Supplementary document for "Adaptive Operator Selection with Bandits for Multiobjective Evolutionary Algorithm Based on Decomposition"

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Abstract

This supplementary document provides the numerical values of the simulations with MOEA/D-DE, MOEA/D-DRA, ENS-MOEA/D and MOEA/D-FRRMAB in Table 1 and Table 2. Moreover, Fig. 1 to Fig. 10 show the performances of MOEA/D-FRRMAB on *IGD* with 72 different combinations of C, D and W. Fig. 11 to Fig. 20 present the the performances of MOEA/D-FRRMAB on I_H with 72 different combinations of C, D and W.

Table 1: Comparative results of MOEA/D-DE, MOEA/D-DRA, ENS-MOEA/D and MOEA/D-FRRMAB on IGD metric

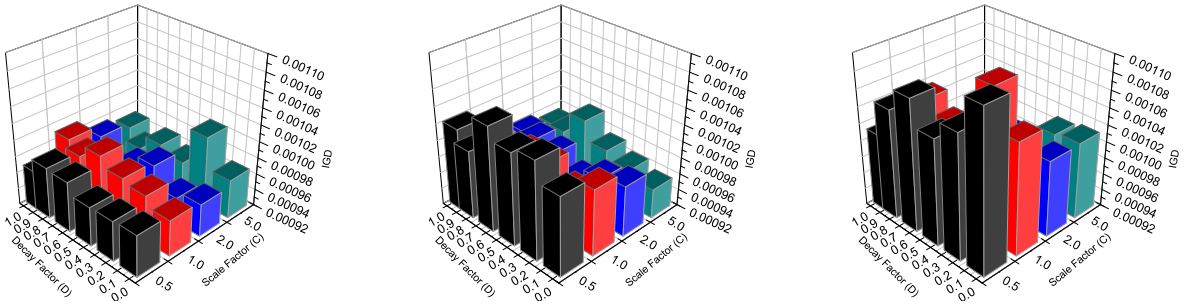
Problem	MOEA/D	DRA	ENS	FRRMAB
UF1	1.258E-3(1.07E-4)†	1.589E-3(6.50E-4)†	1.442E-3(1.26E-4)†	**1.021E-3(1.76E-4)**
UF2	5.710E-3(1.55E-3)†	4.203E-3(2.00E-3)†	3.910E-3(1.11E-3)†	**1.851E-3(5.38E-4)**
UF3	1.342E-2(1.47E-2)†	4.859E-3(5.95E-3)	**3.820E-3(1.45E-3)**	4.404E-3(7.44E-3)
UF4	5.621E-2(3.37E-3)†	5.963E-2(4.26E-3)†	5.532E-2(3.98E-3)†	**5.276E-2(3.19E-3)**
UF5	3.152E-1(4.85E-2)†	2.960E-1(6.56E-2)	2.968E-1(1.34E-1)	**2.949E-1(4.61E-2)**
UF6	1.026E-1(1.01E-1)†	1.686E-1(1.44E-1)†	9.810E-2(7.23E-2)†	**8.298E-2(5.65E-2)**
UF7	1.593E-3(5.03E-4)†	2.918E-3(4.09E-3)†	2.121E-3(3.57E-4)†	**1.202E-3(2.49E-4)**
UF8	5.760E-2(8.94E-3)†	4.779E-2(1.05E-2)†	4.299E-2(6.00E-3)†	**4.067E-2(3.54E-3)**
UF9	5.268E-2(4.02E-2)†	1.052E-1(5.13E-2)†	5.271E-2(3.99E-2)†	**3.826E-2(3.49E-2)**
UF10	5.379E-1(6.68E-2)†	4.138E-1(7.01E-2)‡	**3.989E-1(8.63E-2)**‡	5.266E-1(7.14E-2)

Wilcoxon's rank sum test at a 0.05 significance level is performed between MOEA/D-FRRMAB and each of MOEA/D-DE, MOEA/D-DRA and ENS-MOEA/D. † and ‡ denote the performance of the corresponding algorithm is significantly worse than and better than that of the proposed MOEA/D-FRRMAB, respectively. And the best mean metric value is highlighted in boldface with gray background.

