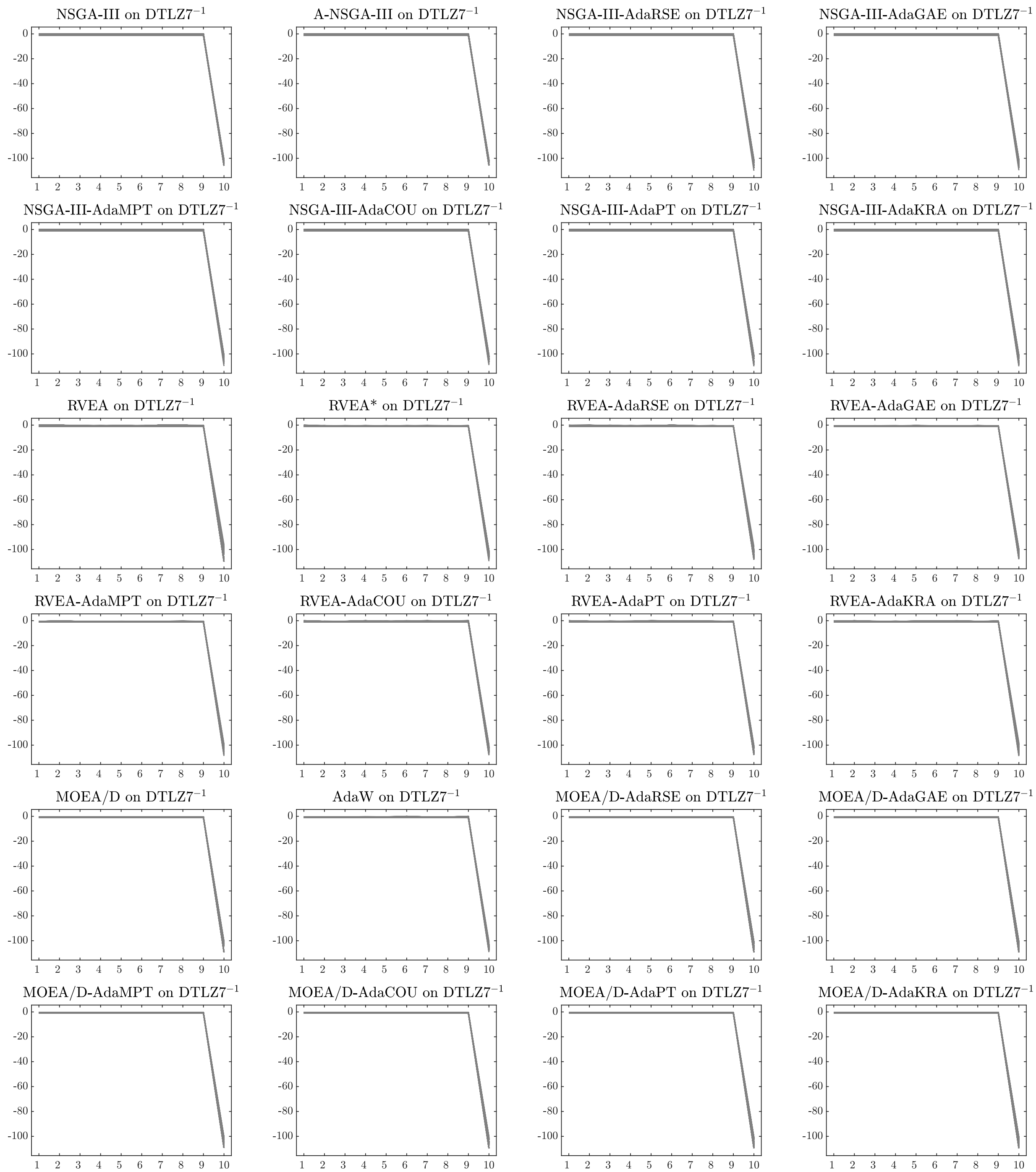

Figure 92: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ7^{-1} with 10 objective functions.

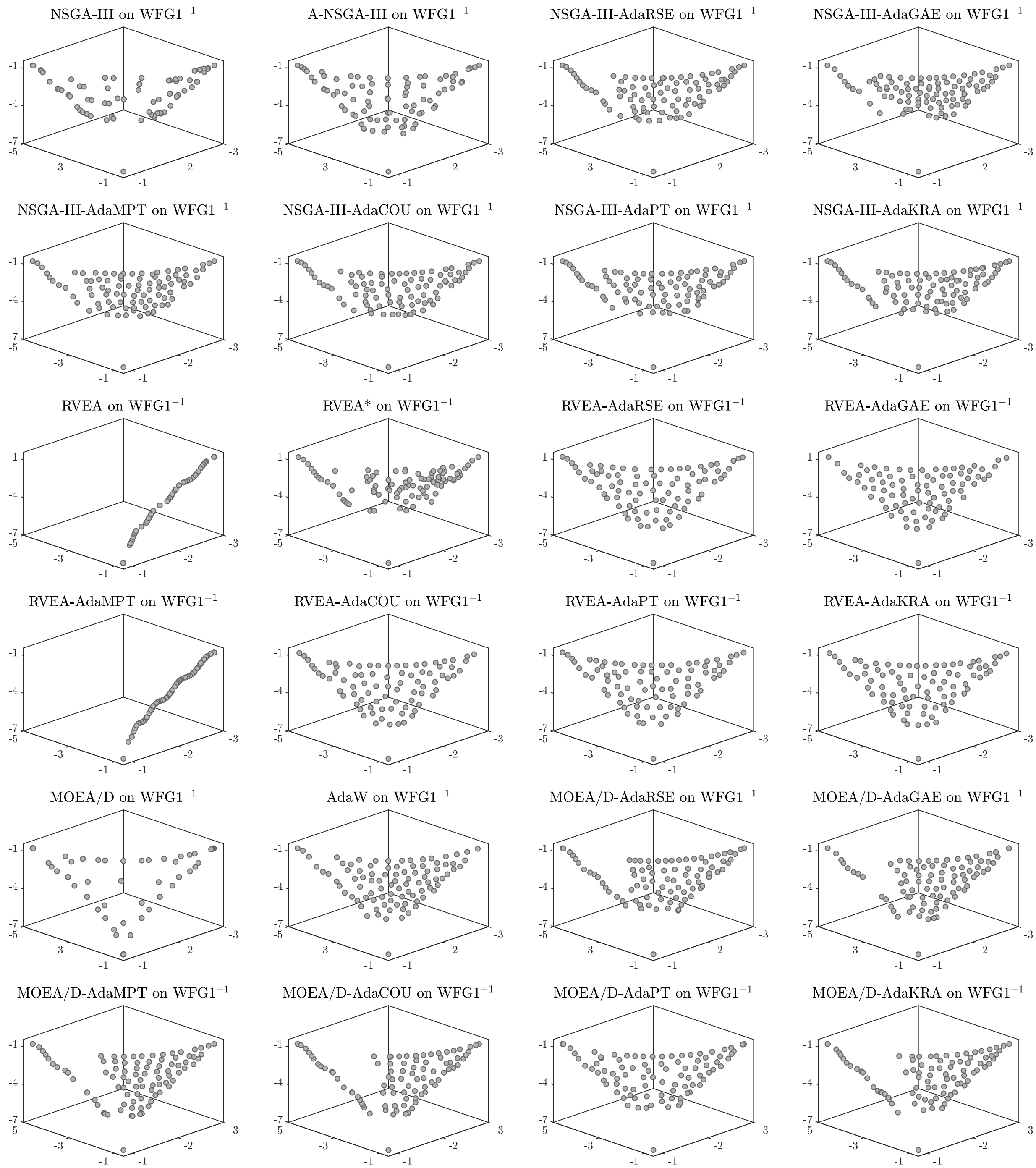

Figure 93: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1^{-1} with 3 objective functions.

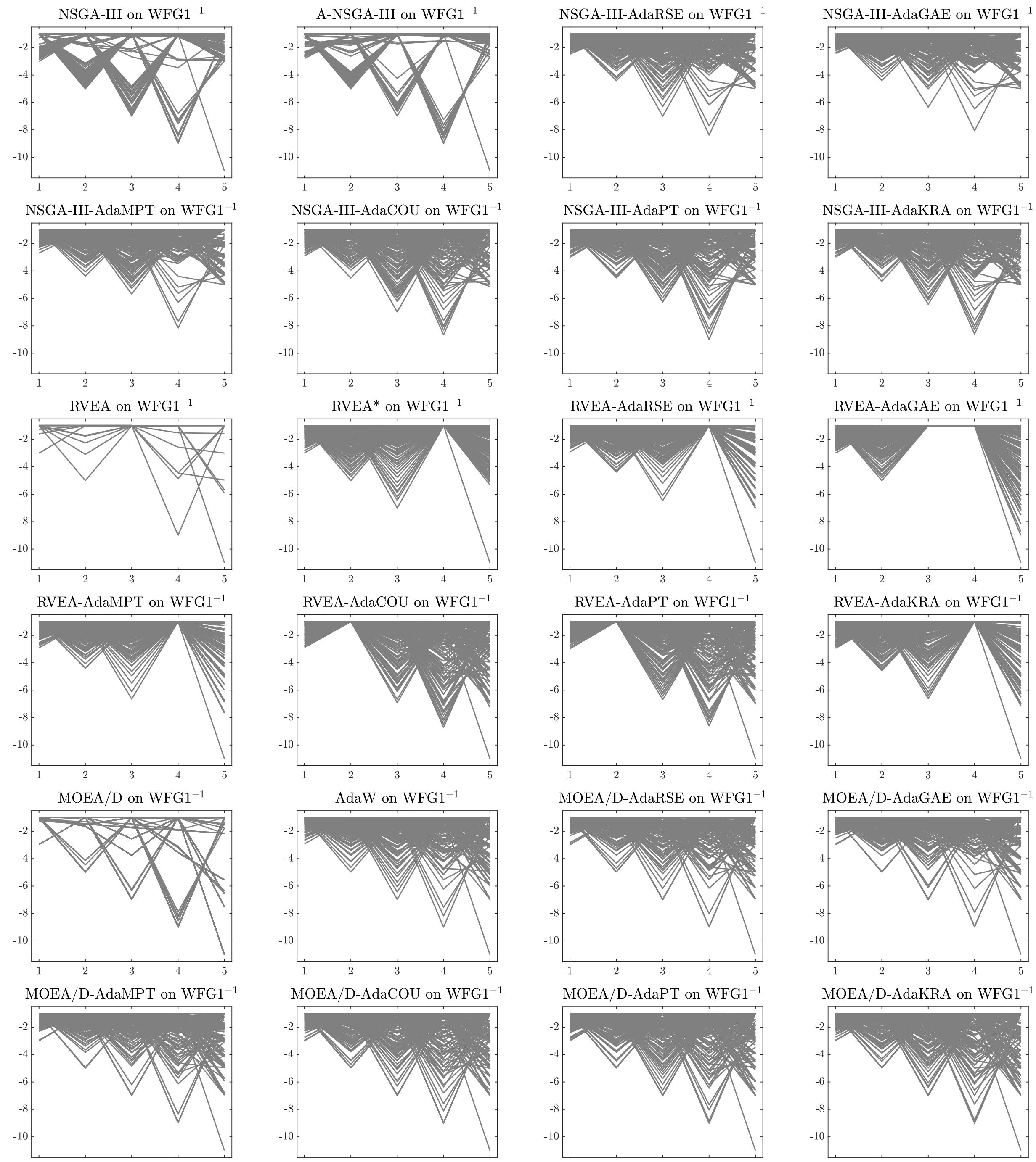

Figure 94: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1^{-1} with 5 objective functions.

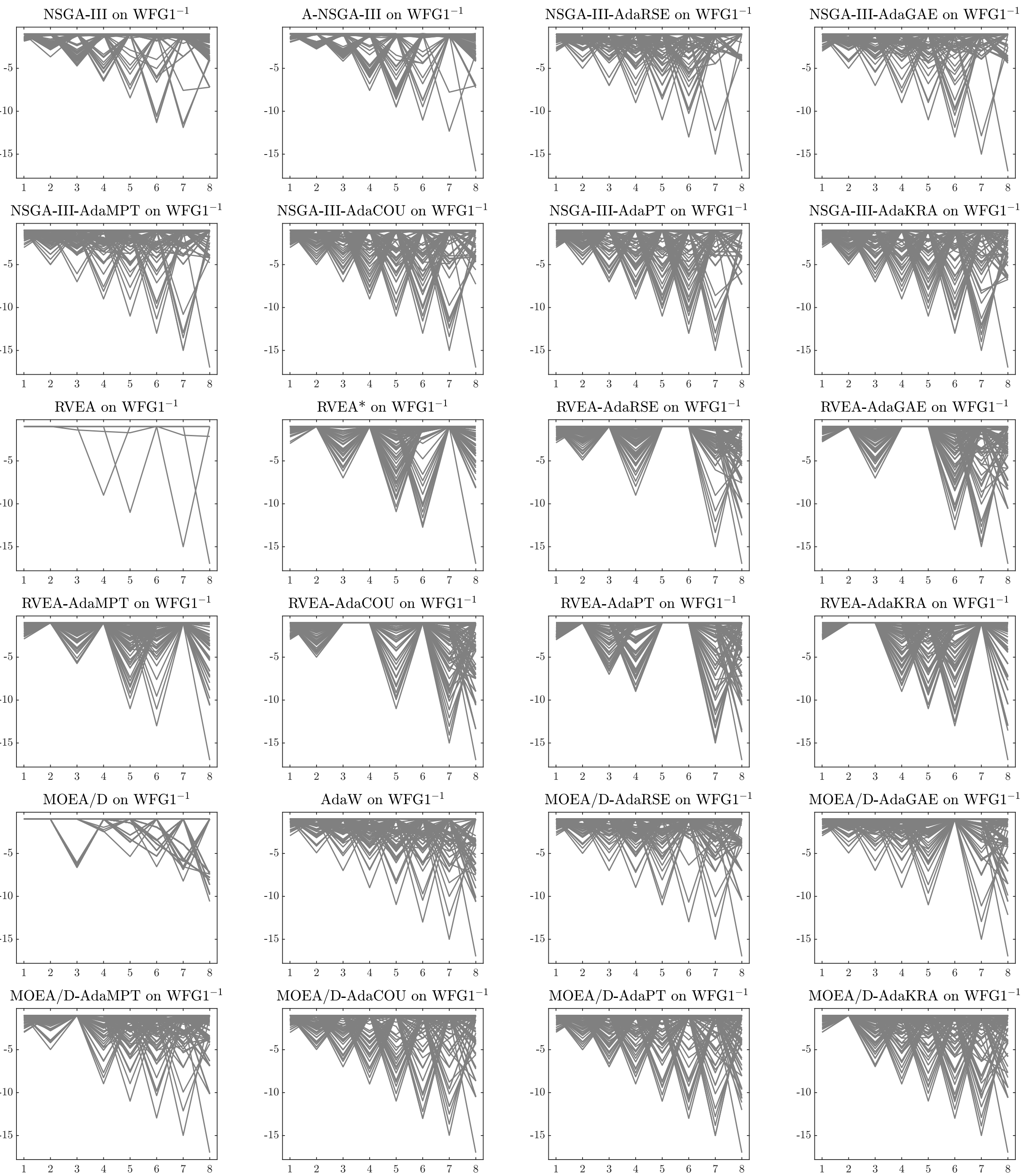

Figure 95: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1^{-1} with 8 objective functions.

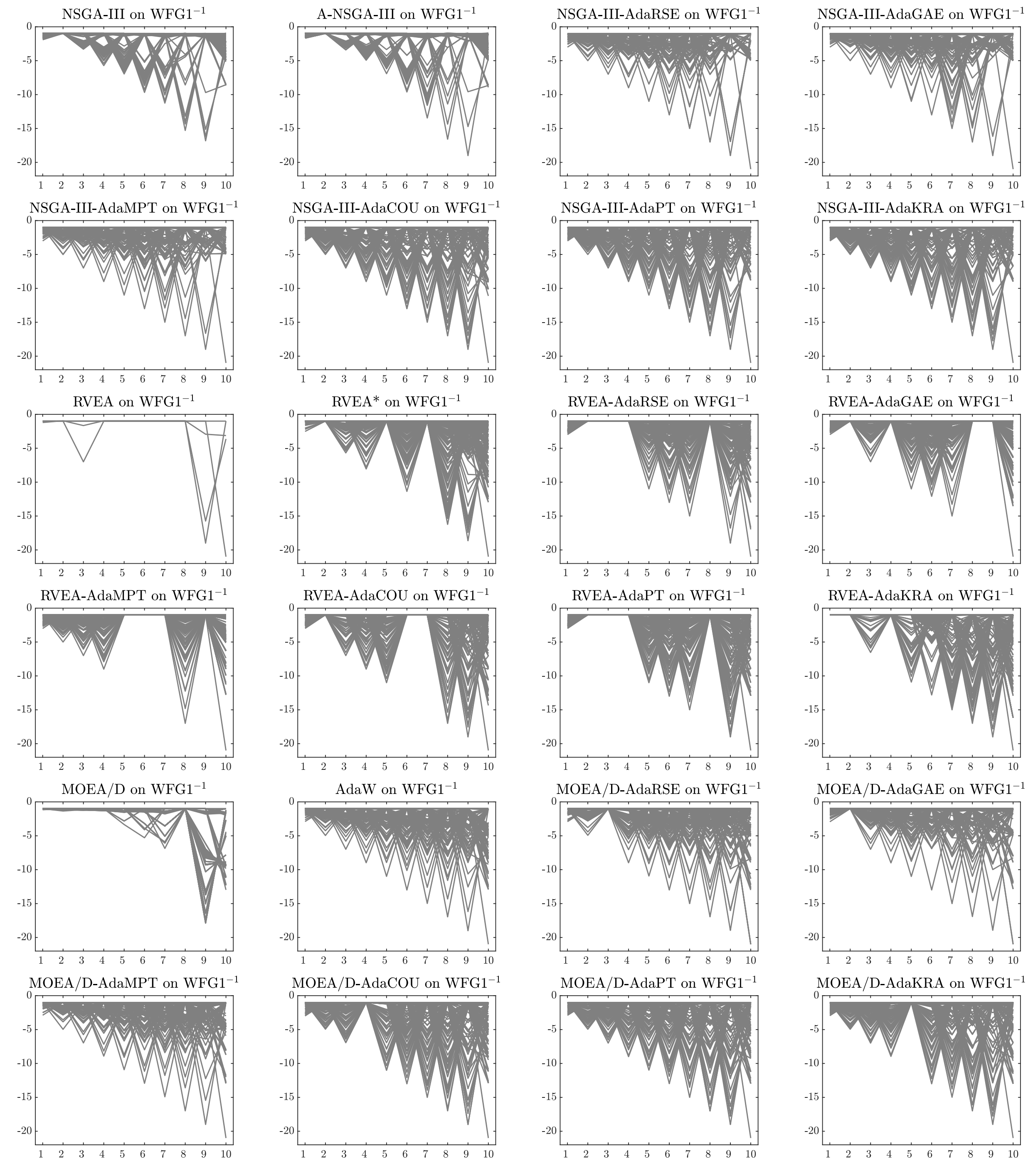

Figure 96: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG1^{-1} with 10 objective functions.

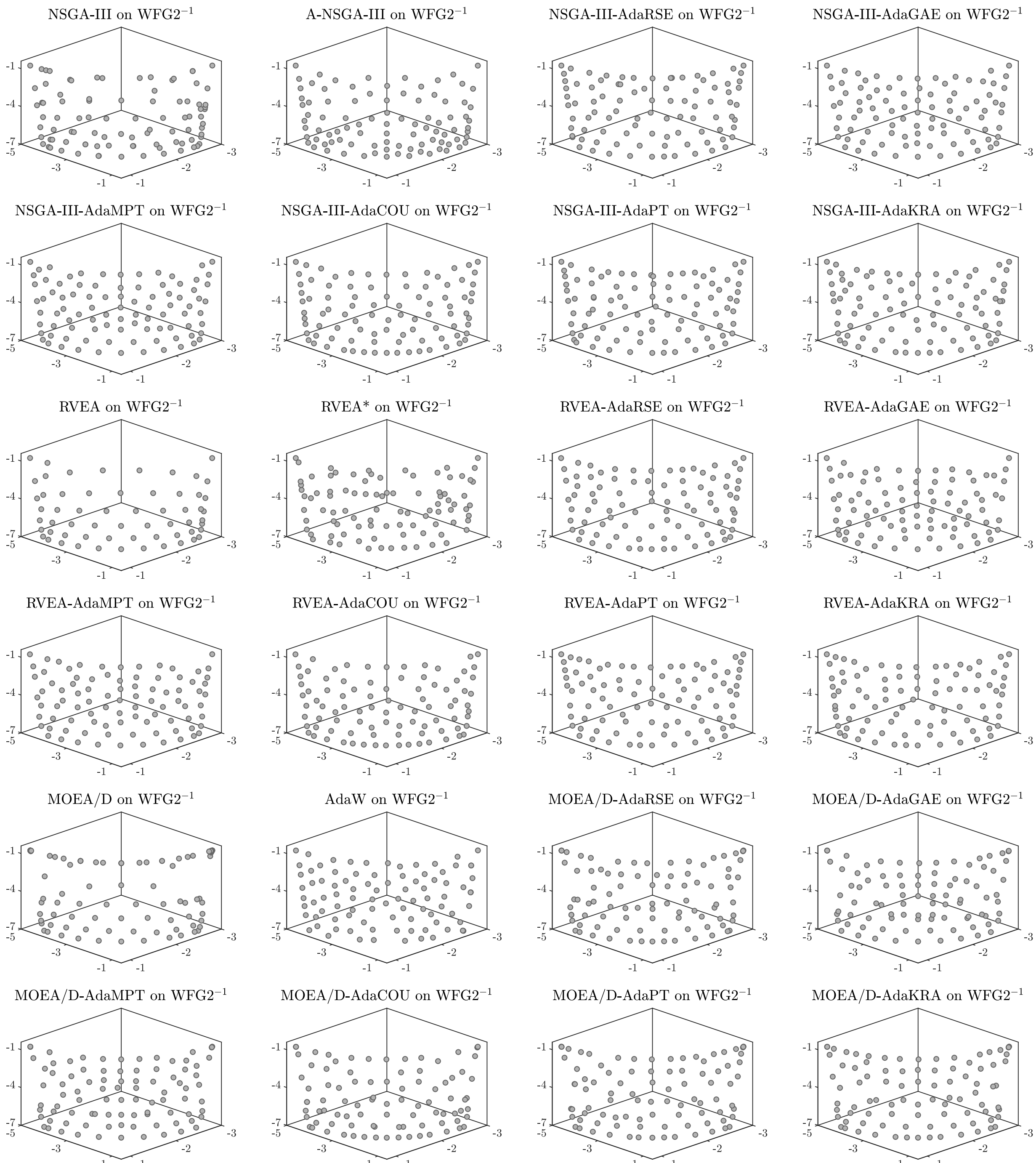

Figure 97: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2^{-1} with 3 objective functions.

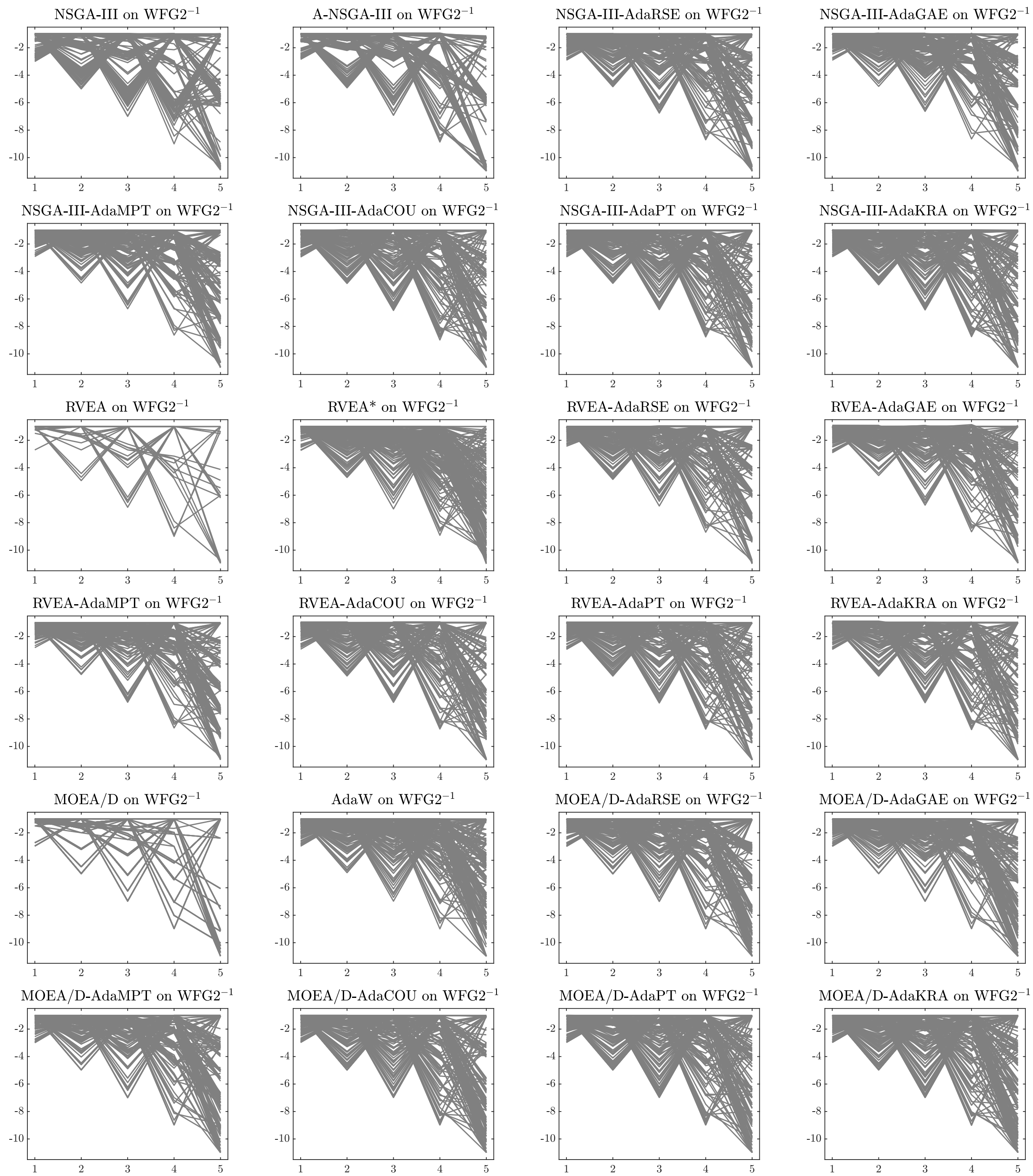

Figure 98: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2^{-1} with 5 objective functions.