Table 2: Comparative results of MOEA/D-DE, MOEA/D-DRA, ENS-MOEA/D and MOEA/D-FRRMAB on I_H metric

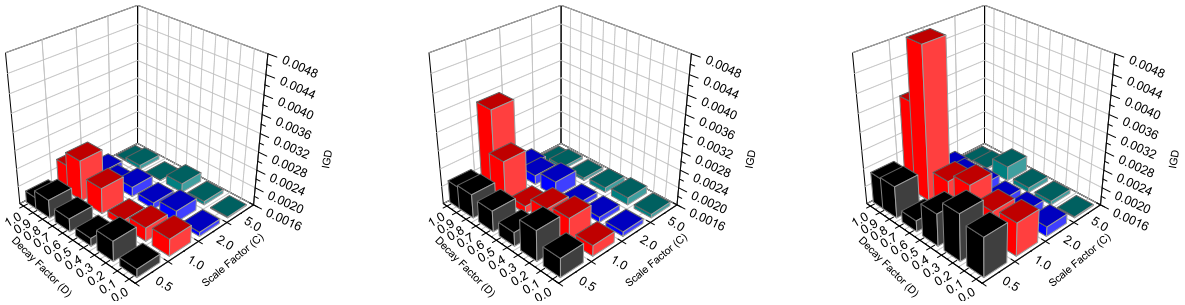
Problem	MOEA/D	DRA	ENS	FRRMAB
UF1	3.6601(1.30E-3)†	3.6588(2.83E-3)†	3.6599(1.01E-3)†	**3.6625(2.05E-3)**
UF2	3.6464(1.37E-2)†	3.6479(1.43E-2)†	3.6501(5.18E-3)†	**3.6554(1.11E-2)**
UF3	3.6163(8.15E-2)†	3.6490(3.46E-2)	**3.6599(1.65E-3)**	3.6543(3.53E-2)
UF4	3.1680(1.62E-2)†	3.1601(1.95E-2)†	3.1692(1.90E-2)†	**3.1825(1.20E-2)**
UF5	2.6478(1.57E-1)†	2.7014(2.99E-1)	2.6573(3.04E-1)	**2.7218(1.36E-1)**
UF6	3.1008(2.69E-1)†	2.9023(3.33E-1)†	3.1105(2.14E-1)†	**3.1373(1.82E-1)**
UF7	3.4901(5.83E-3)	3.4768(4.57E-2)	3.4876(2.08E-3)†	**3.4902(4.83E-3)**
UF8	7.3320(1.84E-2)†	7.3659(2.09E-2)†	7.3700(1.34E-2)	**7.3715(1.32E-2)**
UF9	7.5512(1.73E-1)†	7.3549(2.38E-1)†	7.5494(1.74E-1)†	**7.6437(1.53E-1)**
UF10	3.4193(3.00E-1)†	3.7542(3.27E-1)‡	**3.8276(6.50E-1)**‡	3.5095(3.45E-1)

Wilcoxon's rank sum test at a 0.05 significance level is performed between MOEA/D-FRRMAB and each of MOEA/D-DE, MOEA/D-DRA and ENS-MOEA/D. † and ‡ denote the performance of the corresponding algorithm is significantly worse than and better than that of the proposed MOEA/D-FRRMAB, respectively. And the best mean metric value is highlighted in boldface with gray background.



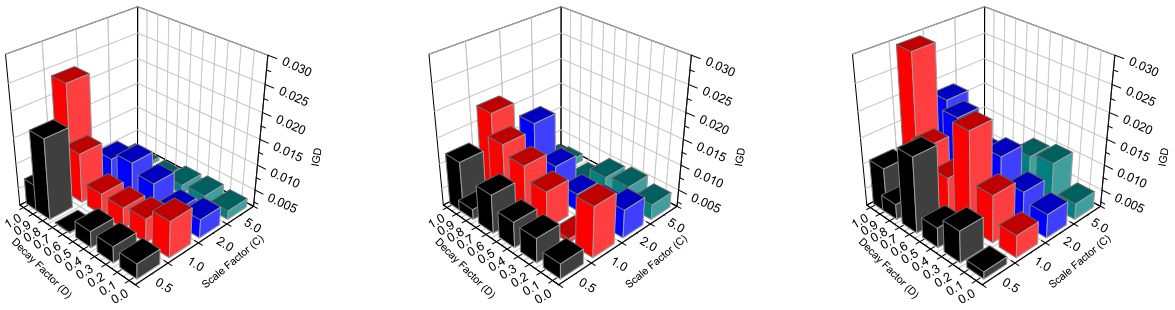
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 1: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 1 (*a to c*)