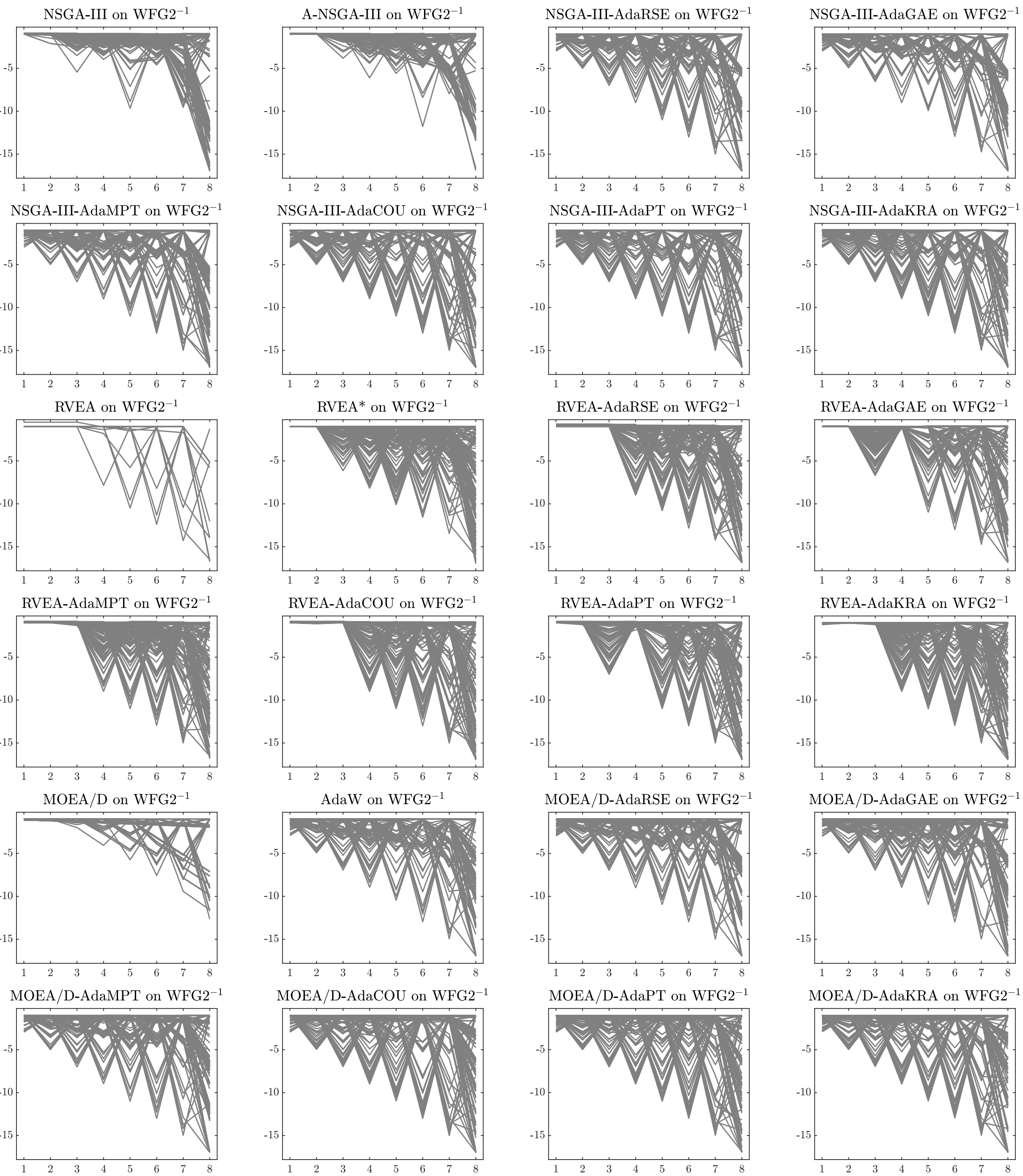

Figure 99: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2^{-1} with 8 objective functions.

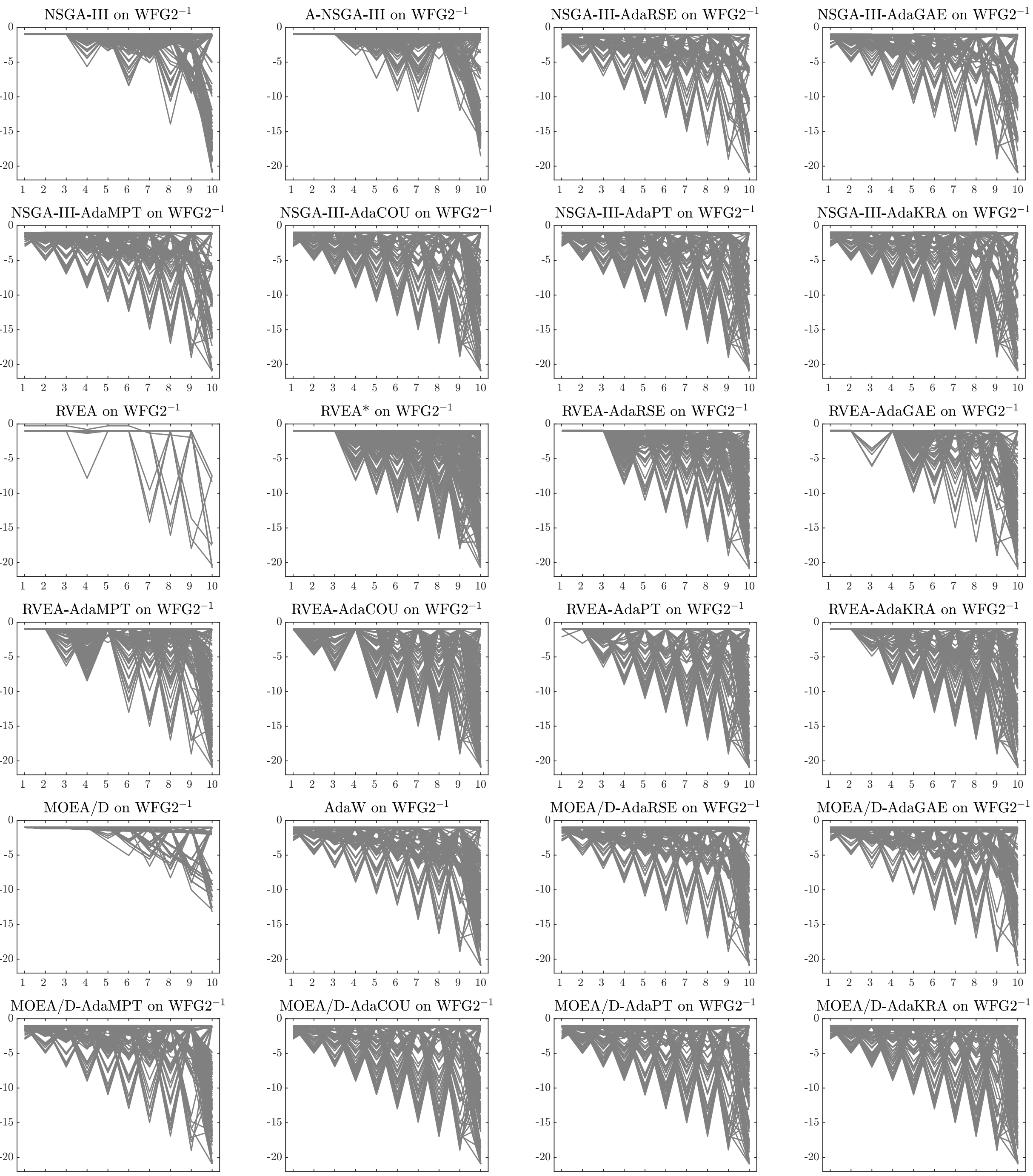

Figure 100: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG2^{-1} with 10 objective functions.

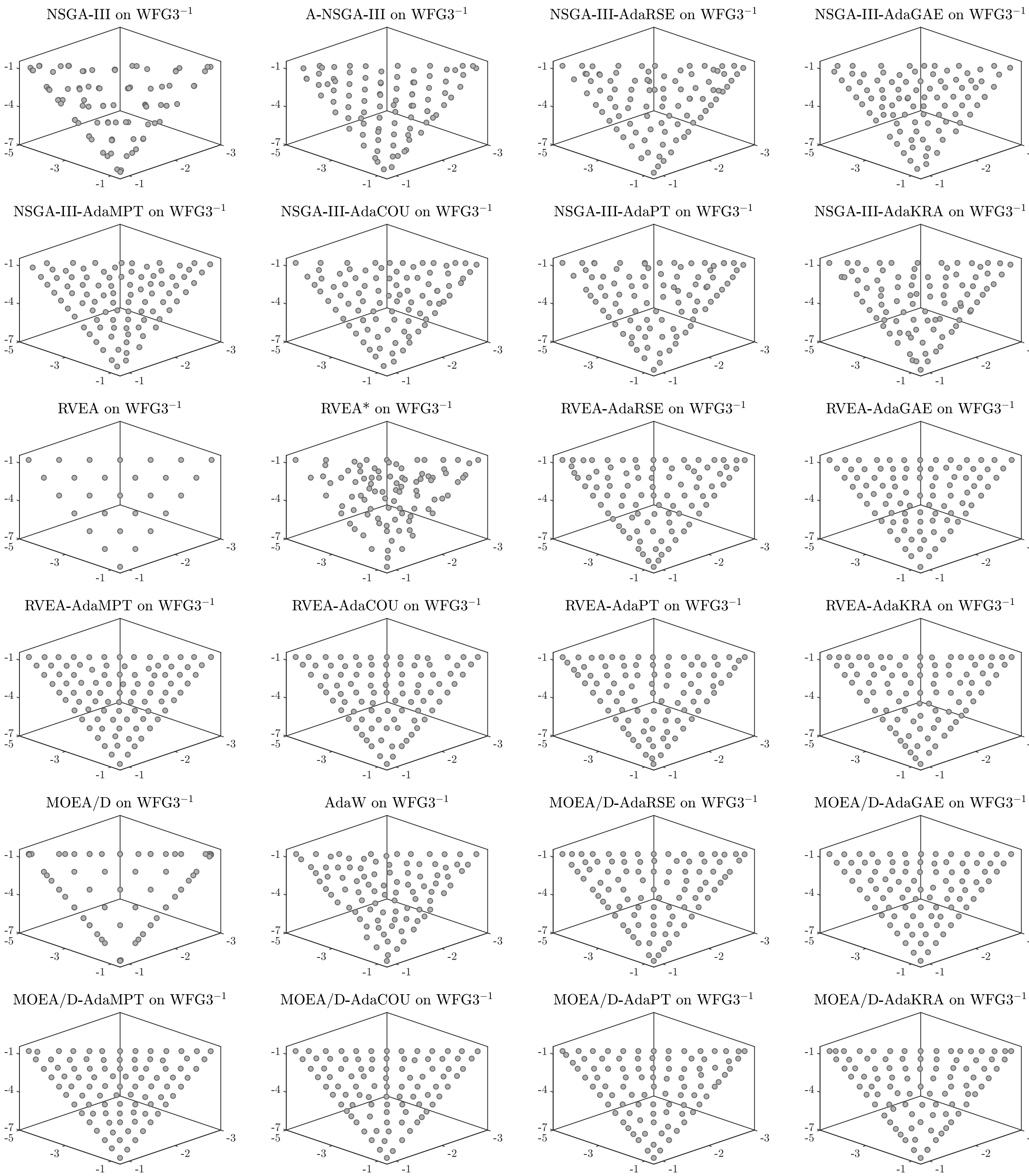

Figure 101: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3^{-1} with 3 objective functions.

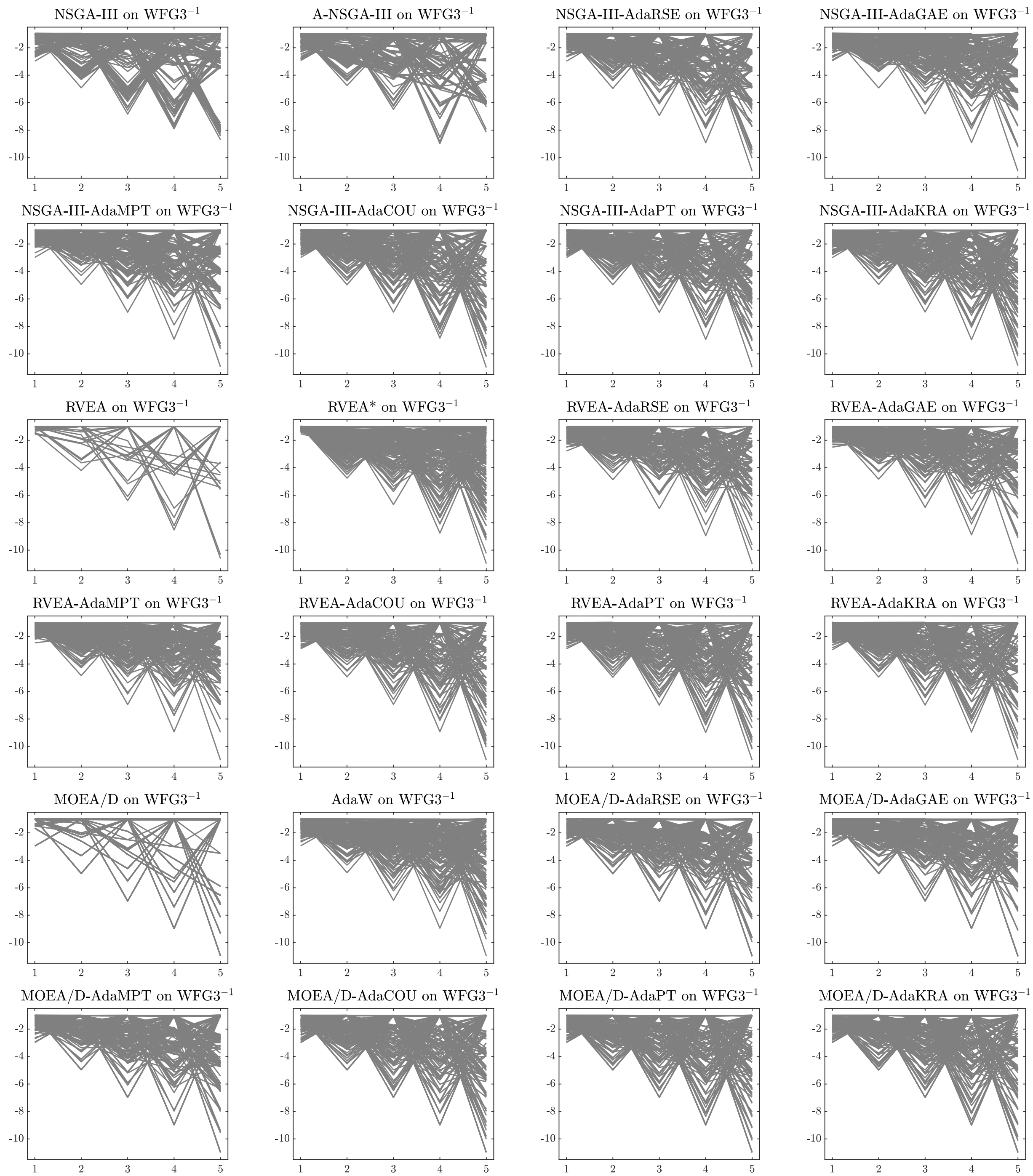

Figure 102: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3^{-1} with 5 objective functions.

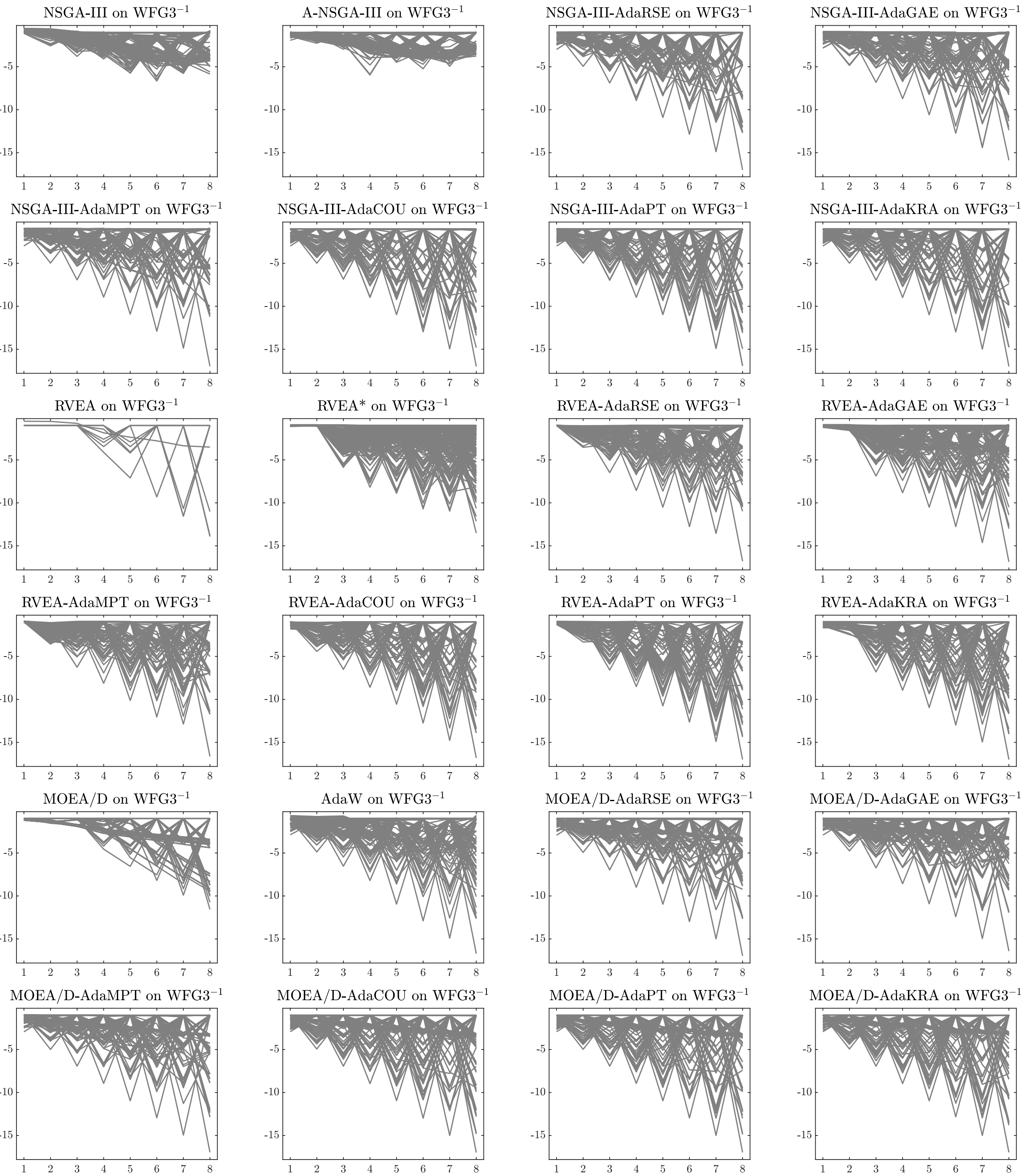

Figure 103: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3^{-1} with 8 objective functions.

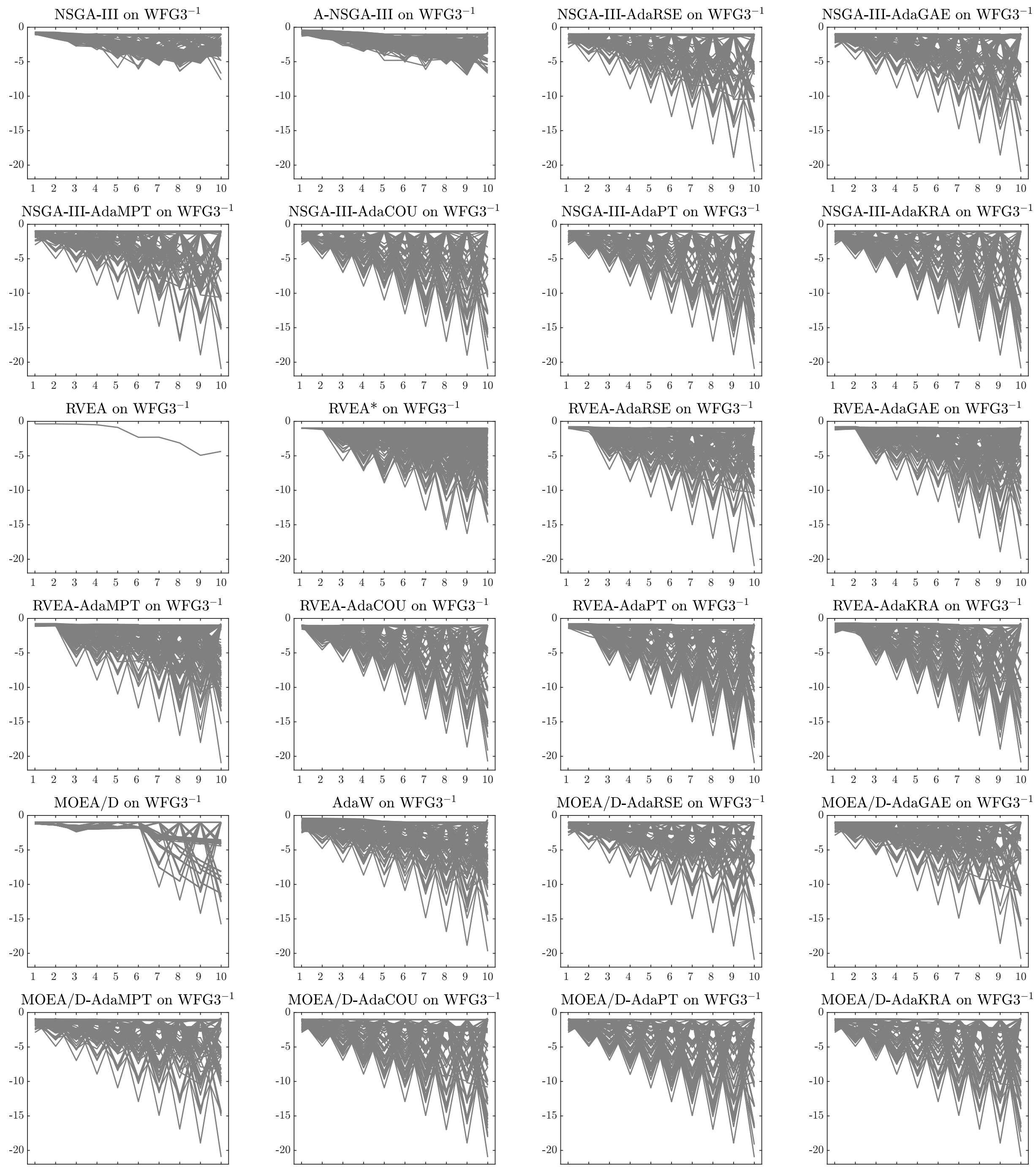

Figure 104: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG3^{-1} with 10 objective functions.