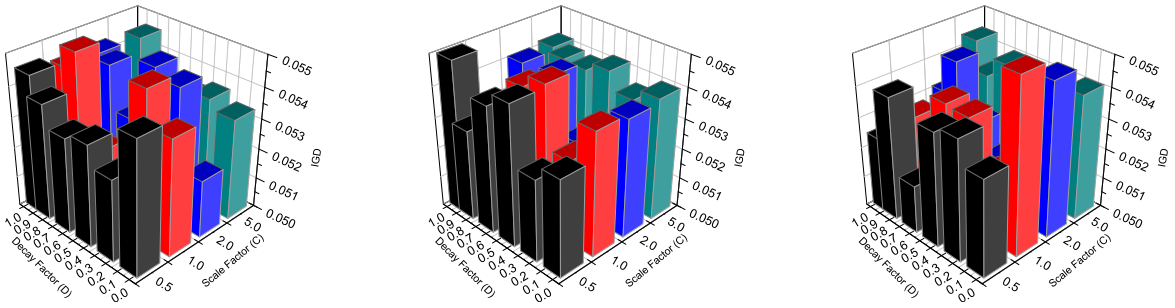
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 2: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 2 (*a to c*)



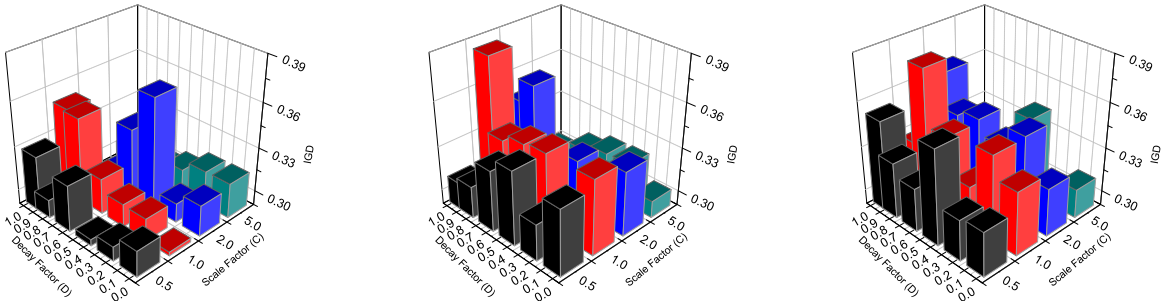
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 3: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 3 (*a to c*)



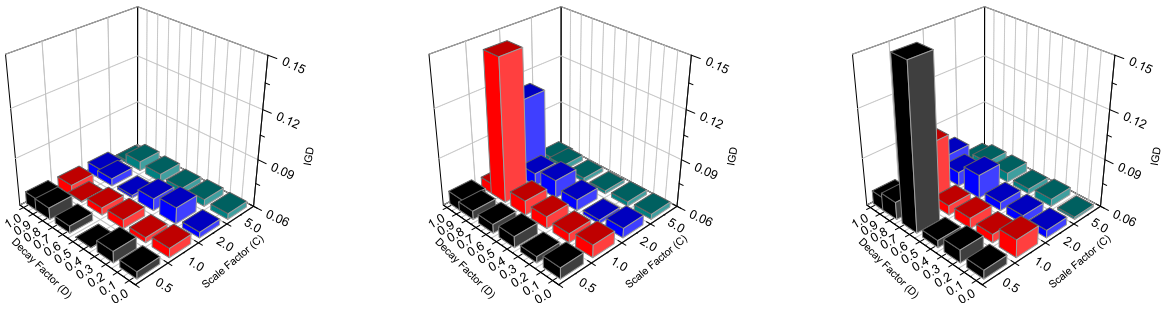
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 4: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 4 (*a to c*)



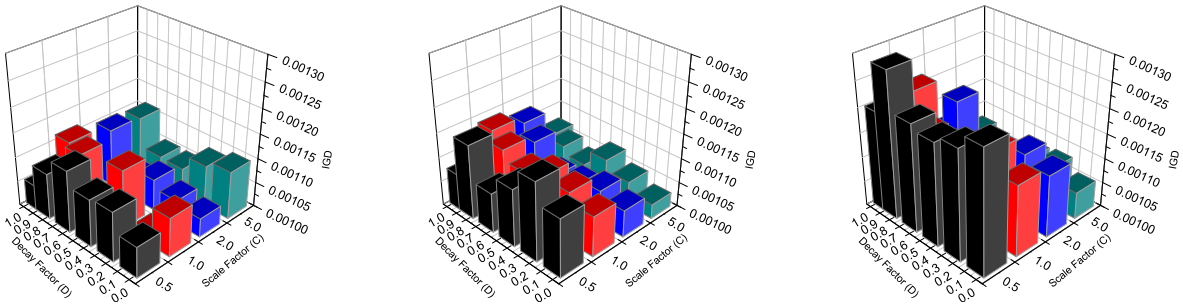
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 5: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 5 (*a to c*)