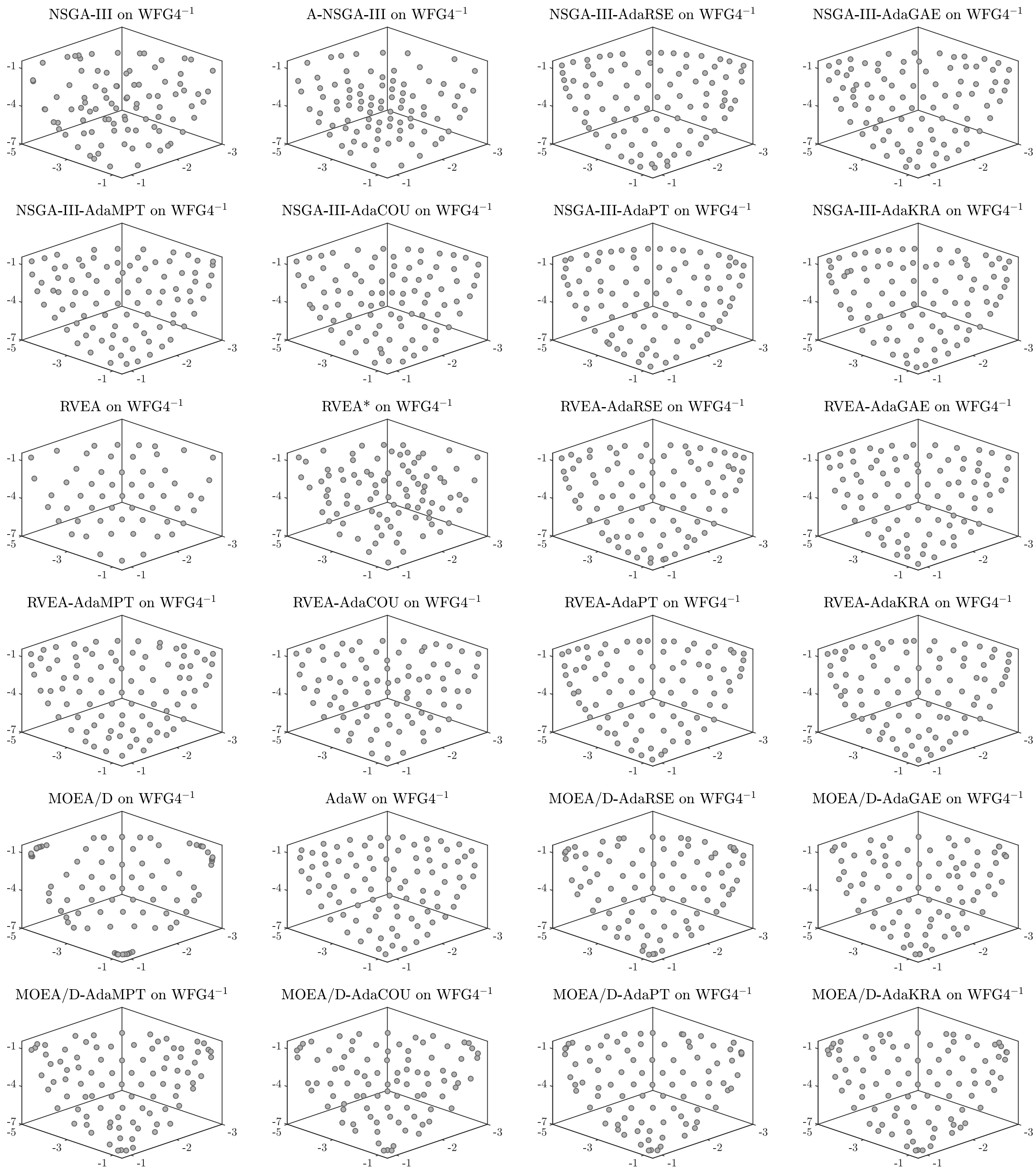

Figure 105: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 3 objective functions.

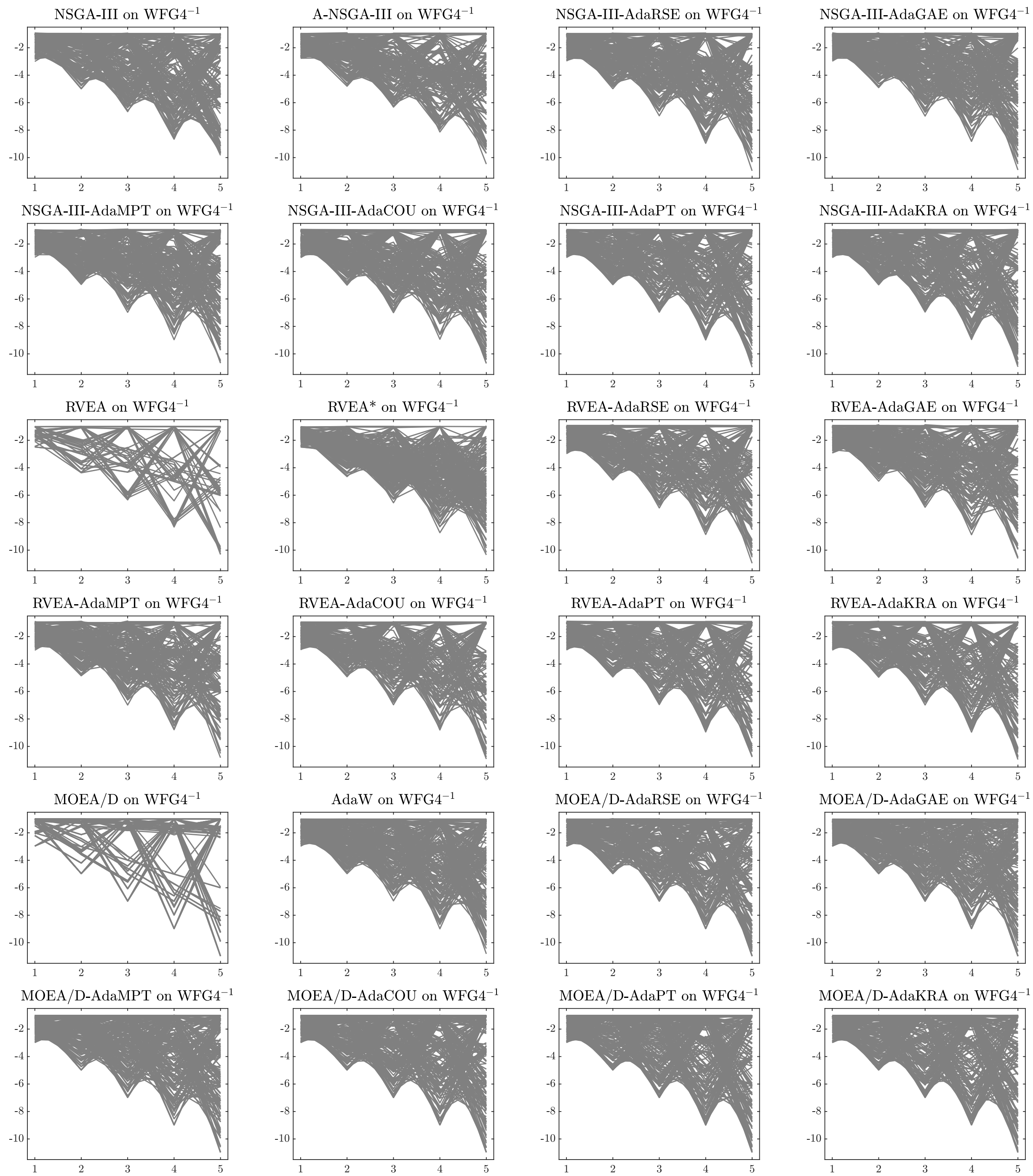

Figure 106: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 5 objective functions.

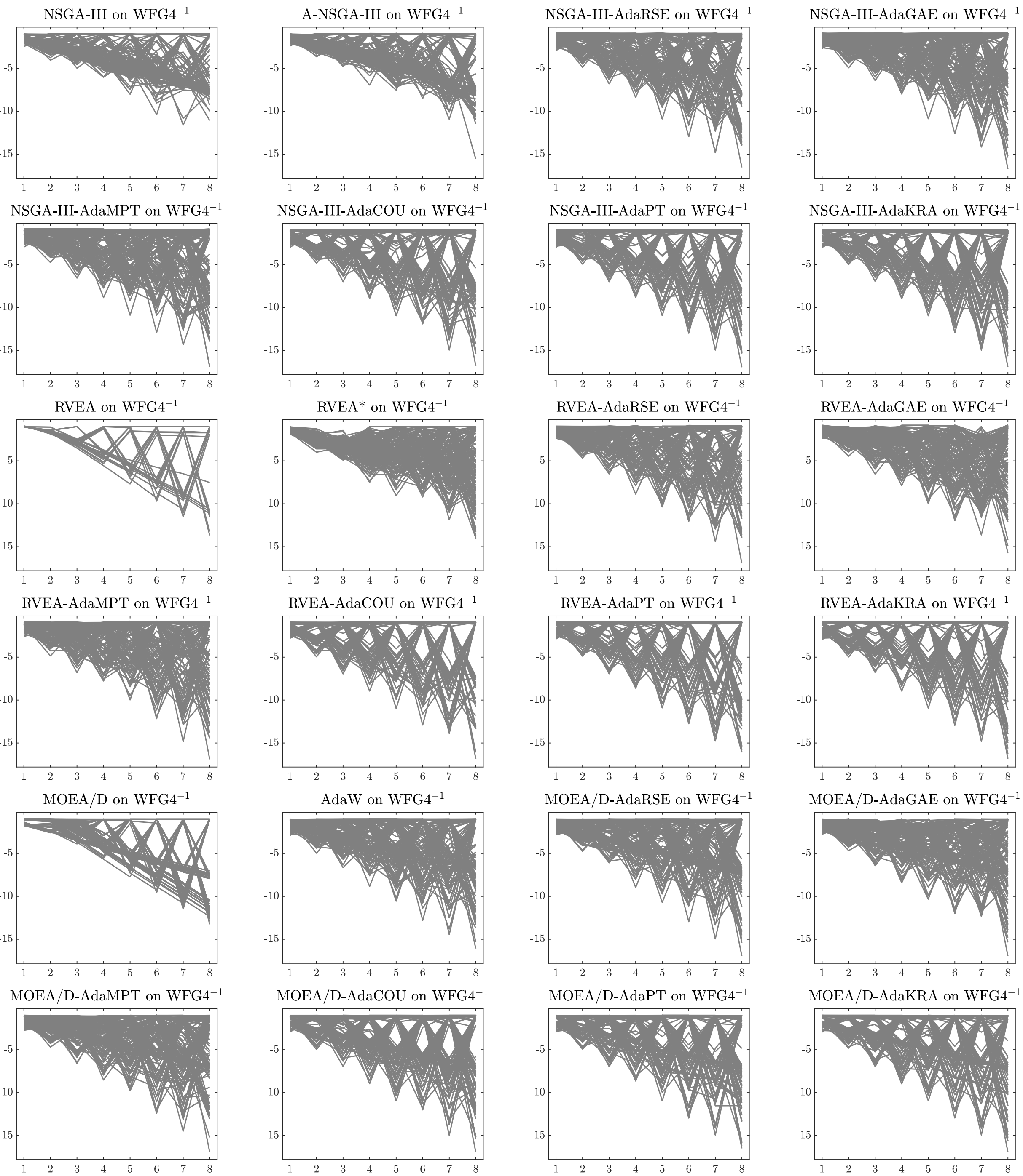

Figure 107: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 8 objective functions.

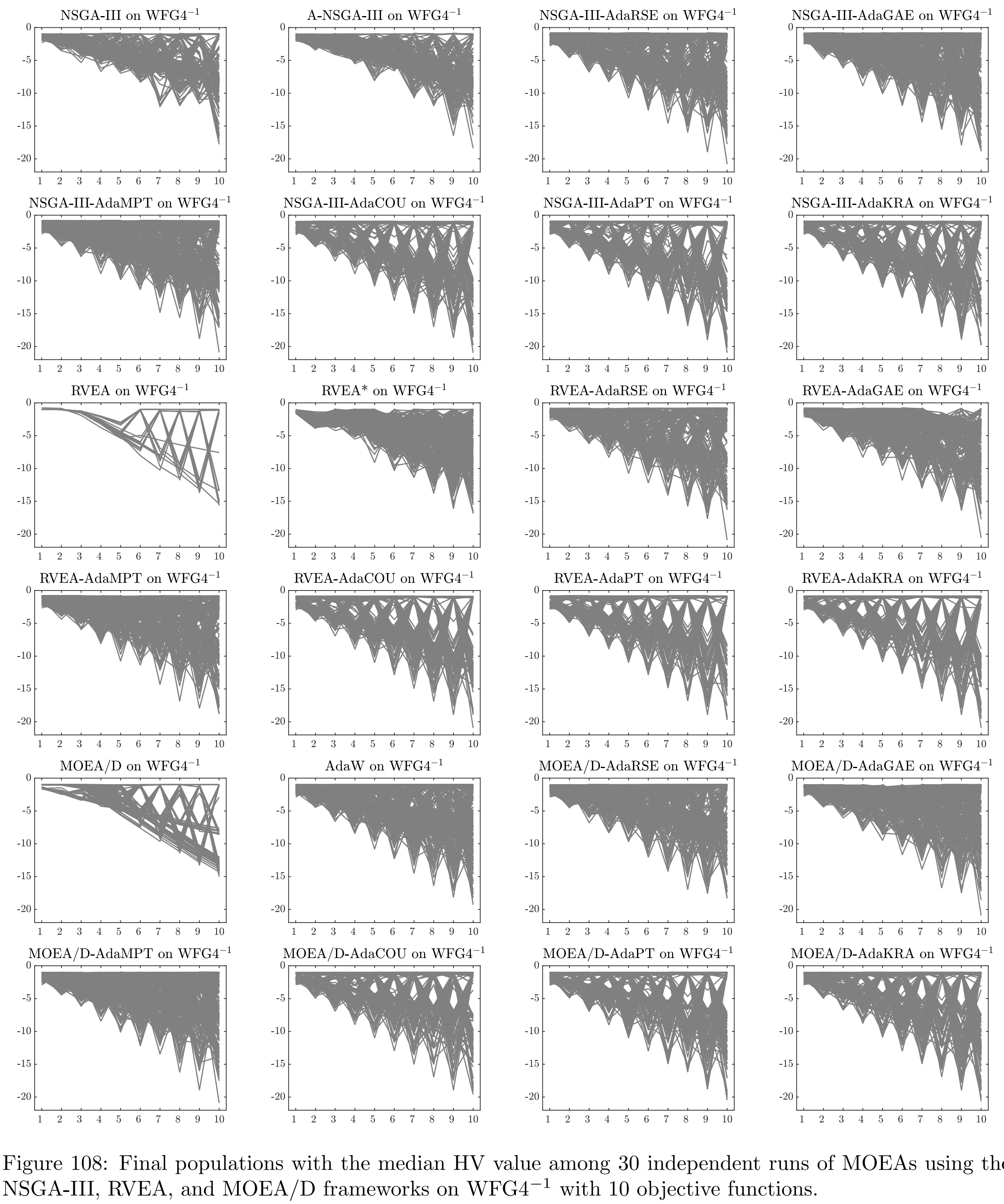

Figure 108: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 10 objective functions.

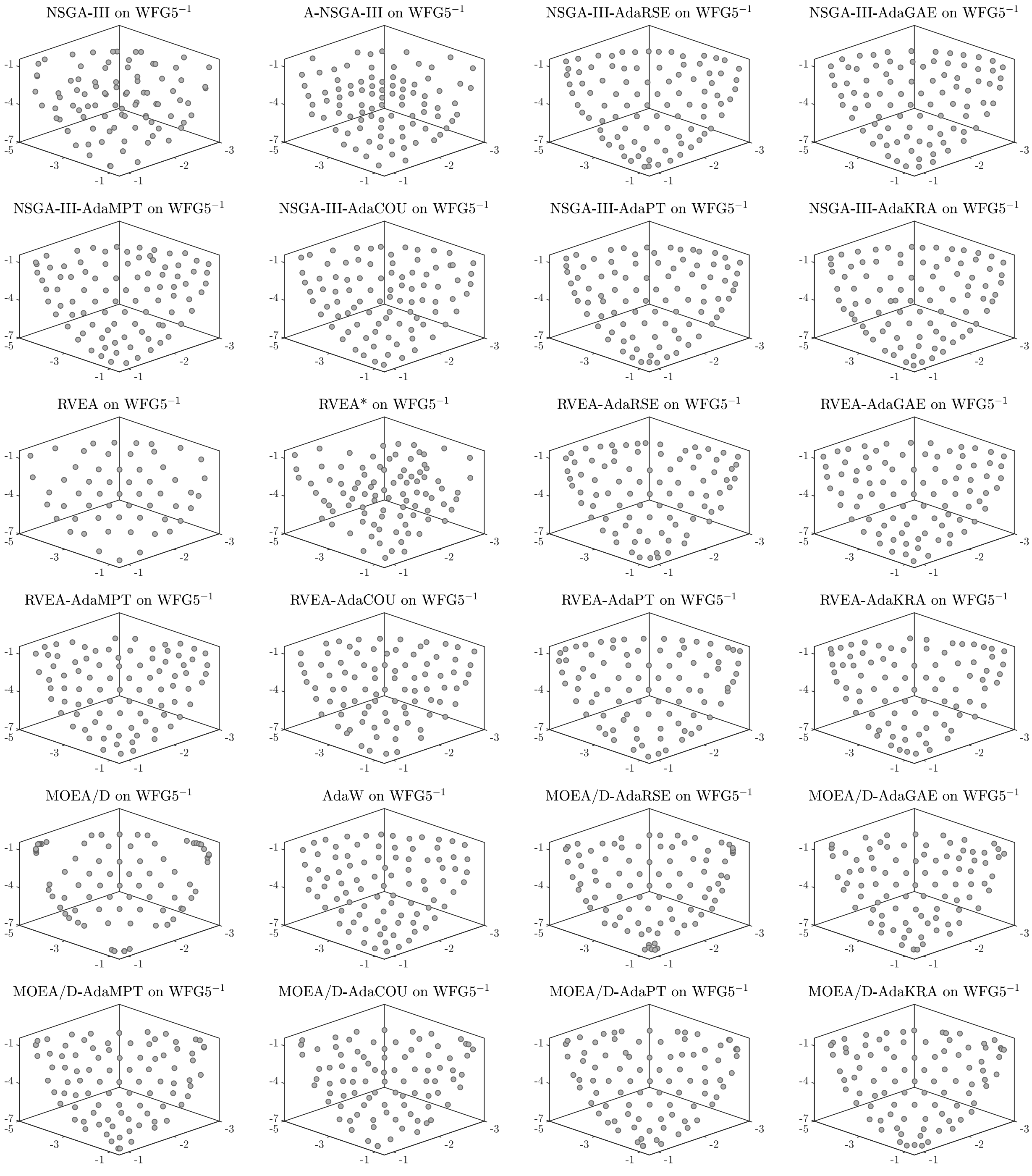

Figure 109: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5^{-1} with 3 objective functions.

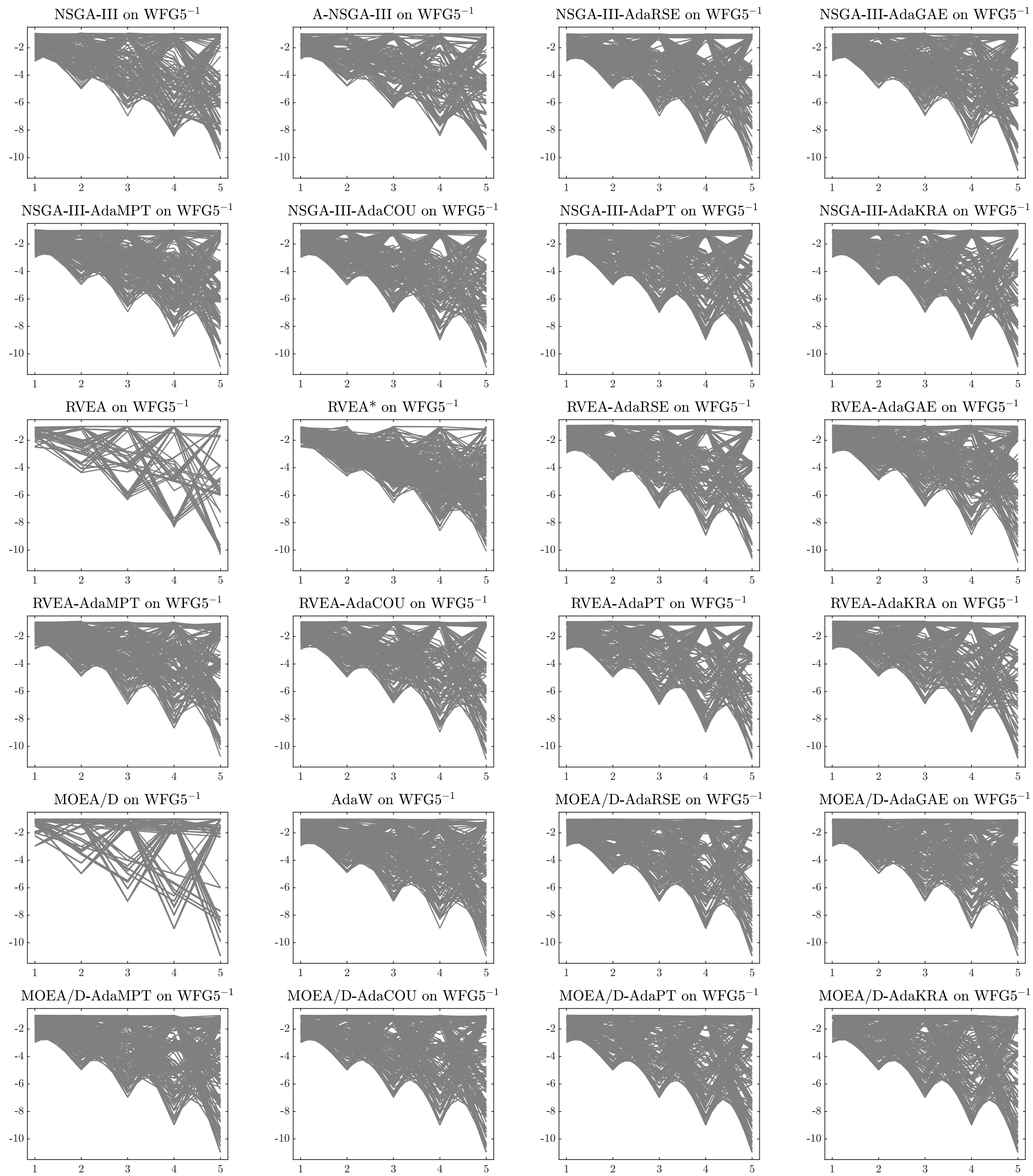

Figure 110: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5^{-1} with 5 objective functions.

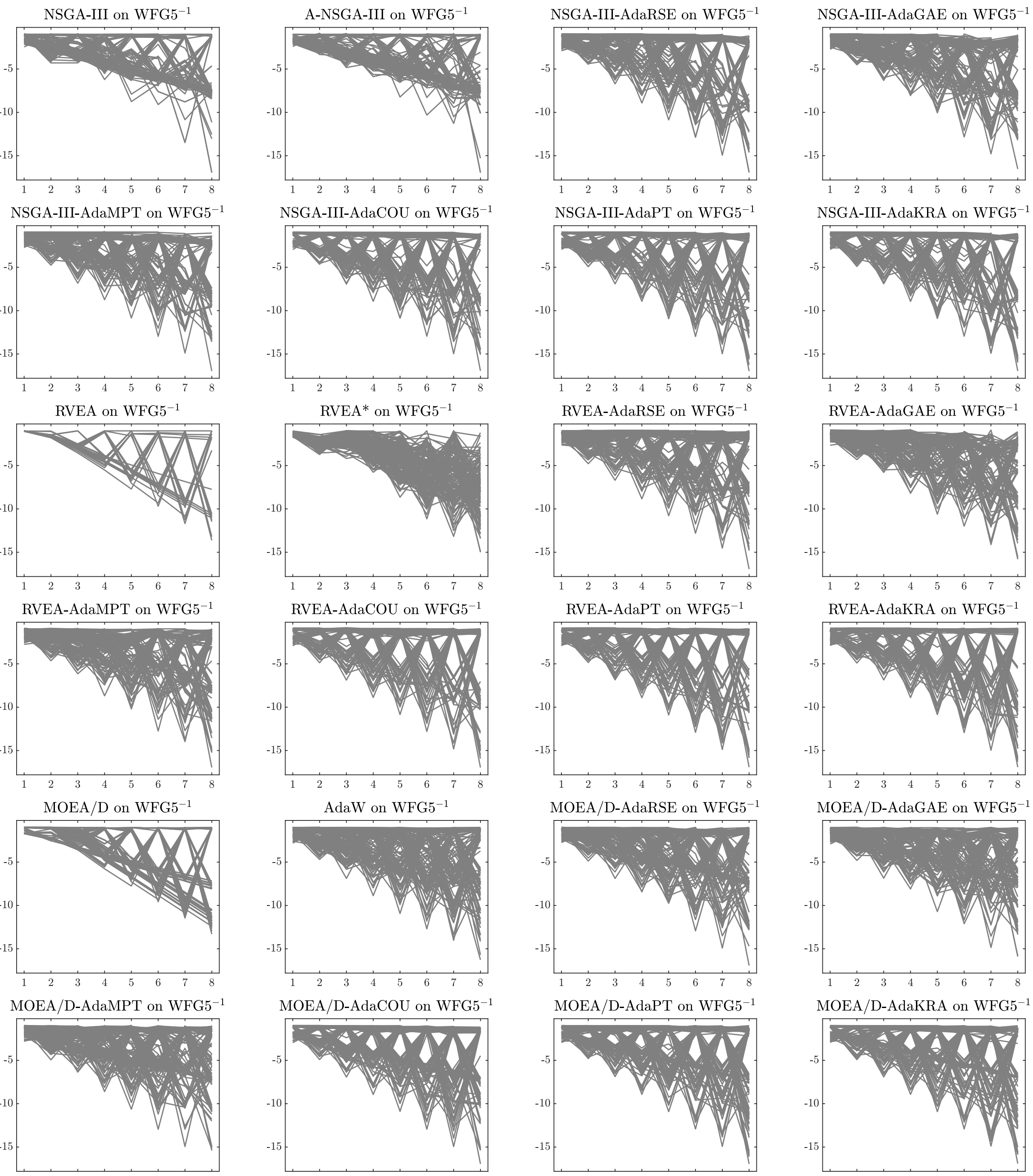

Figure 111: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5^{-1} with 8 objective functions.

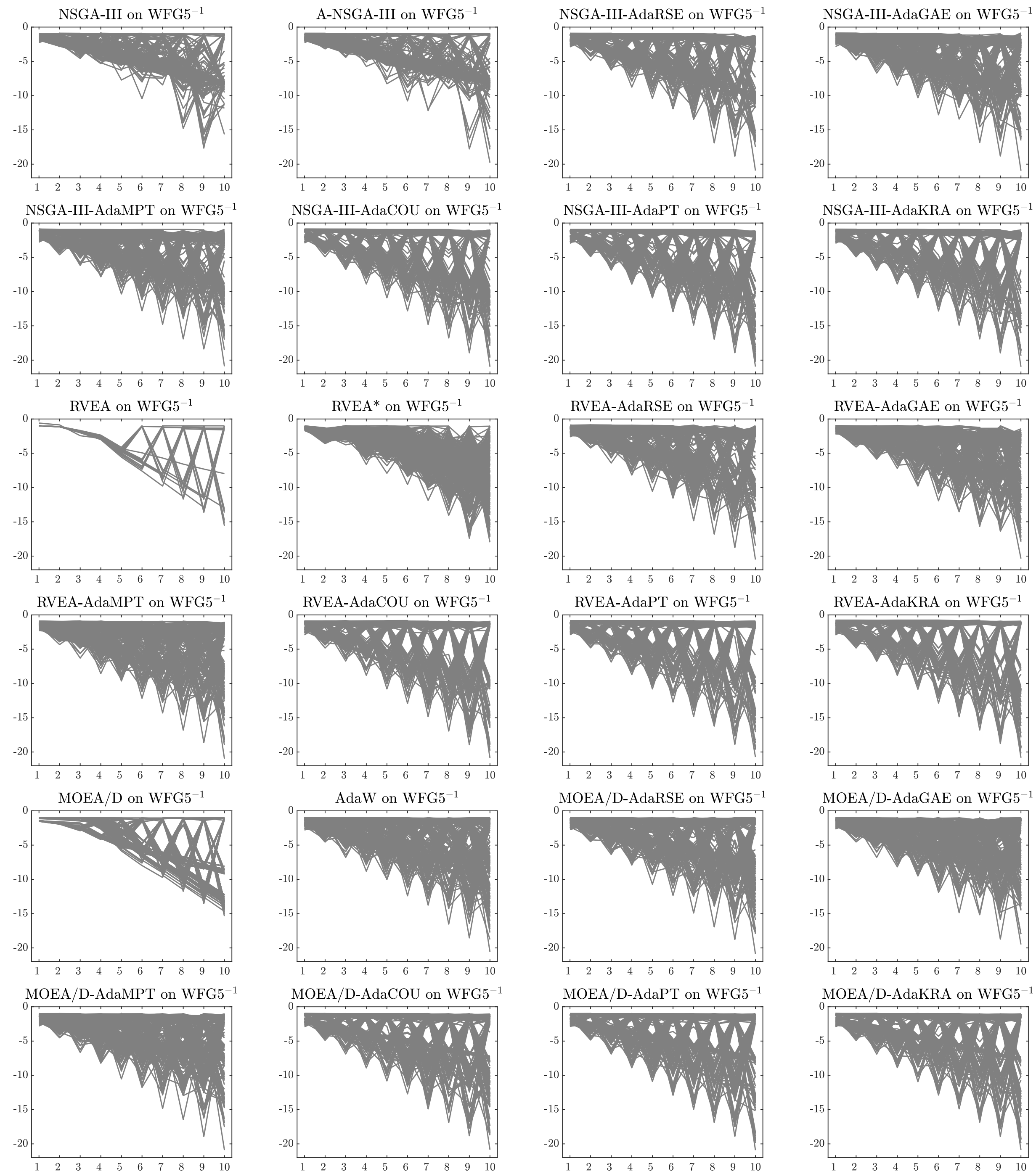

Figure 112: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG5^{-1} with 10 objective functions.

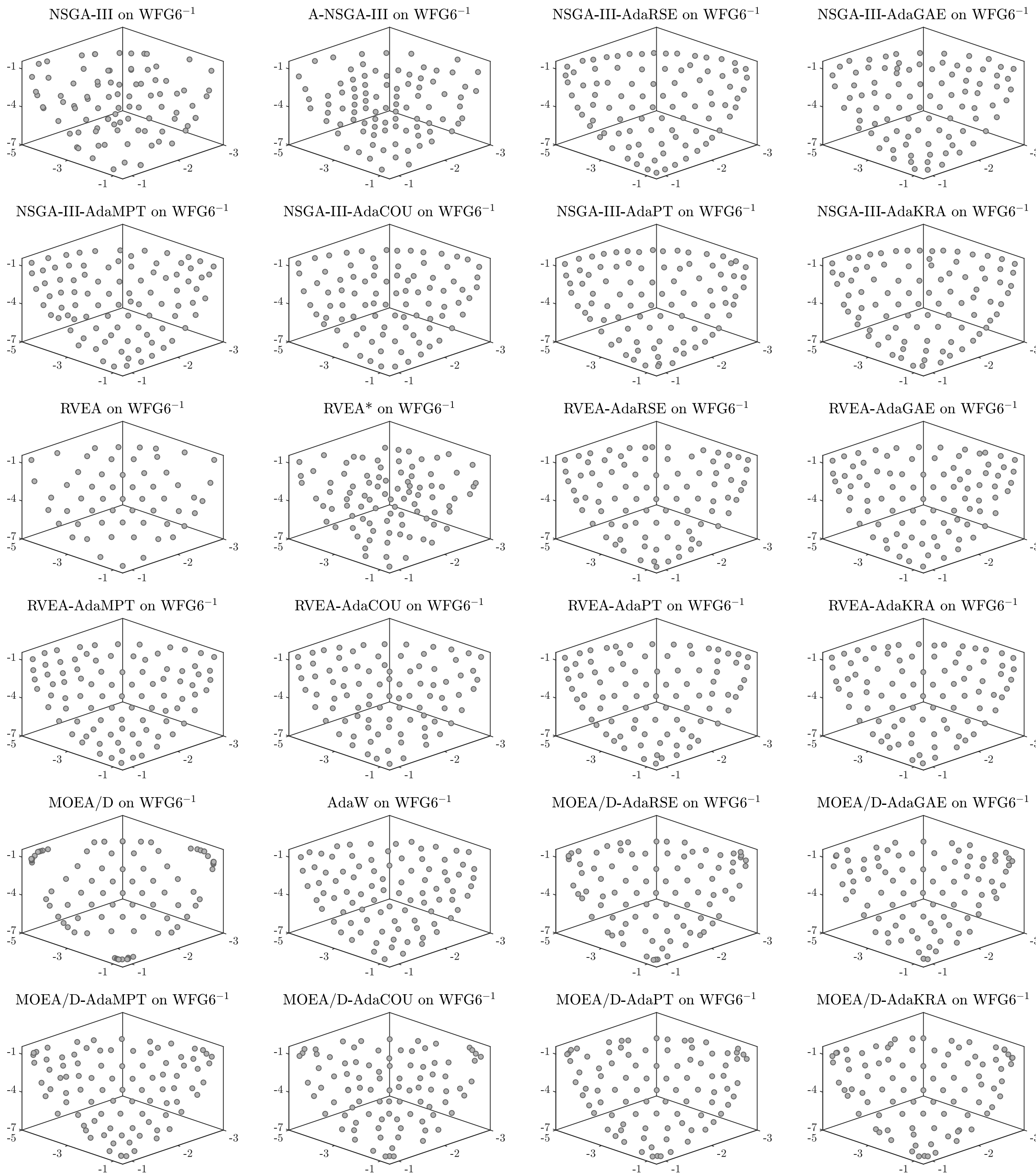

Figure 113: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6^{-1} with 3 objective functions.

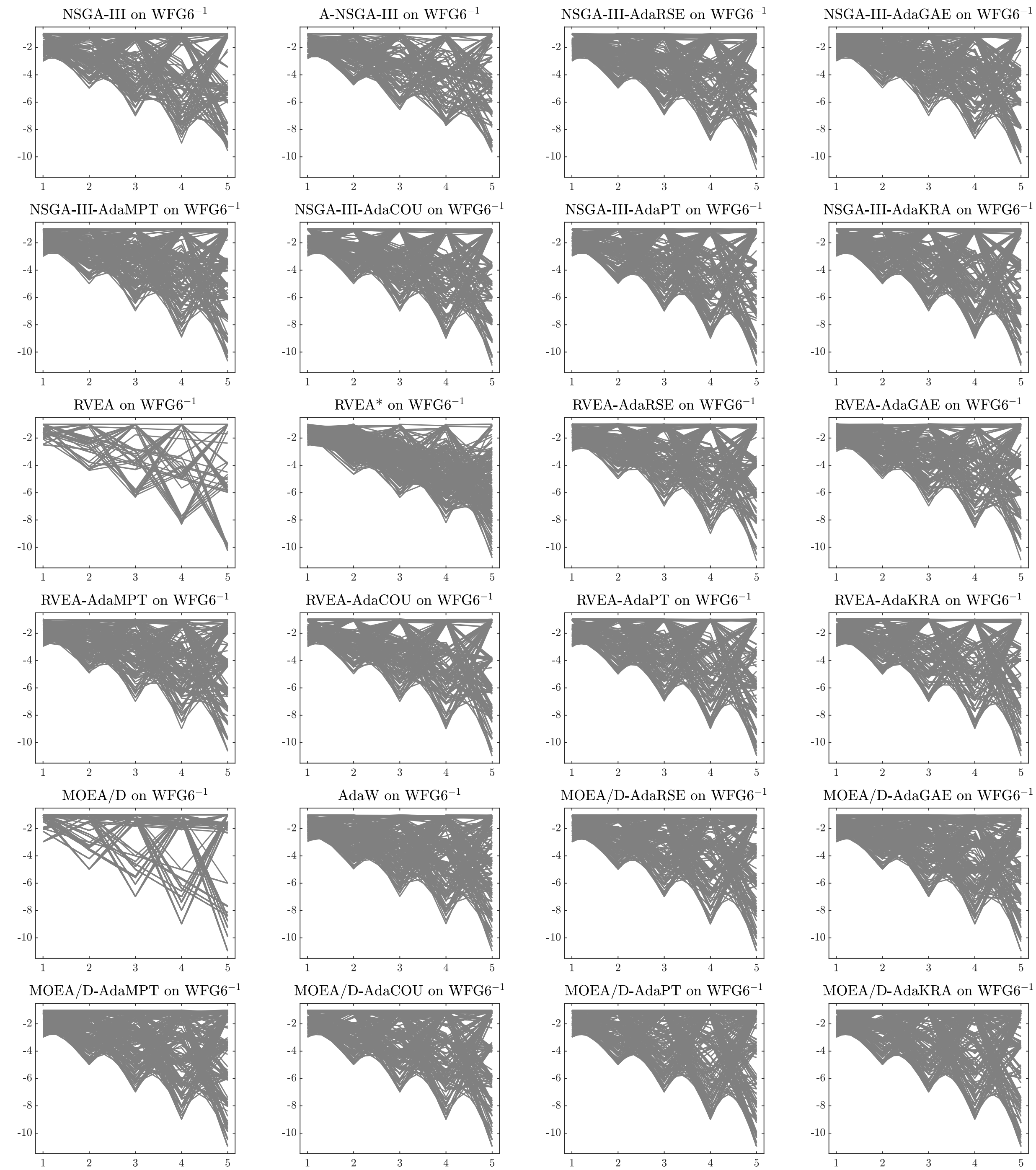

Figure 114: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6^{-1} with 5 objective functions.

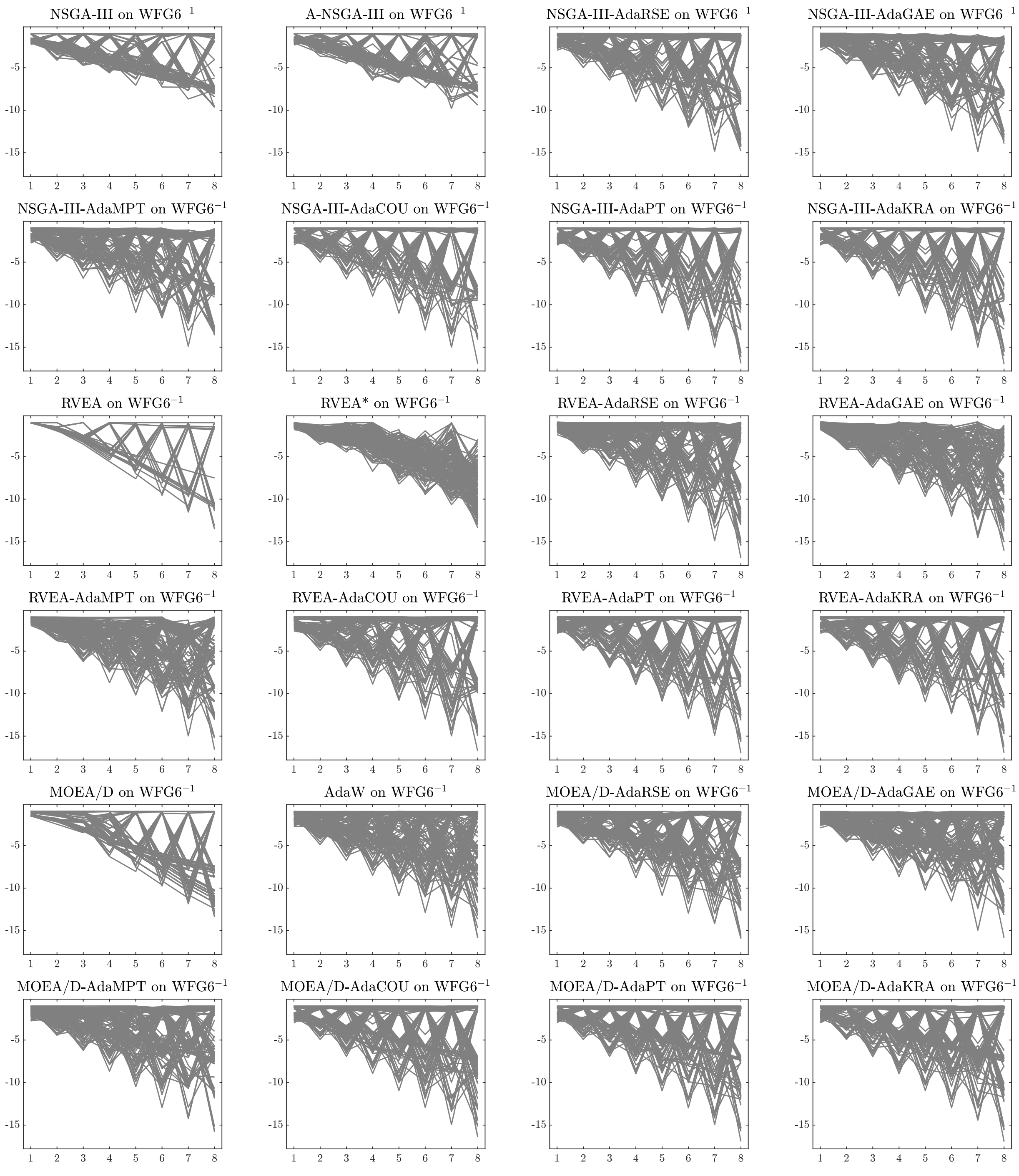

Figure 115: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6^{-1} with 8 objective functions.

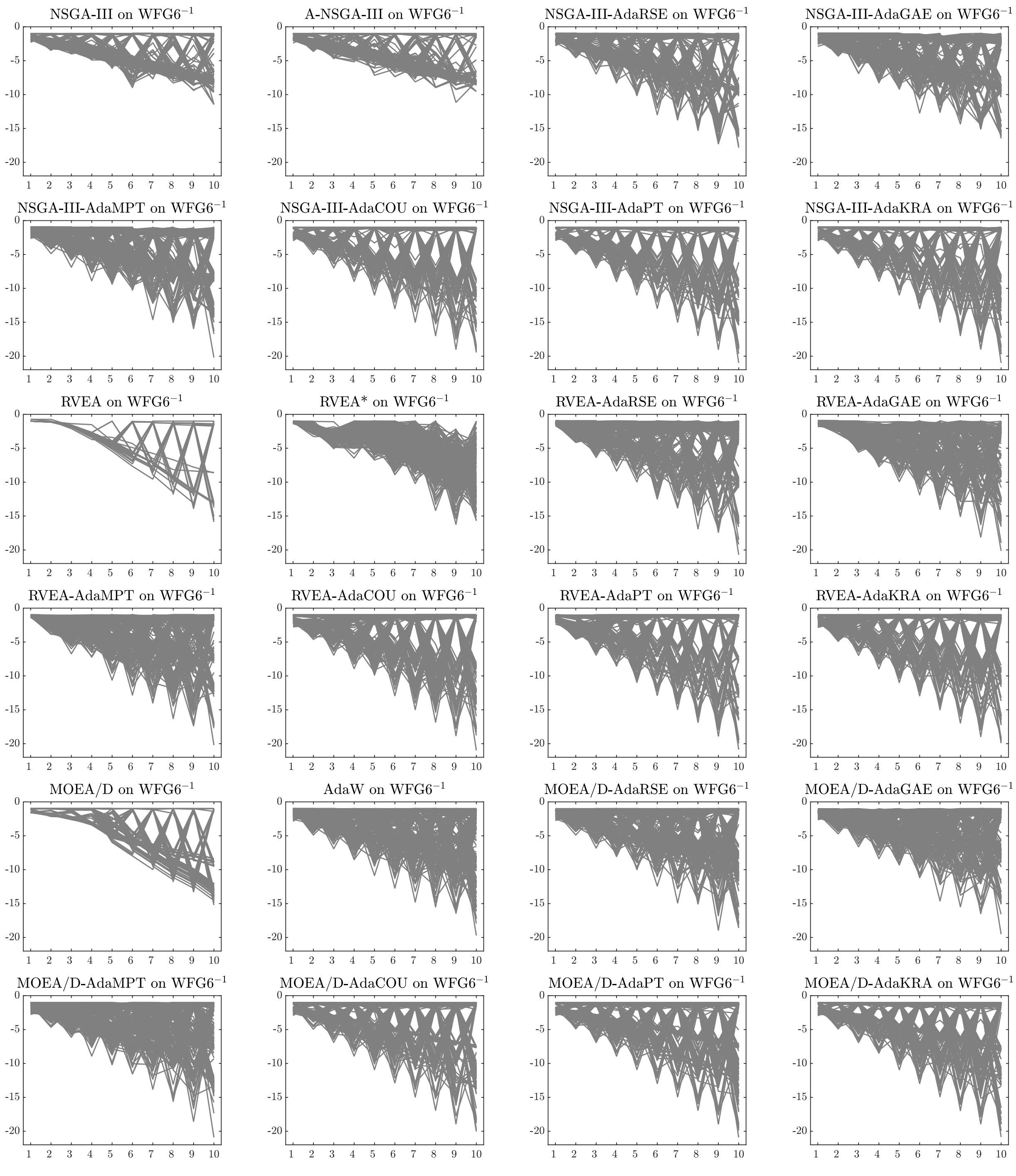

Figure 116: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG6^{-1} with 10 objective functions.

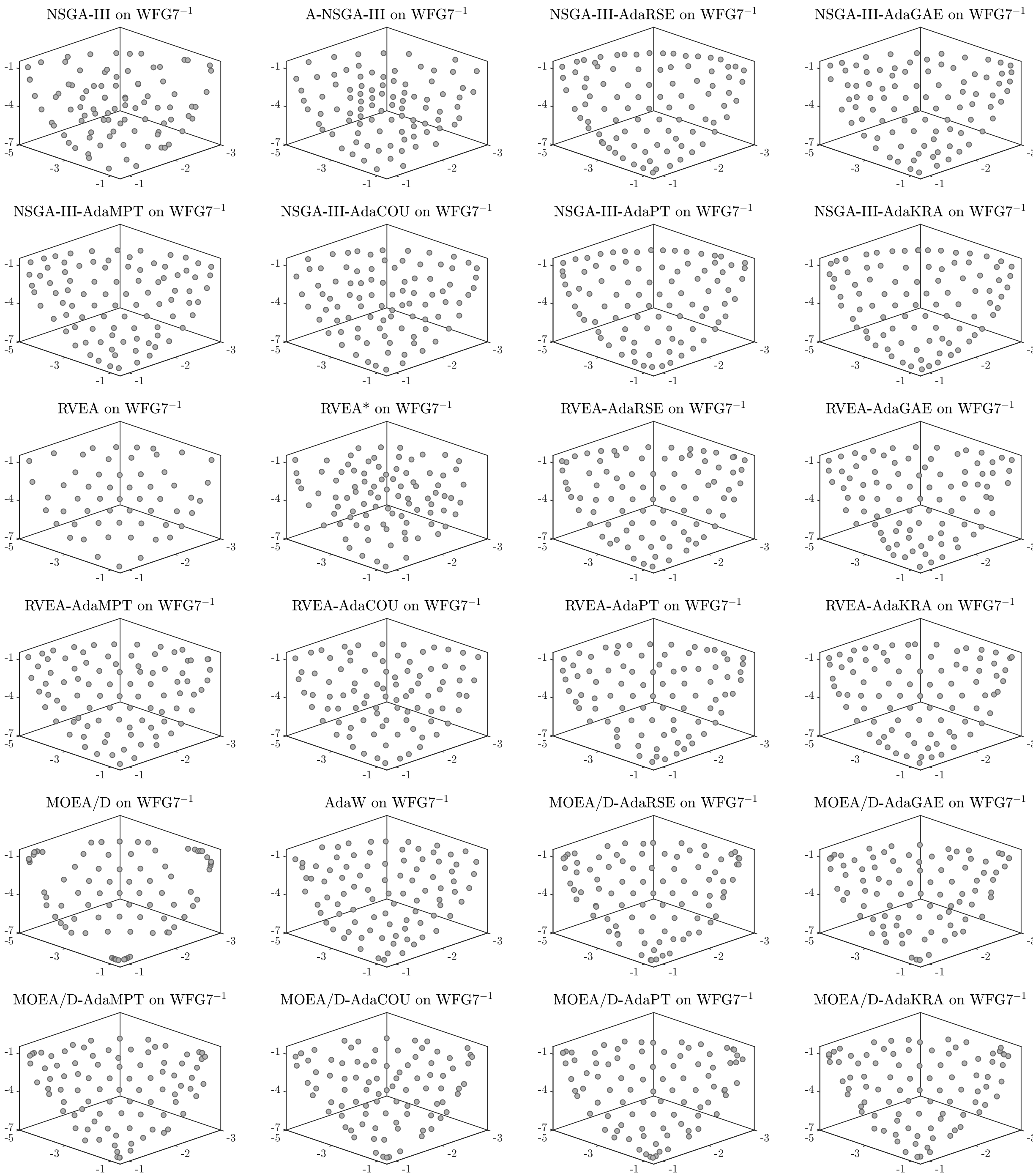

Figure 117: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7^{-1} with 3 objective functions.

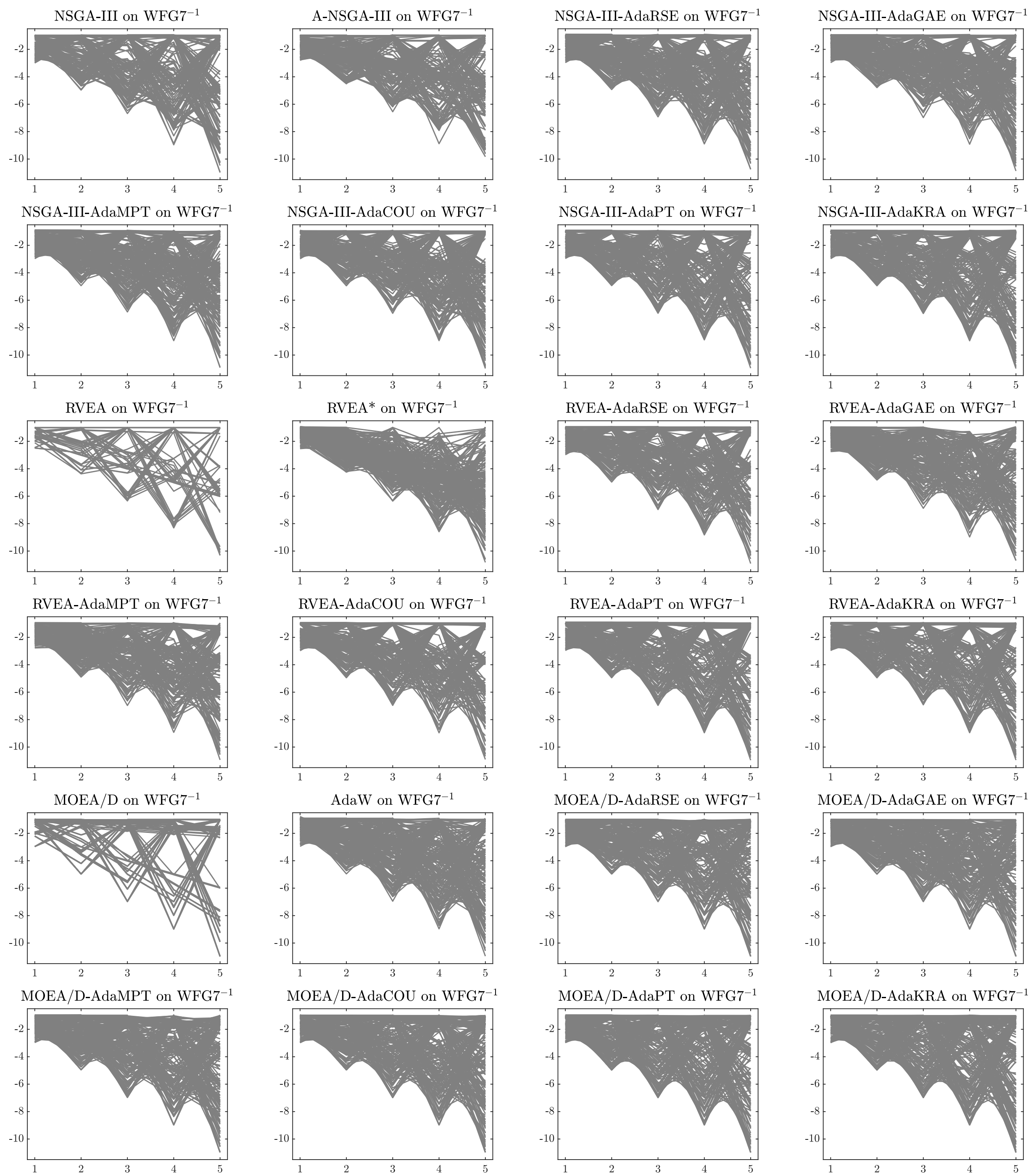

Figure 118: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7^{-1} with 5 objective functions.

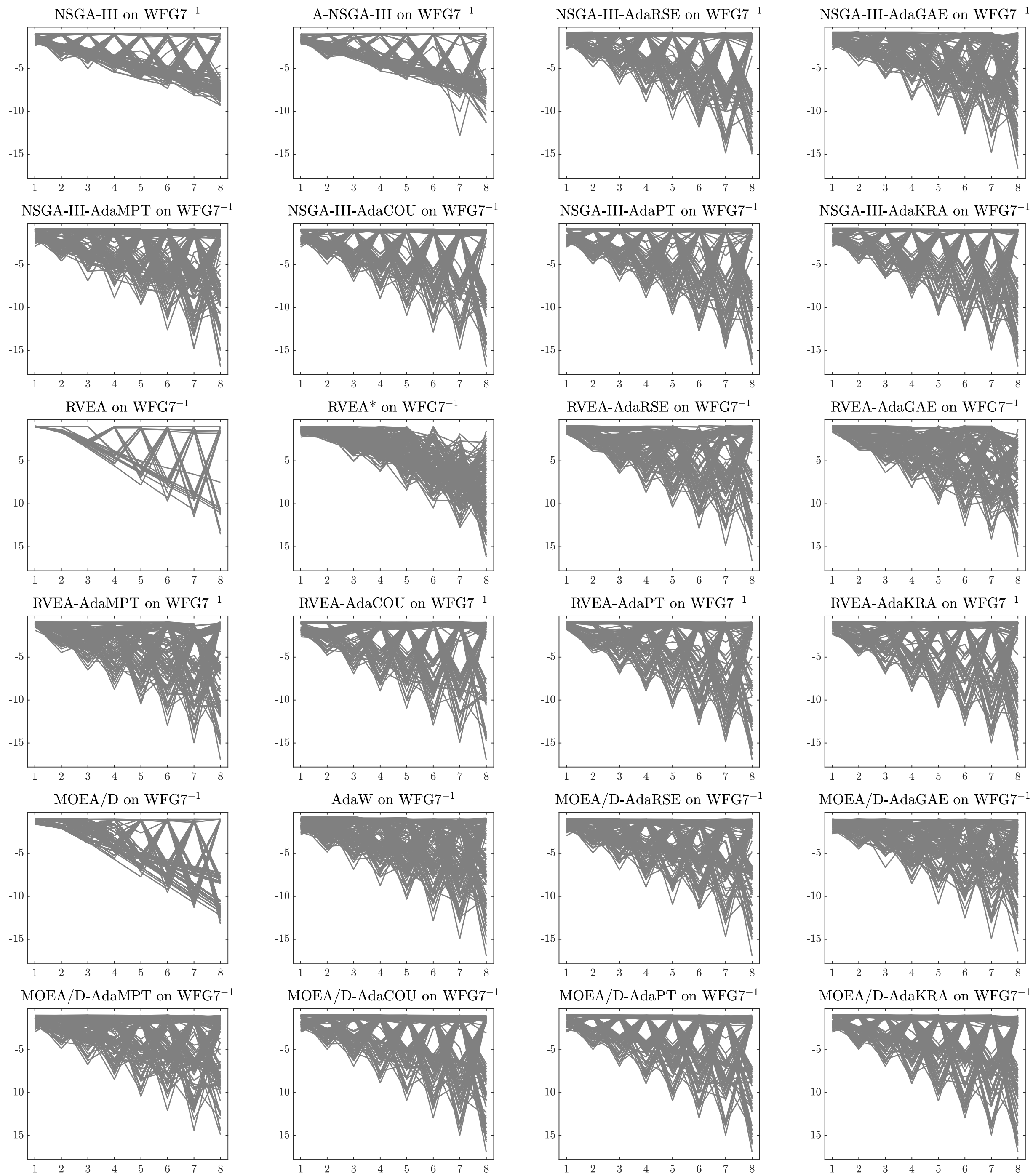

Figure 119: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7^{-1} with 8 objective functions.

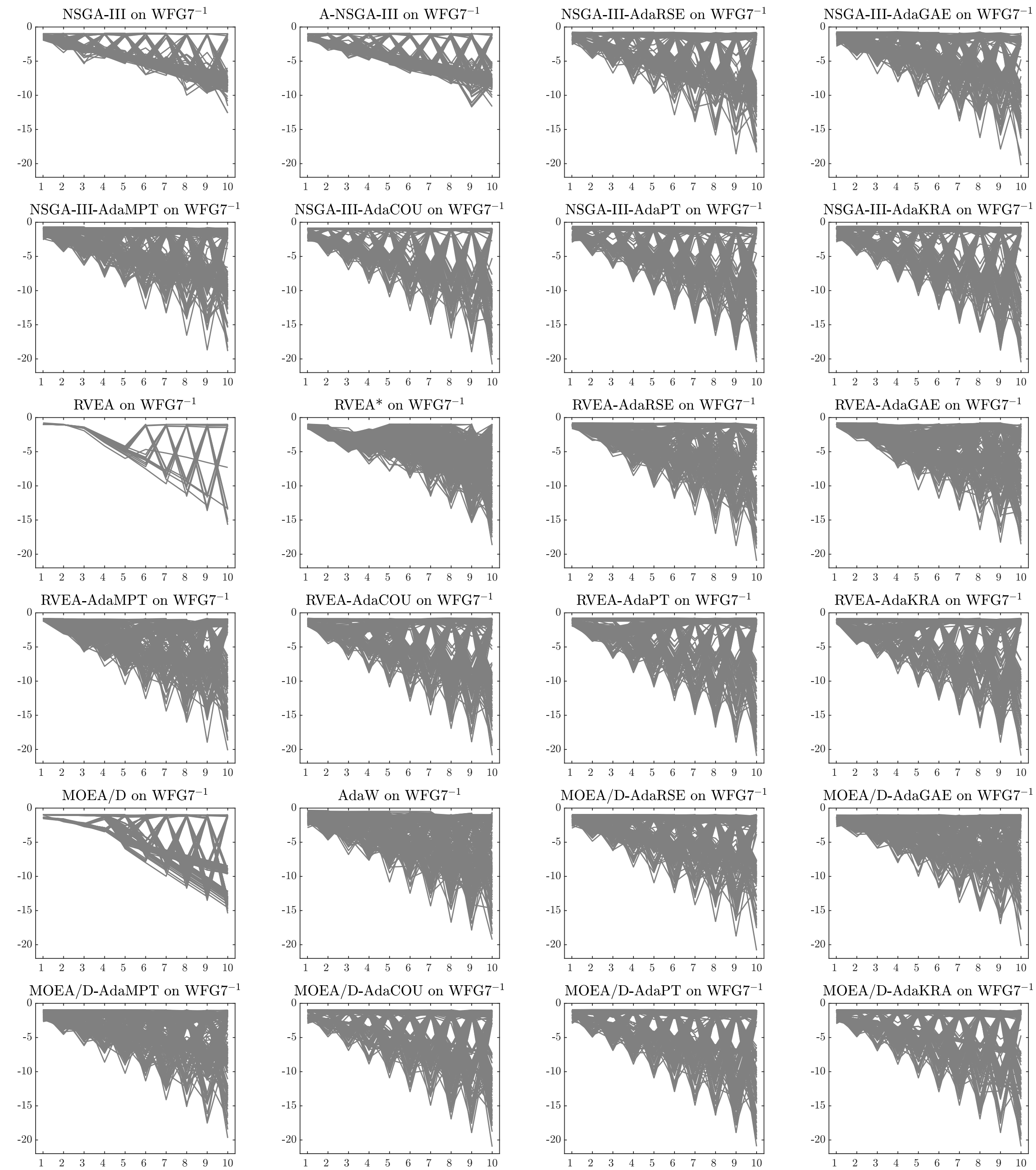

Figure 120: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG7^{-1} with 10 objective functions.

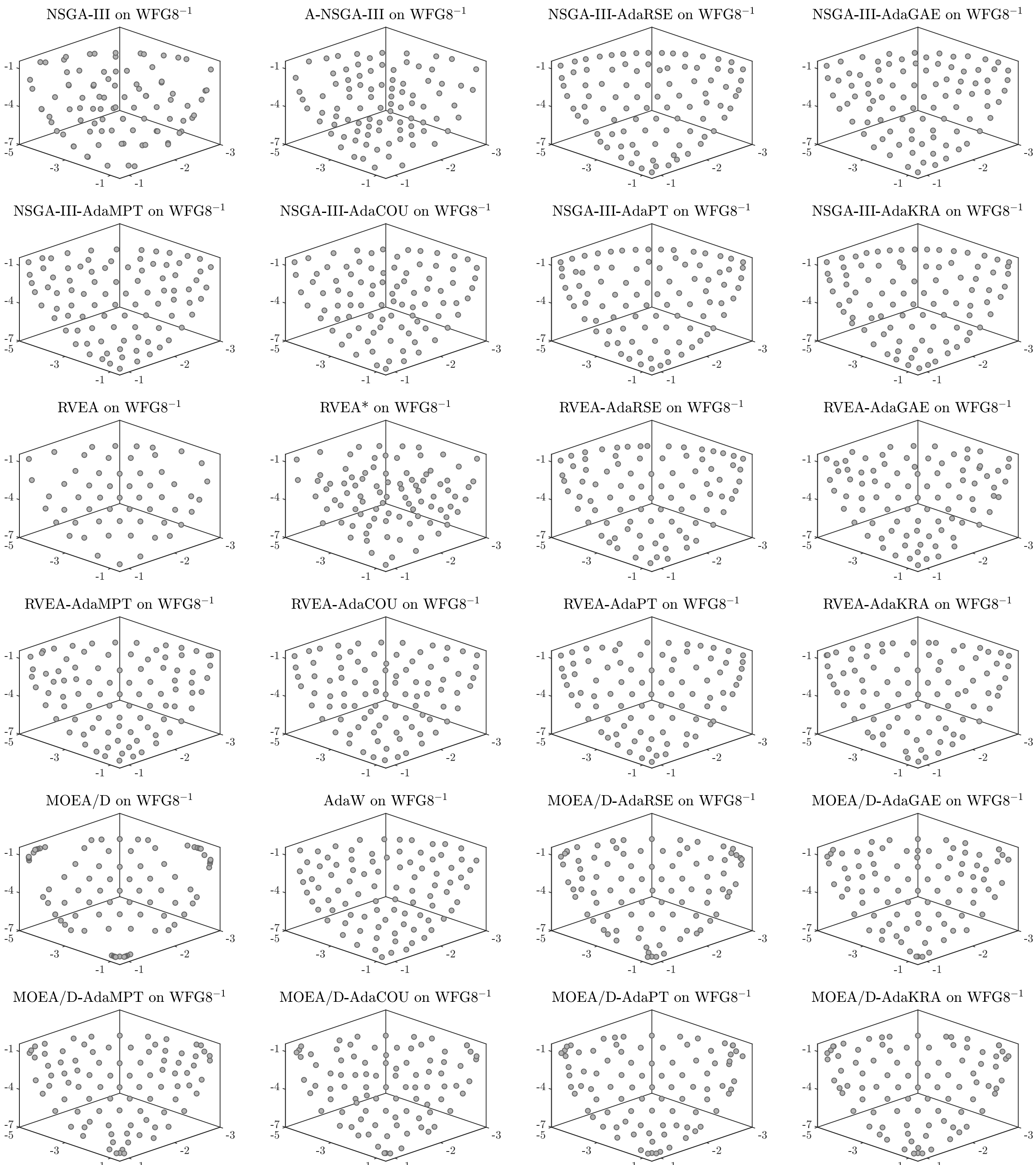

Figure 121: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8^{-1} with 3 objective functions.

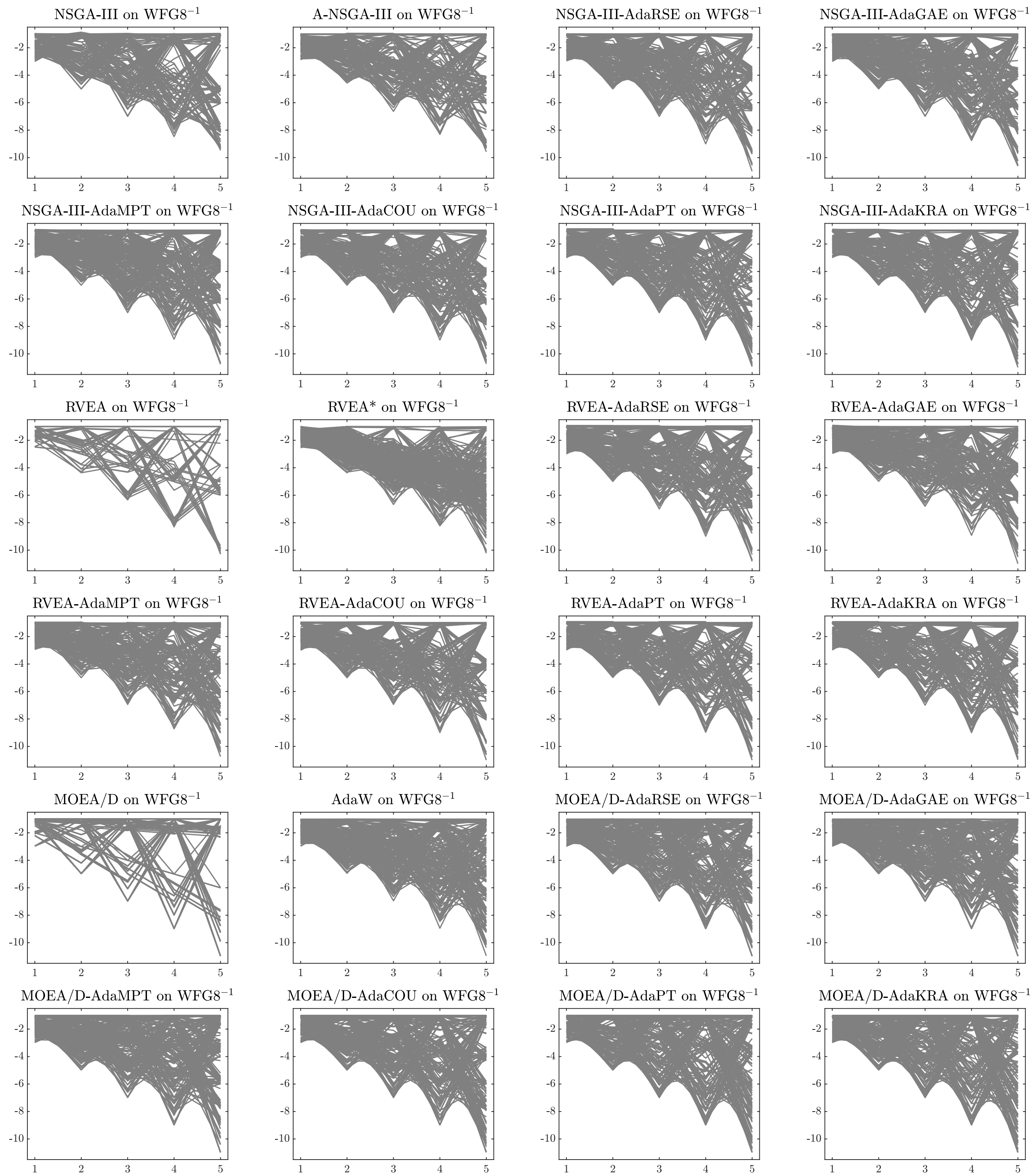

Figure 122: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8^{-1} with 5 objective functions.

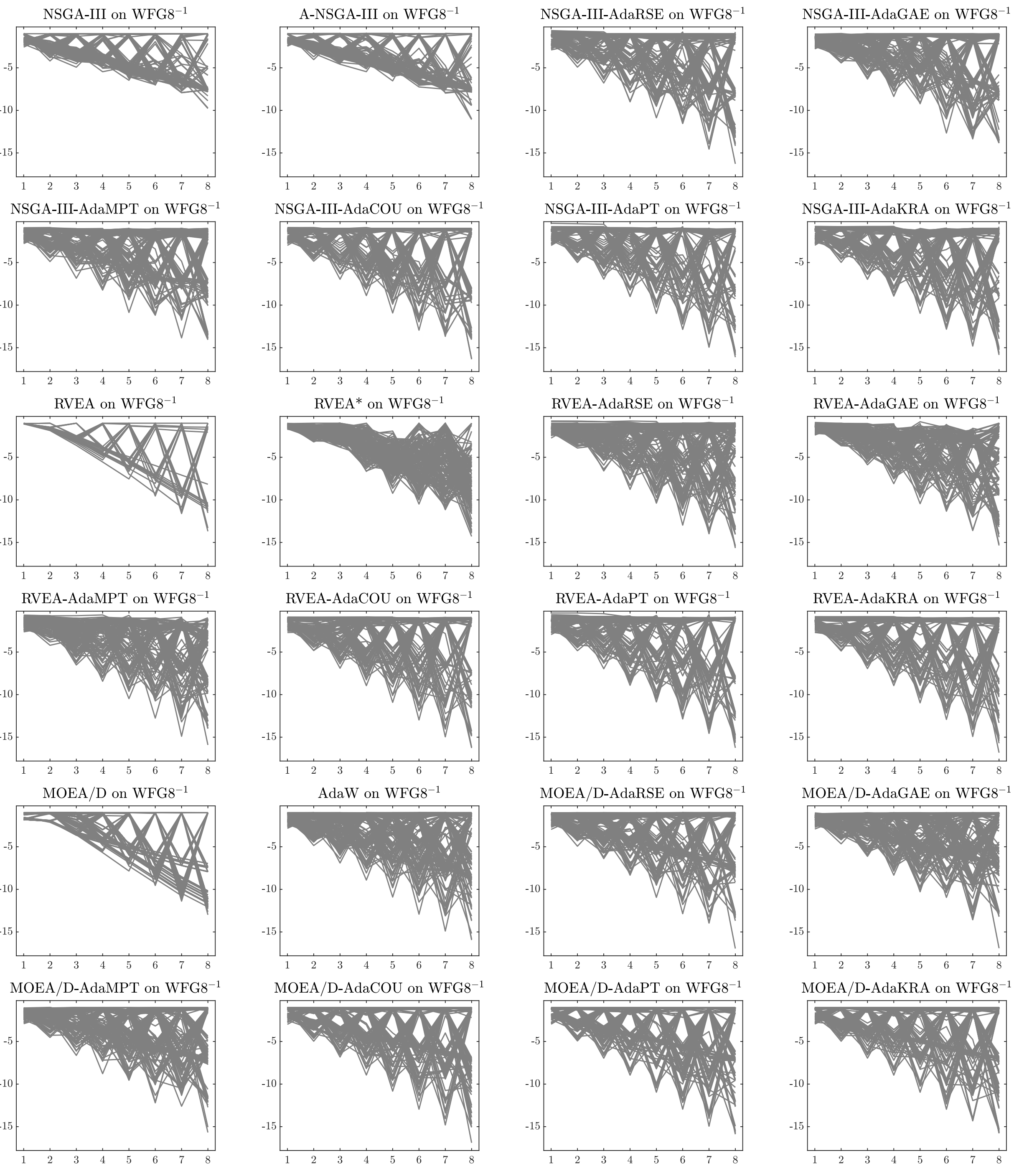

Figure 123: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8^{-1} with 8 objective functions.

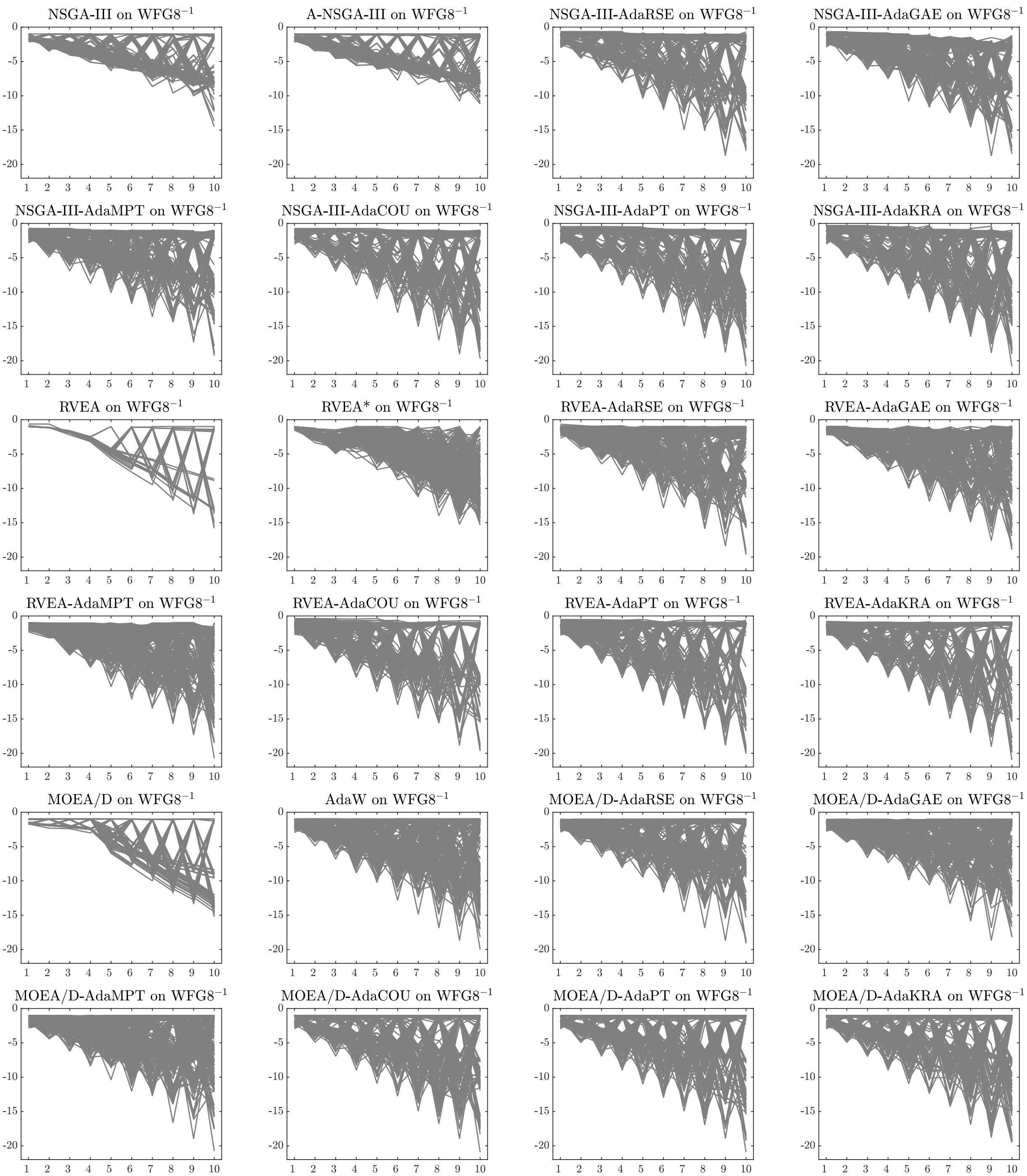

Figure 124: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG8^{-1} with 10 objective functions.

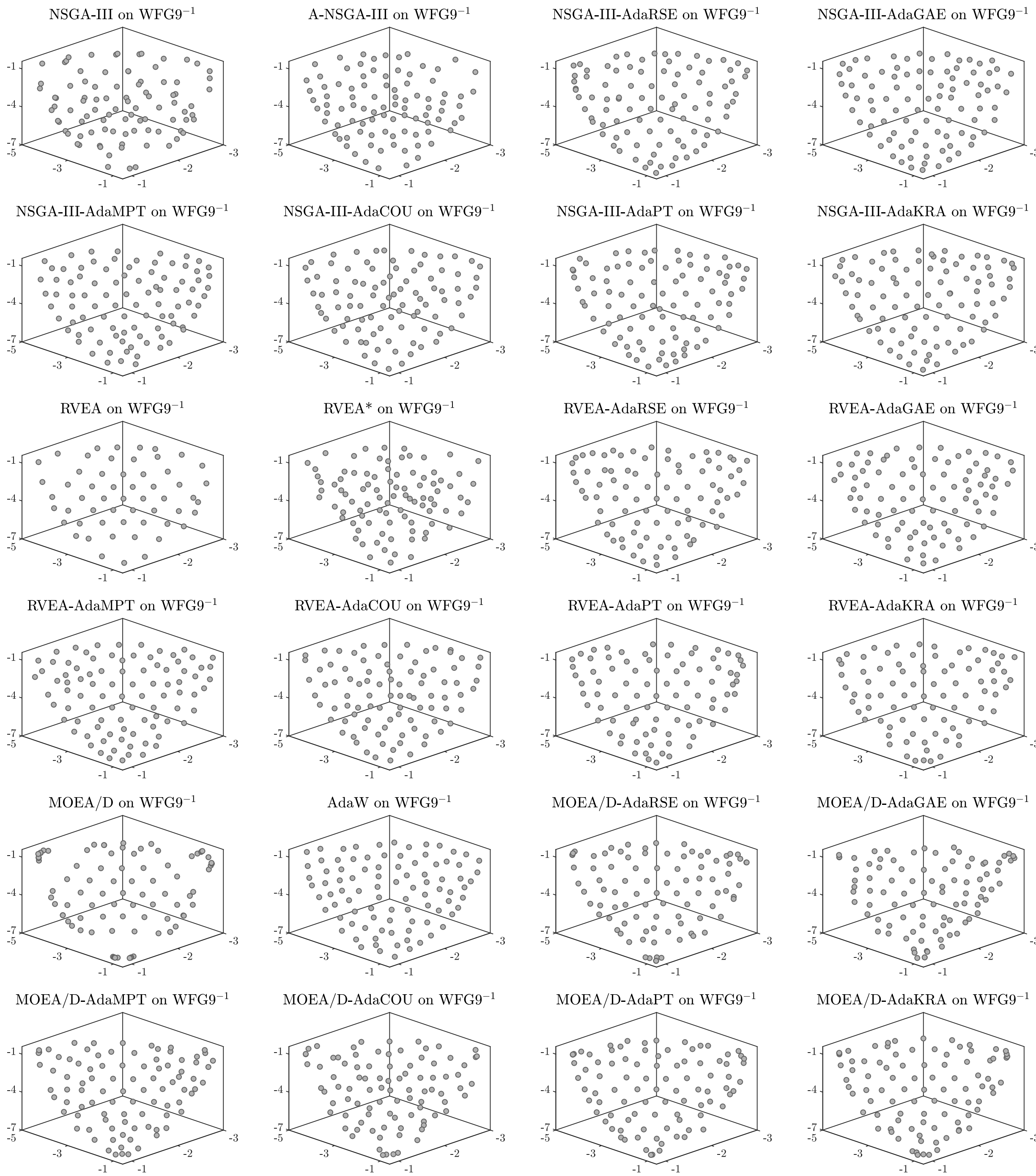

Figure 125: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9^{-1} with 3 objective functions.

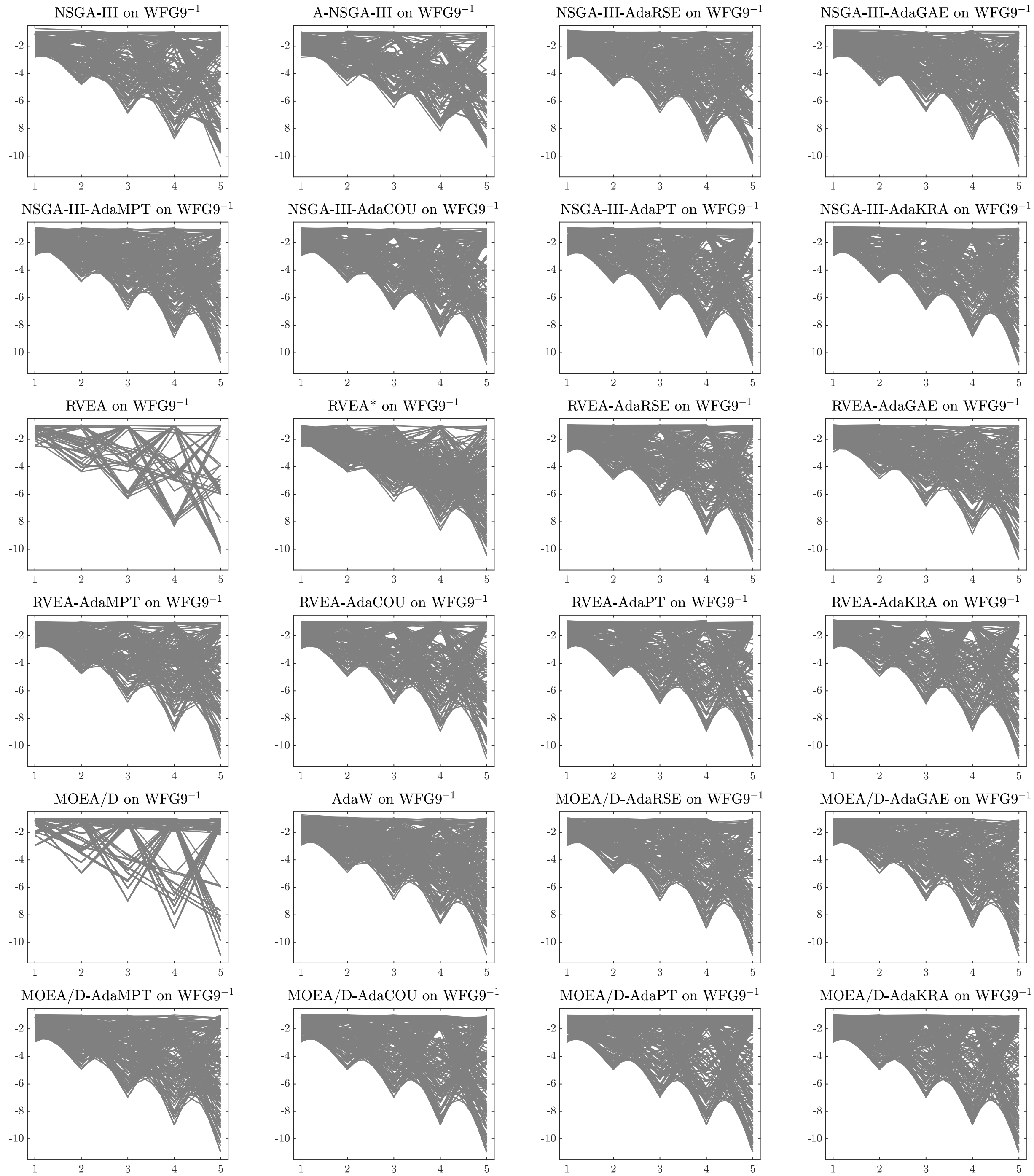

Figure 126: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9^{-1} with 5 objective functions.

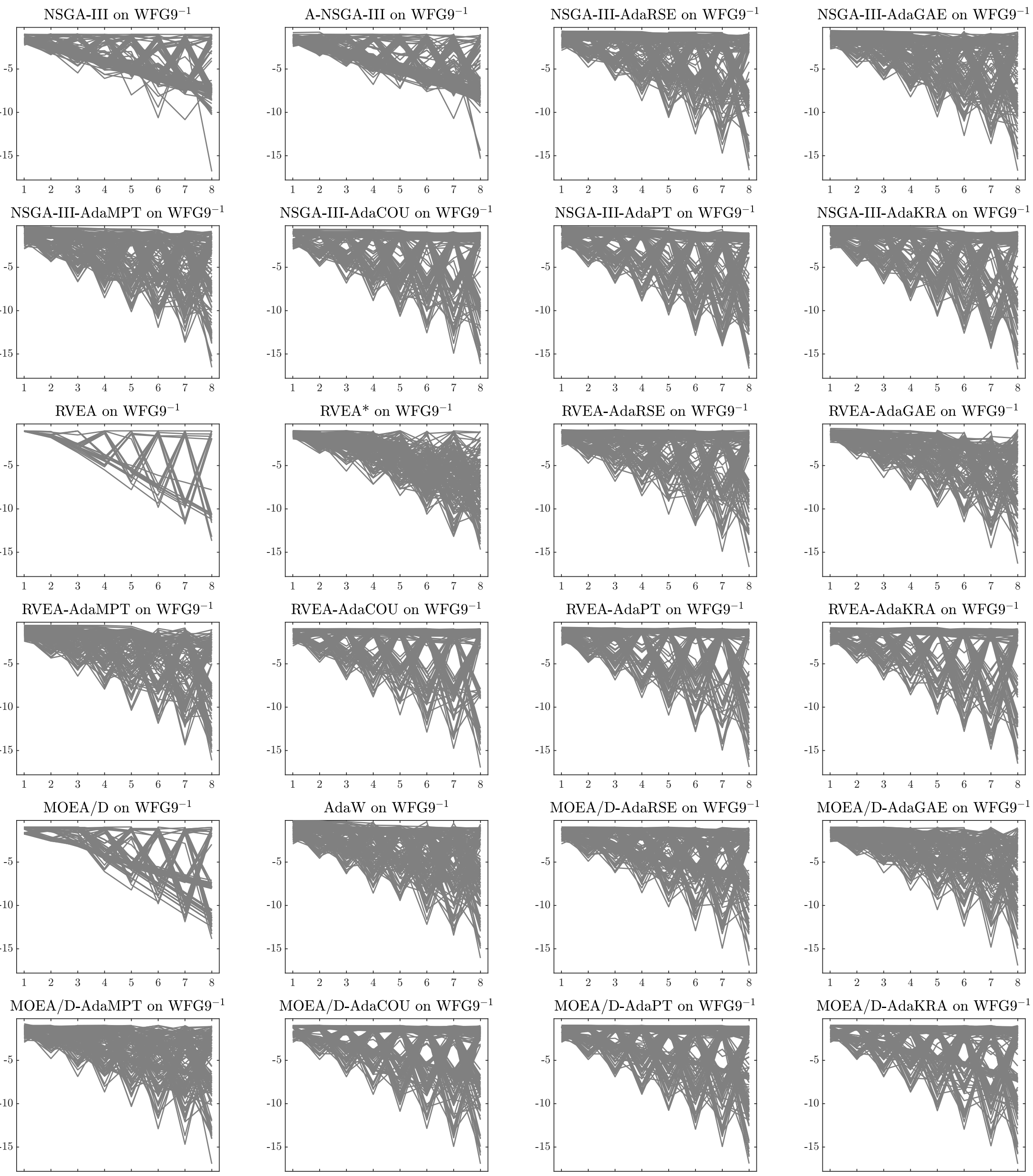

Figure 127: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9^{-1} with 8 objective functions.

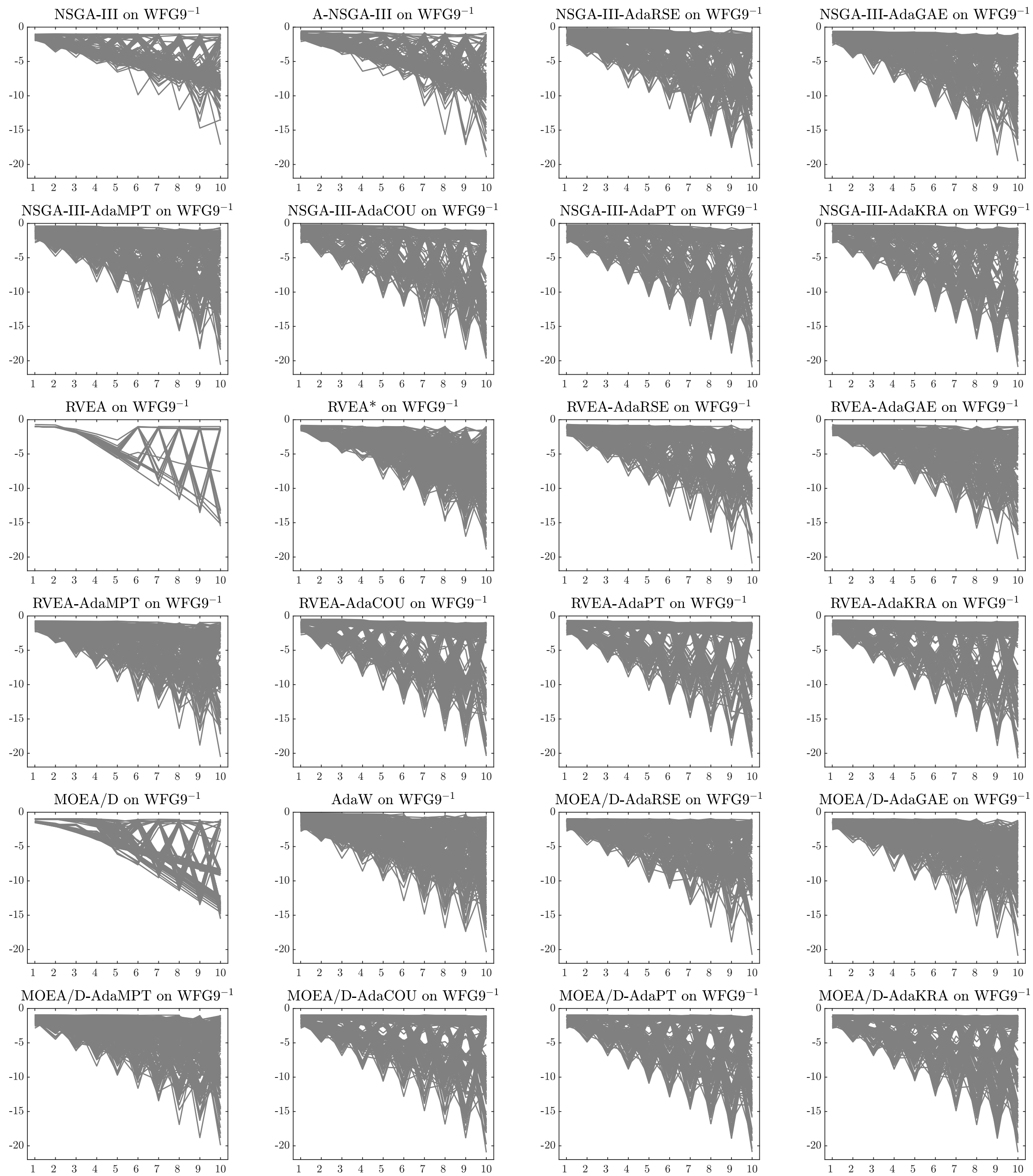

Figure 128: Final populations with the median HV value among 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG9^{-1} with 10 objective functions.

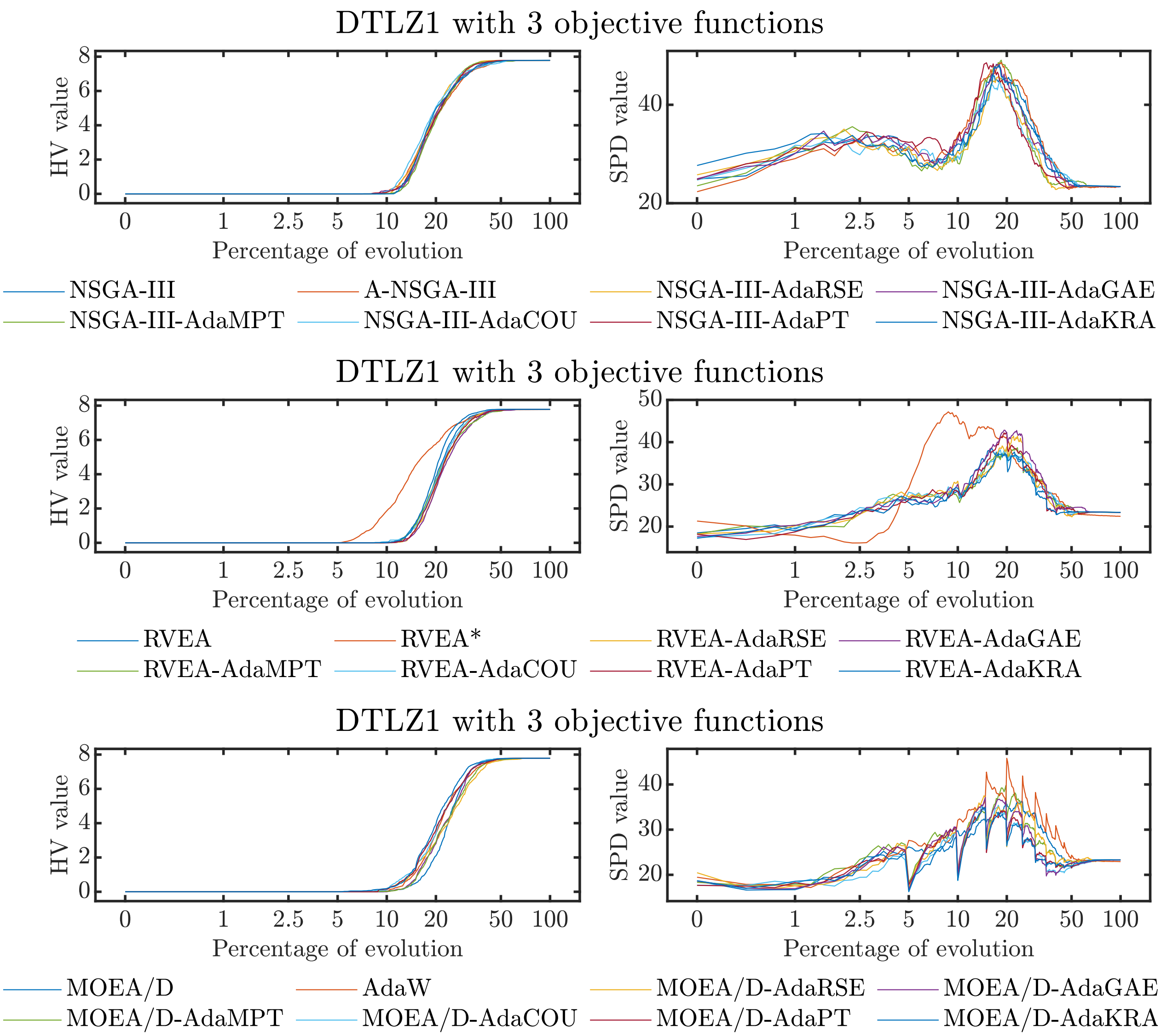

Figure 129: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 3 objective functions.

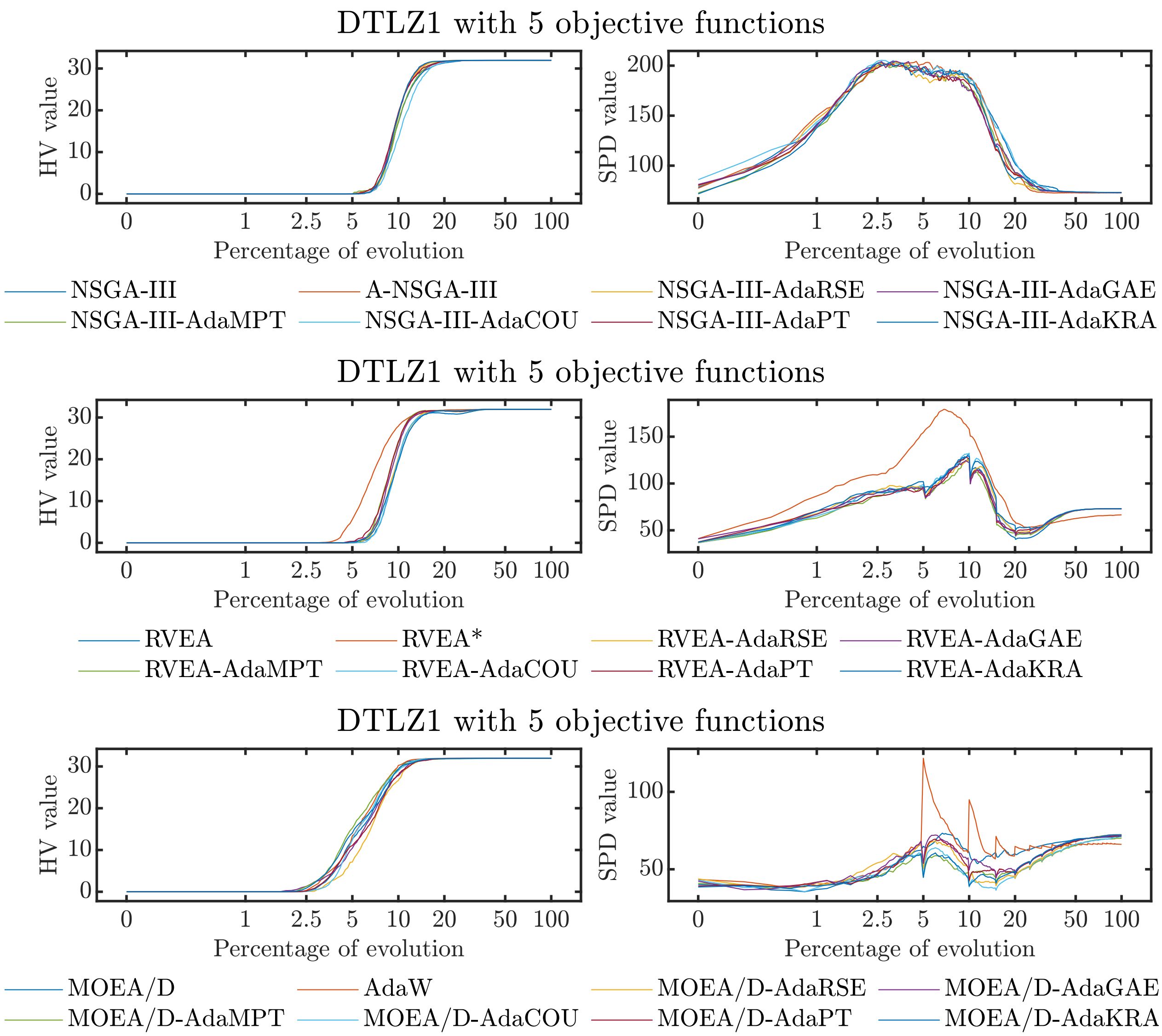

Figure 130: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 5 objective functions.

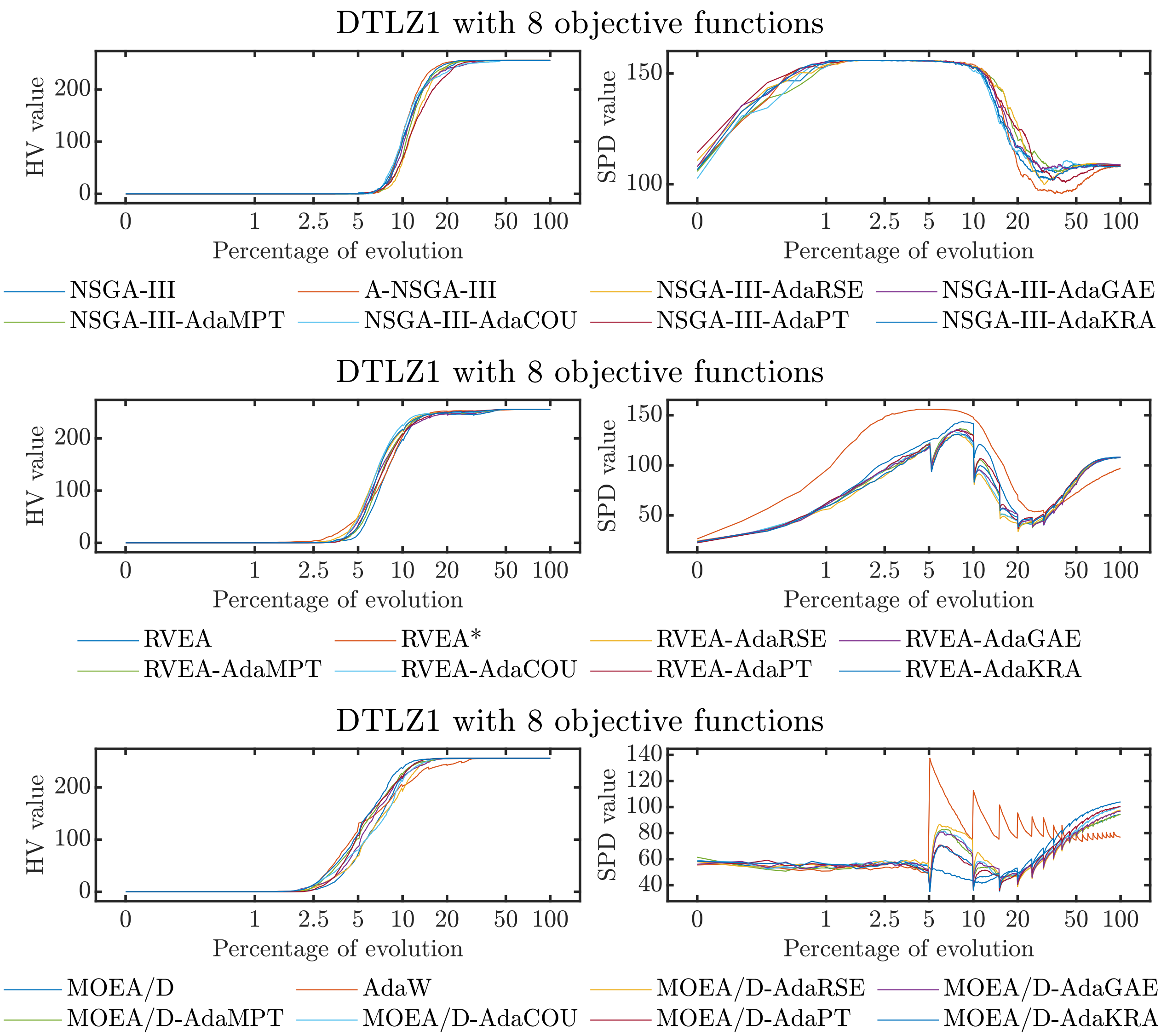

Figure 131: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 8 objective functions.

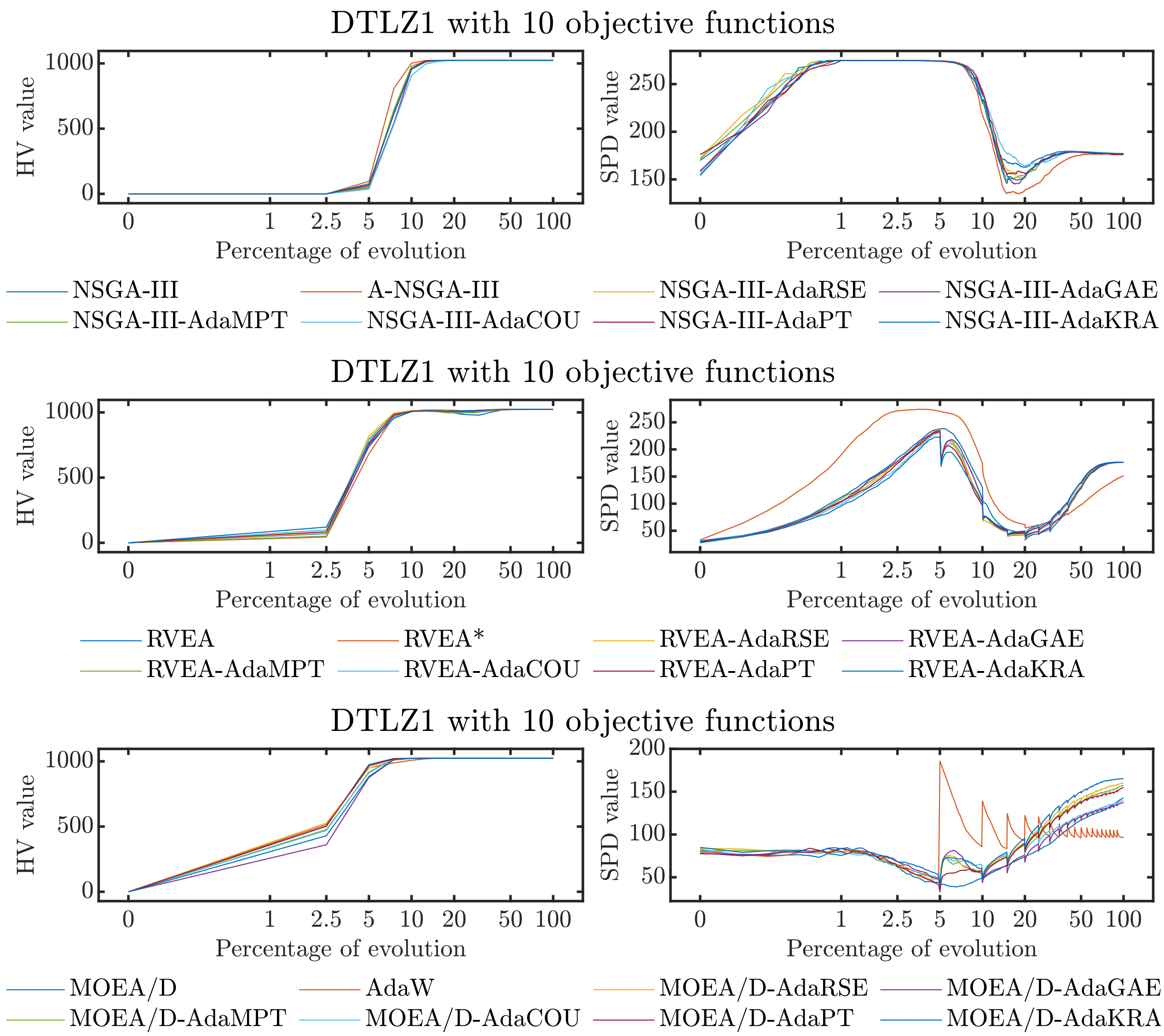

Figure 132: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1 with 10 objective functions.

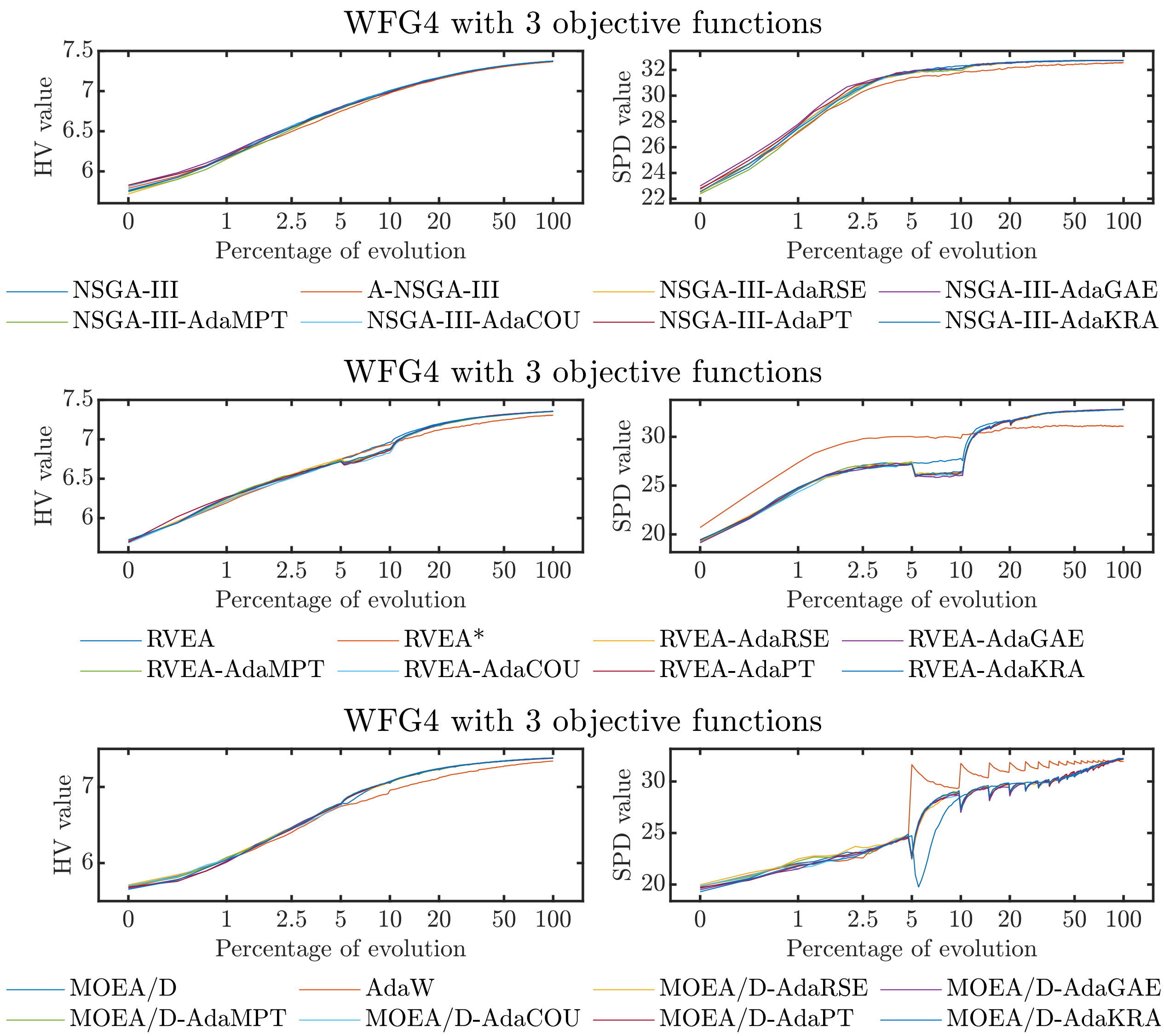

Figure 133: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 3 objective functions.

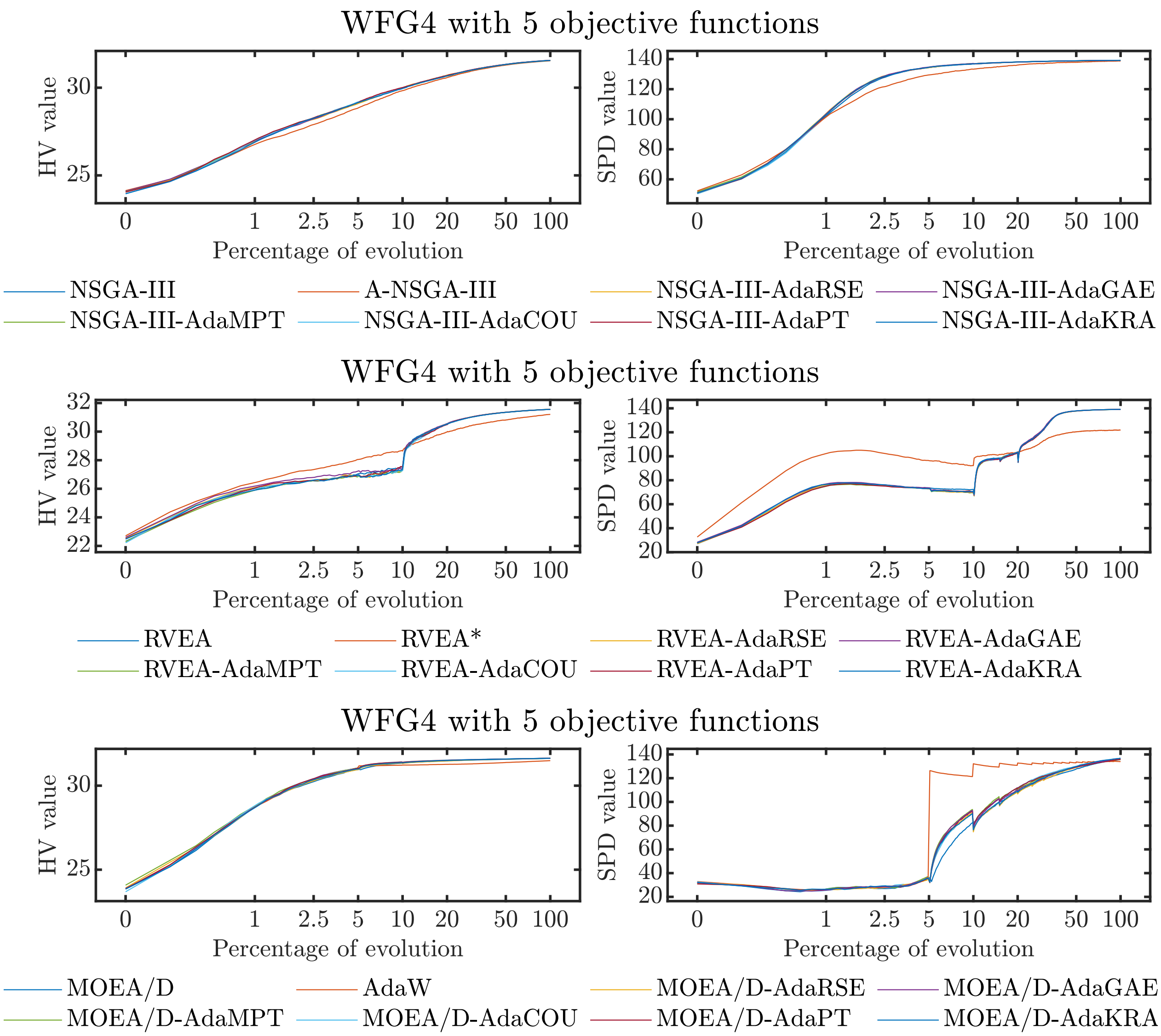

Figure 134: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 5 objective functions.

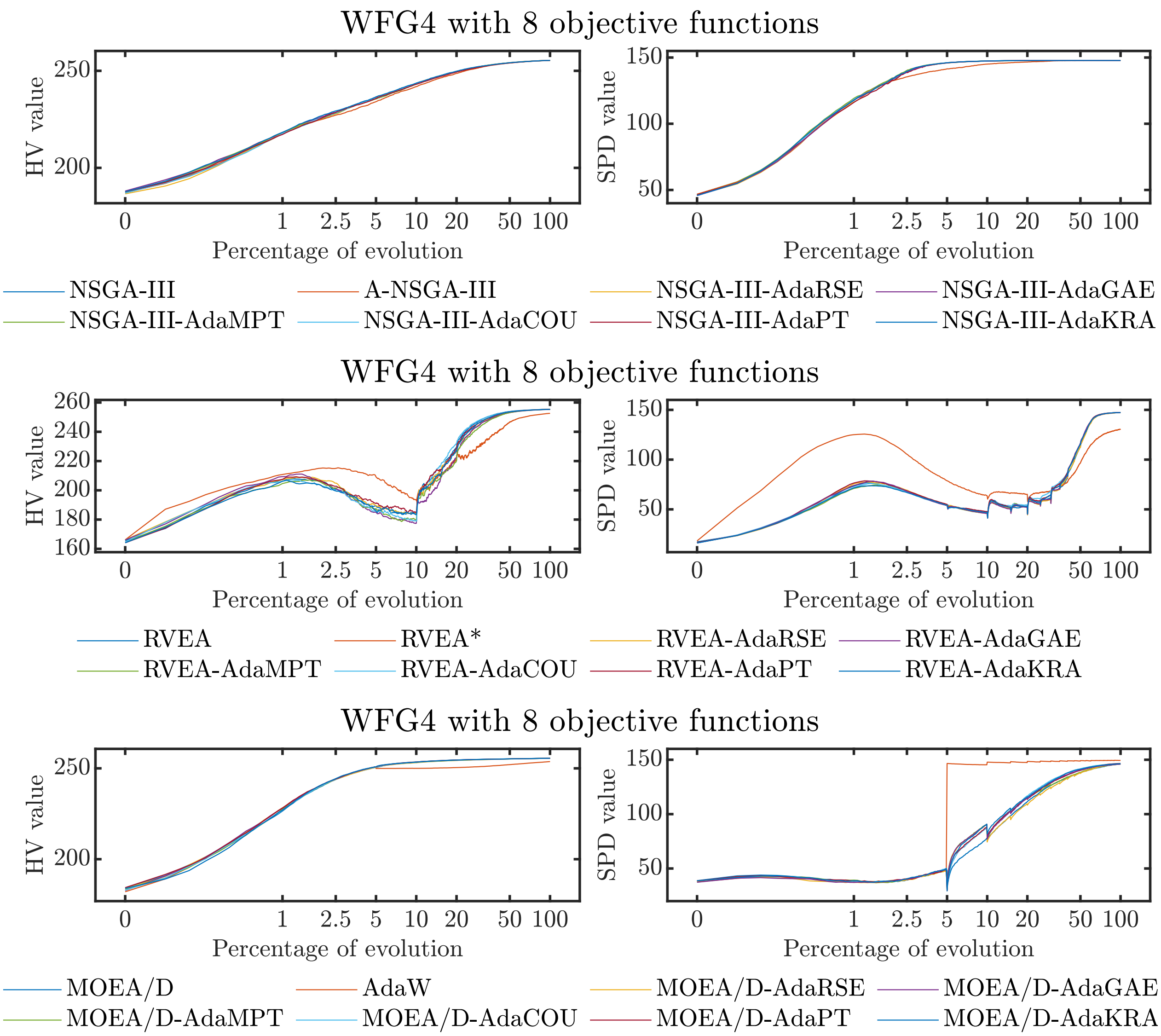

Figure 135: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 8 objective functions.

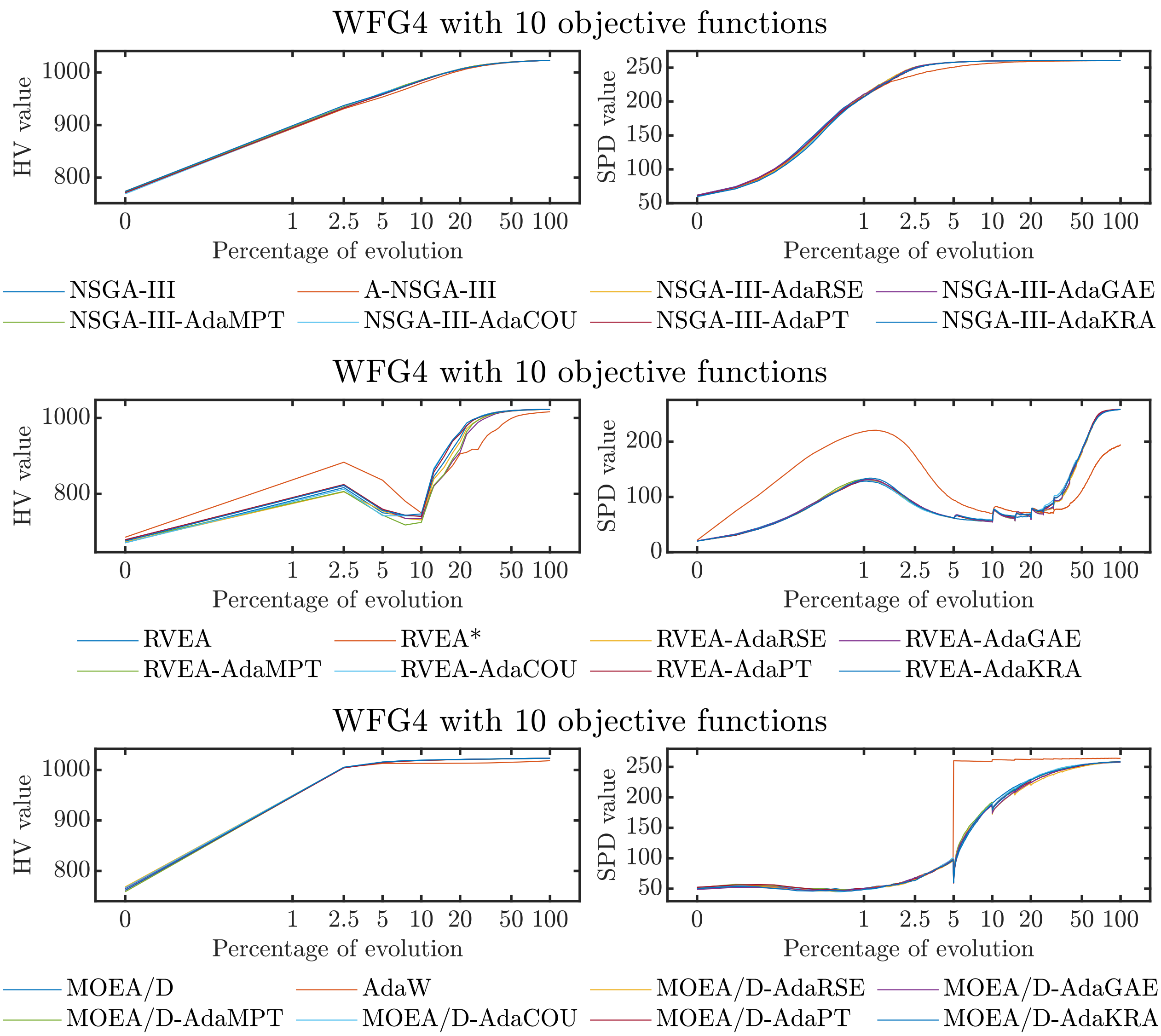

Figure 136: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4 with 10 objective functions.

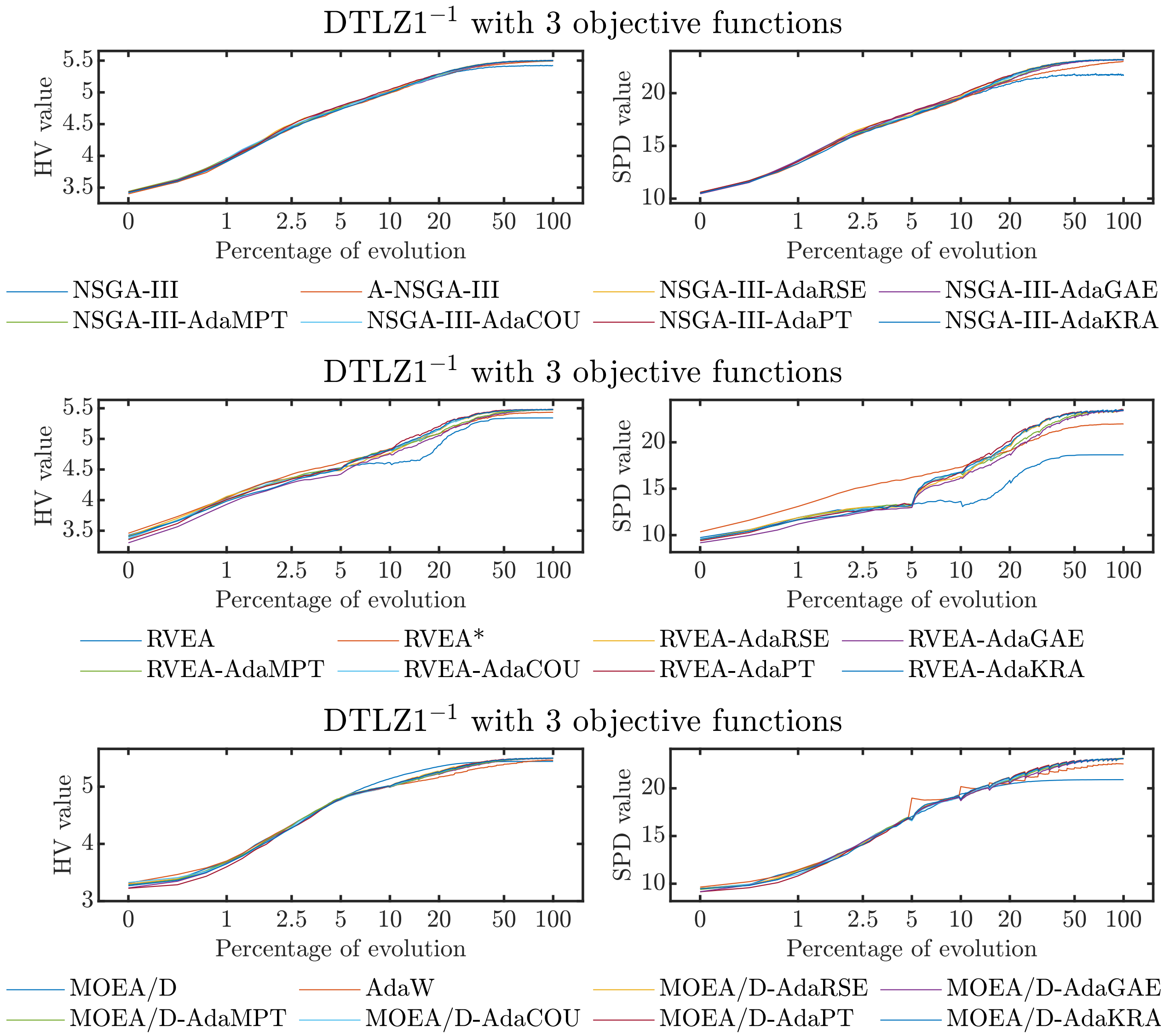

Figure 137: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 3 objective functions.

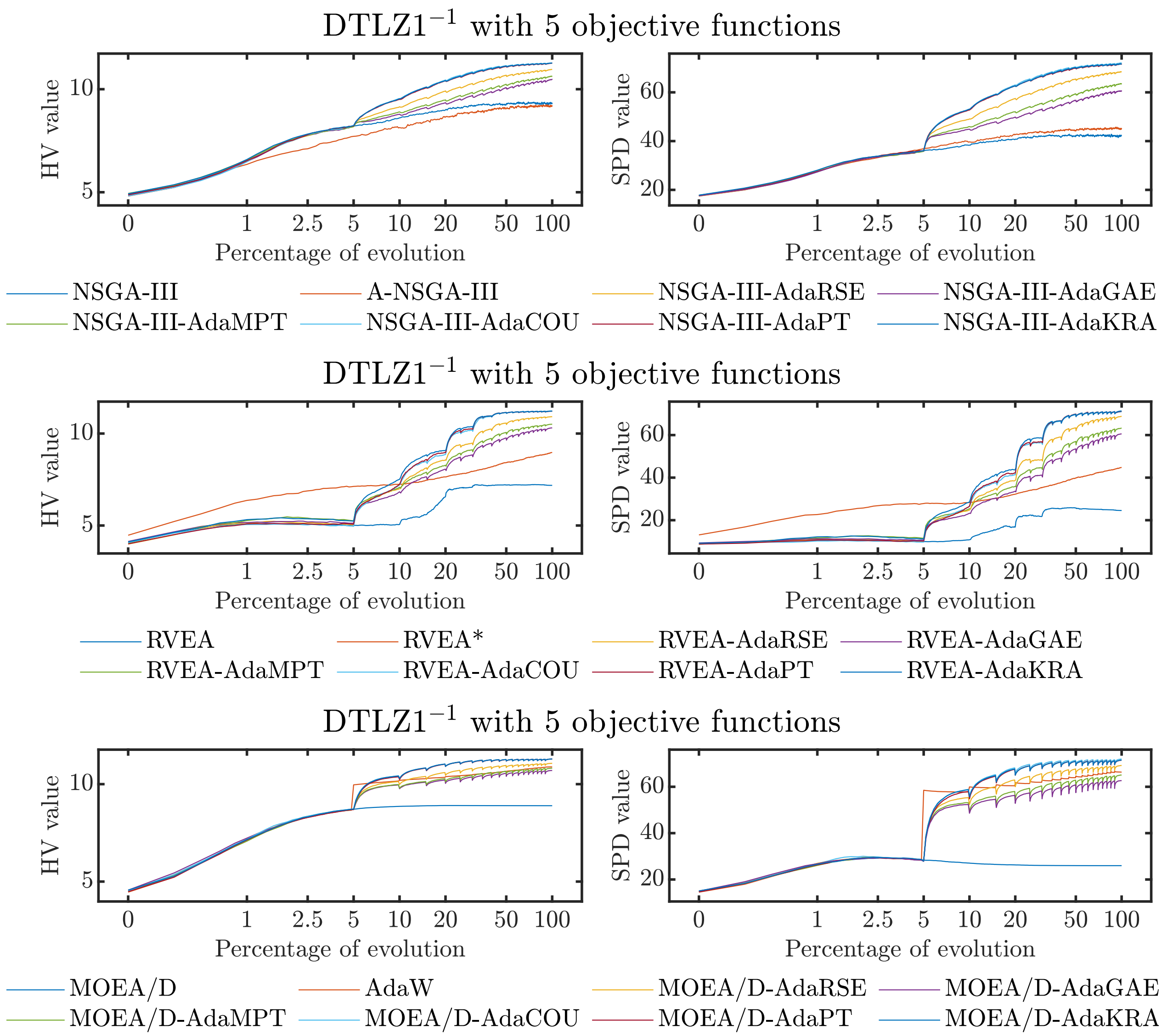

Figure 138: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 5 objective functions.

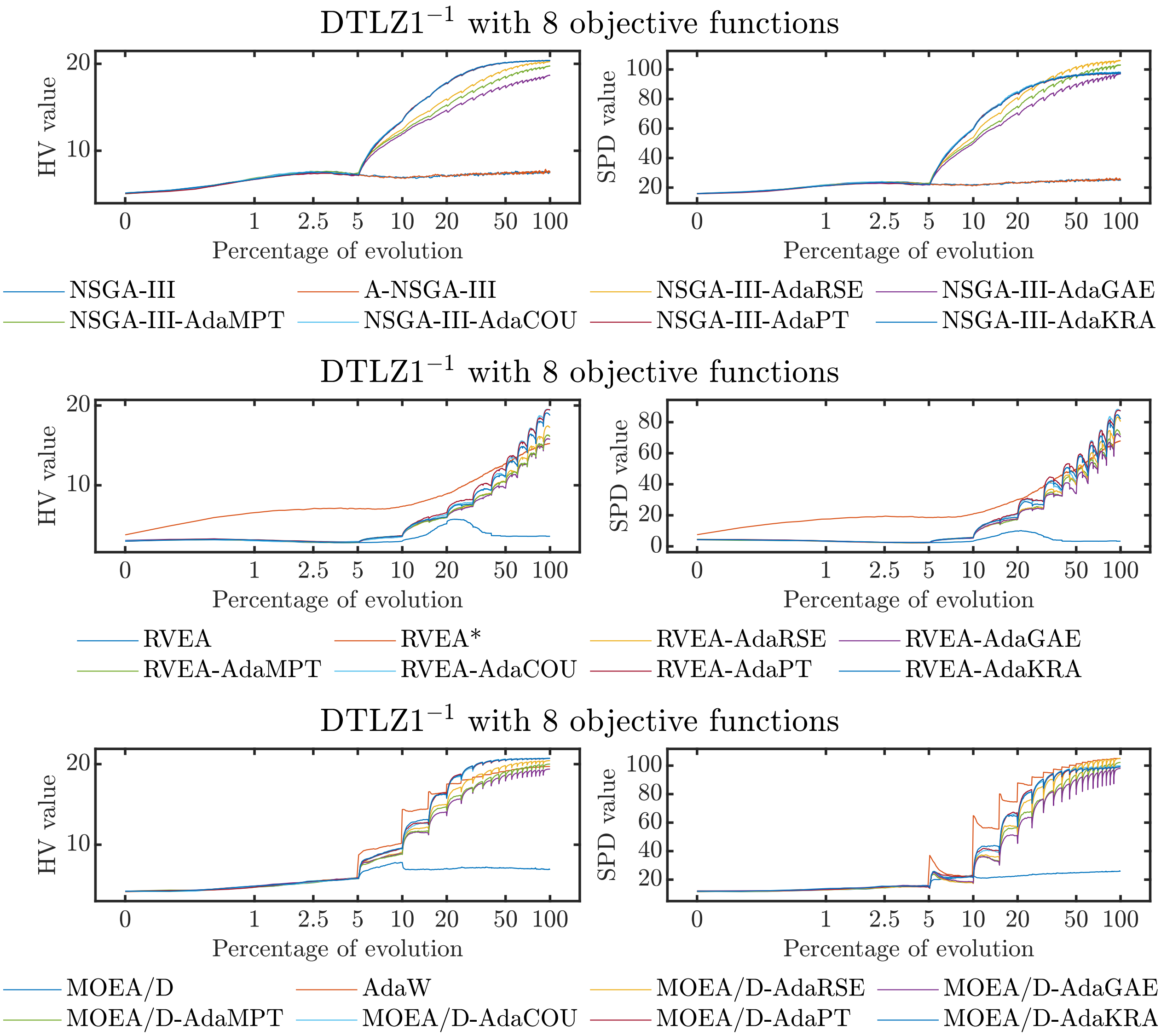

Figure 139: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 8 objective functions.

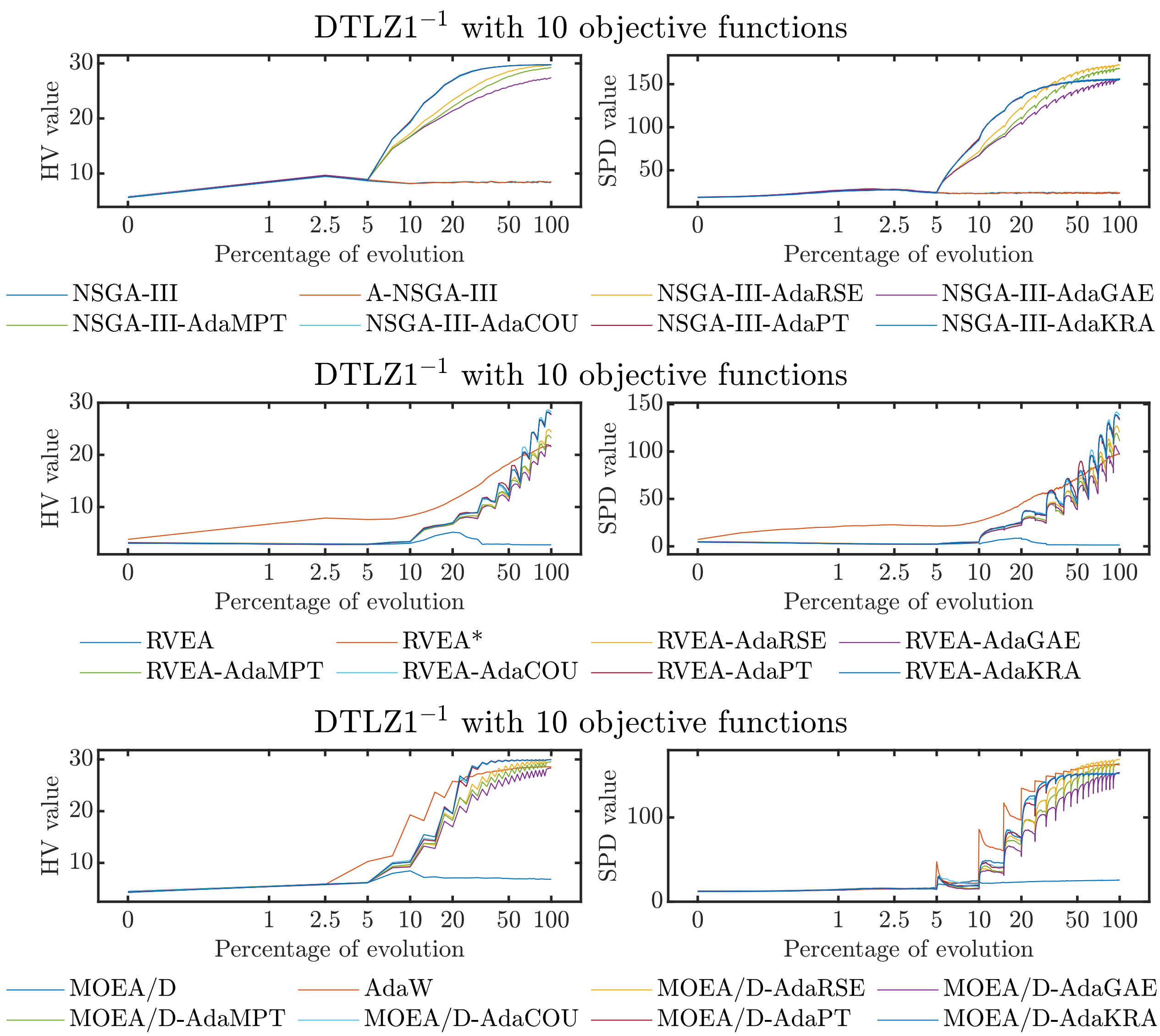

Figure 140: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on DTLZ1^{-1} with 10 objective functions.

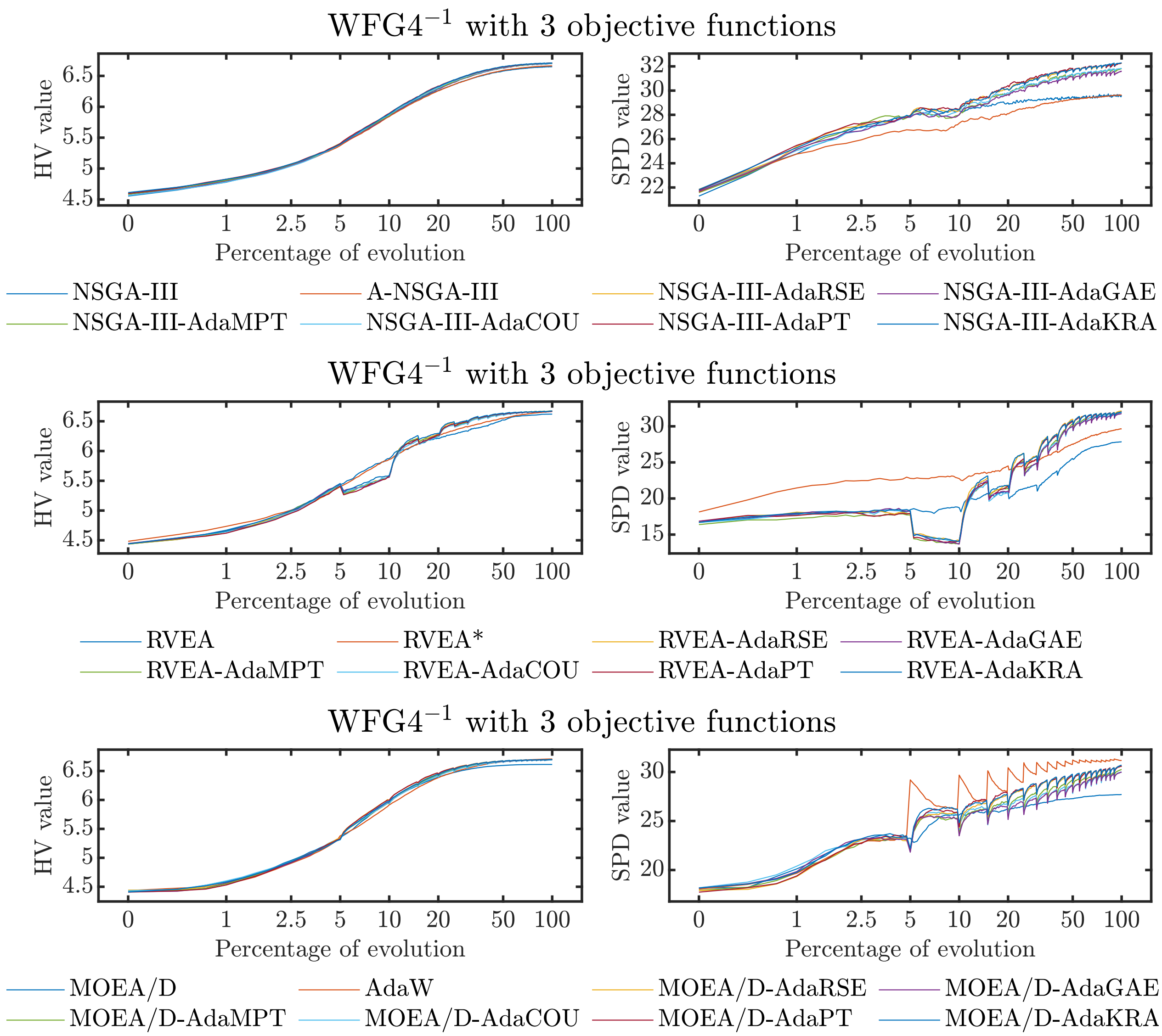

Figure 141: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 3 objective functions.

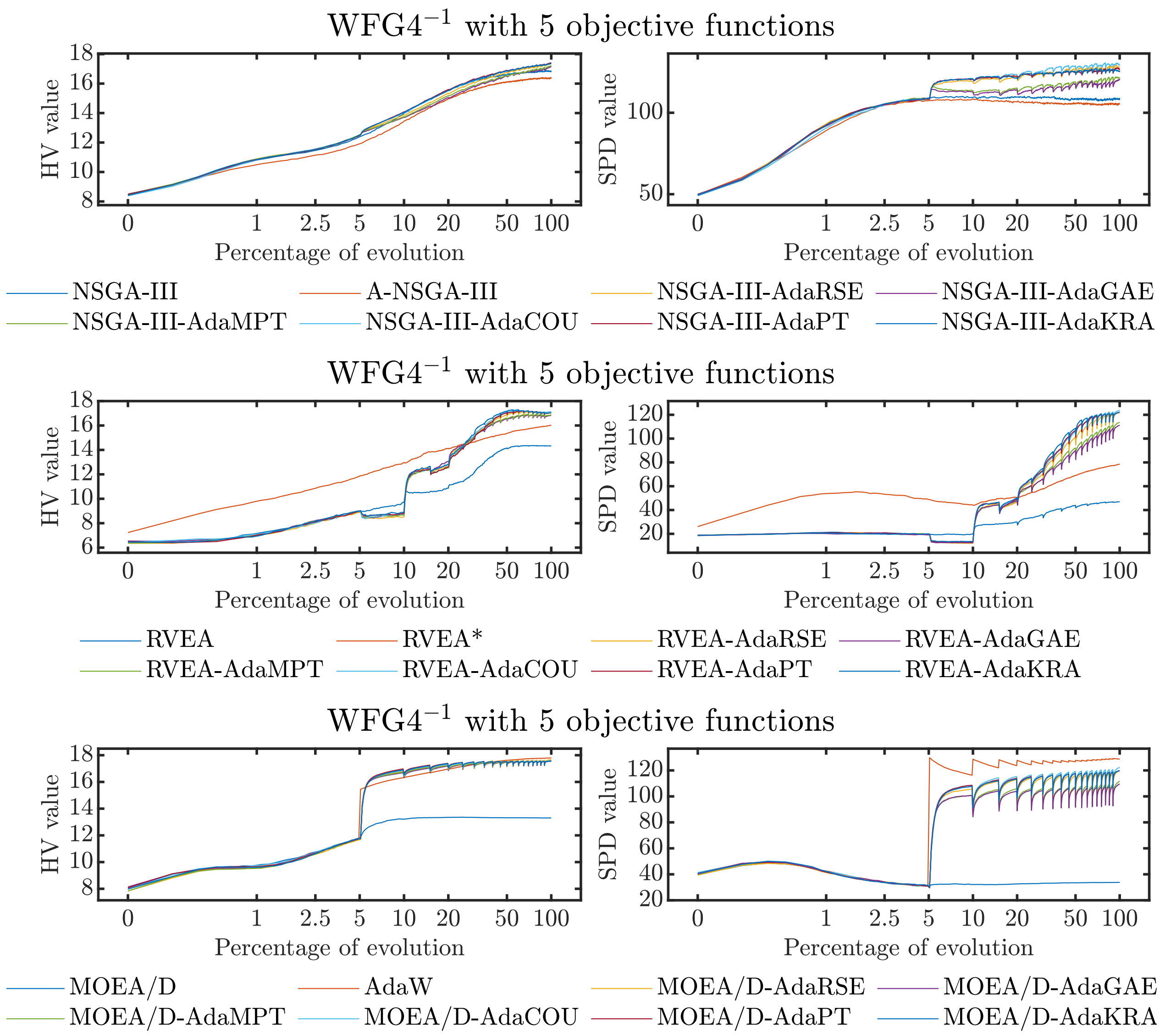

Figure 142: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 5 objective functions.

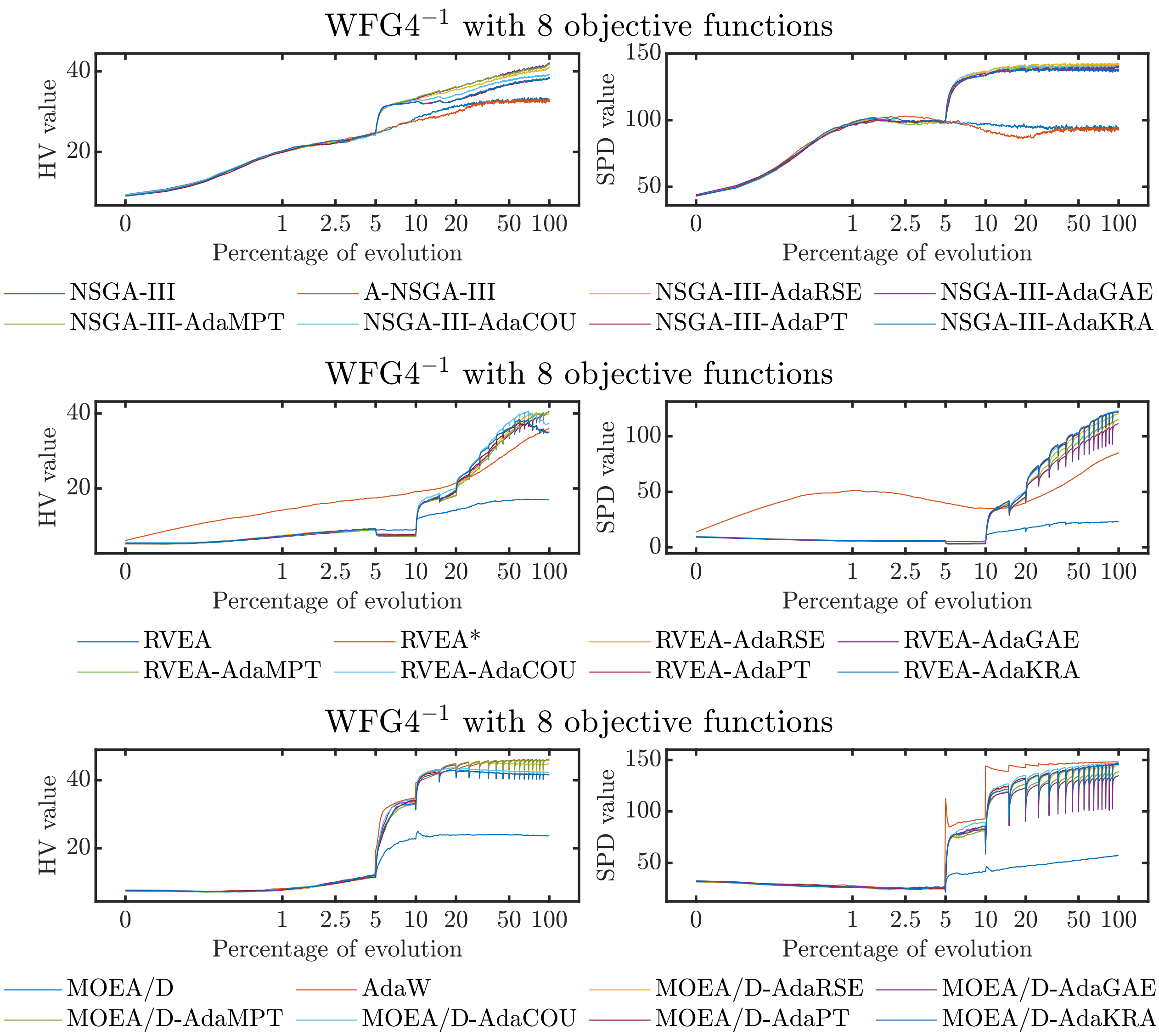

Figure 143: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 8 objective functions.

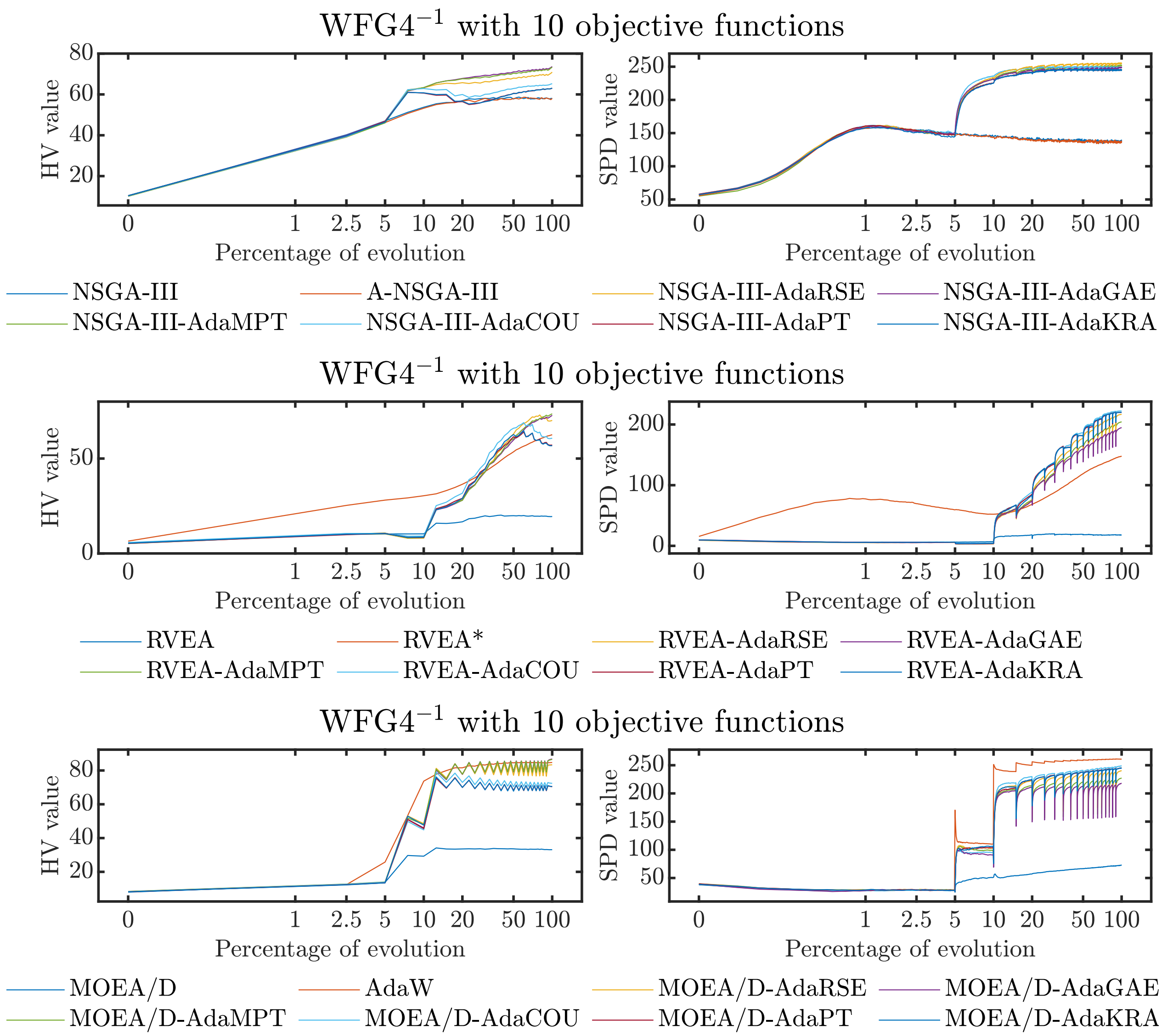

Figure 144: Convergence and diversity graphs with the mean HV value and SPD value of 30 independent runs of MOEAs using the NSGA-III, RVEA, and MOEA/D frameworks on WFG4^{-1} with 10 objective functions.