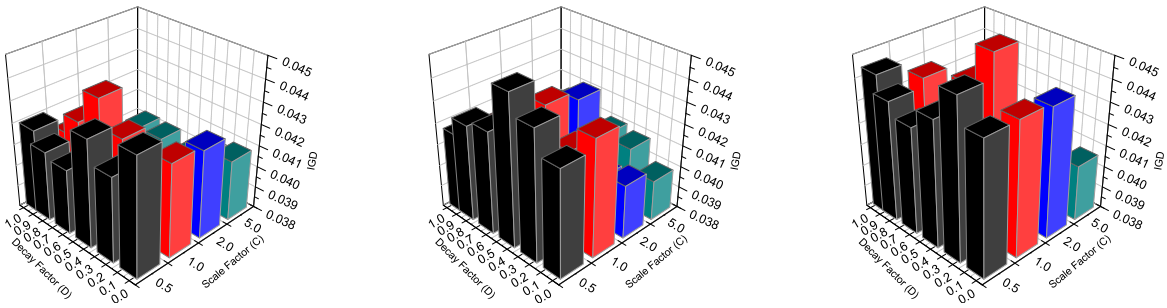
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 6: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 6 (*a to c*)



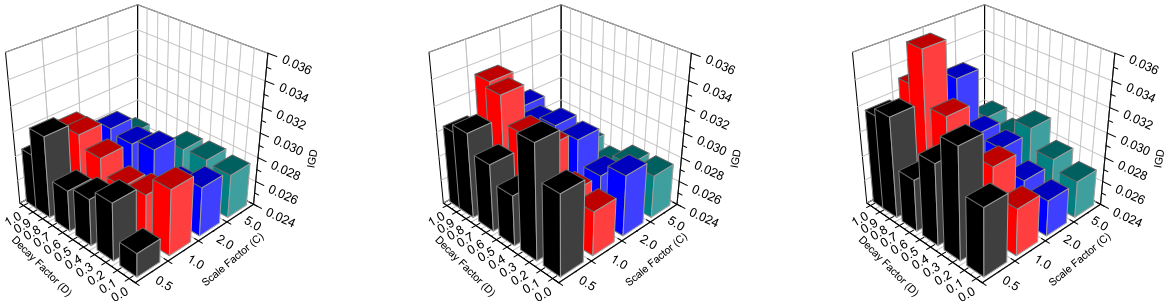
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 7: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 7 (*a to c*)



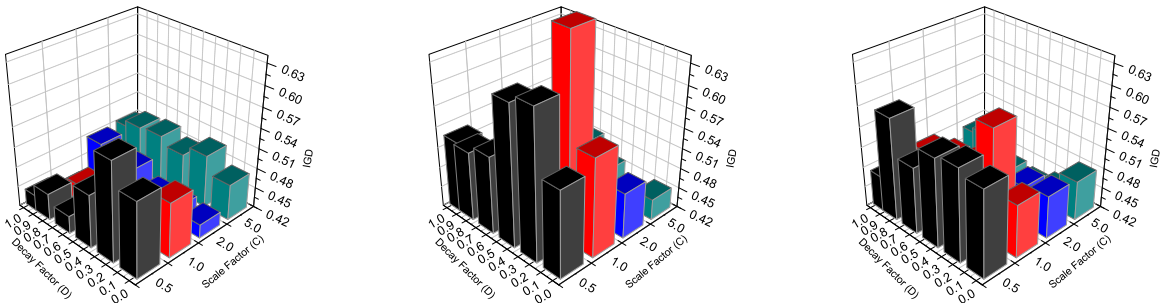
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 8: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 8 (*a to c*)



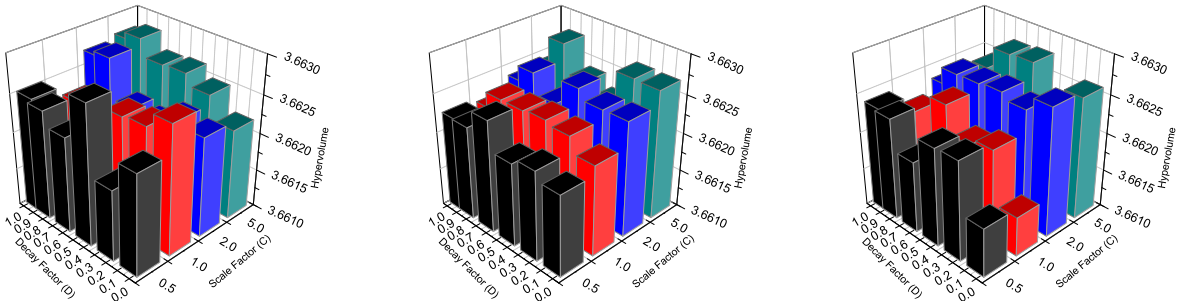
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 9: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 9 (*a to c*)



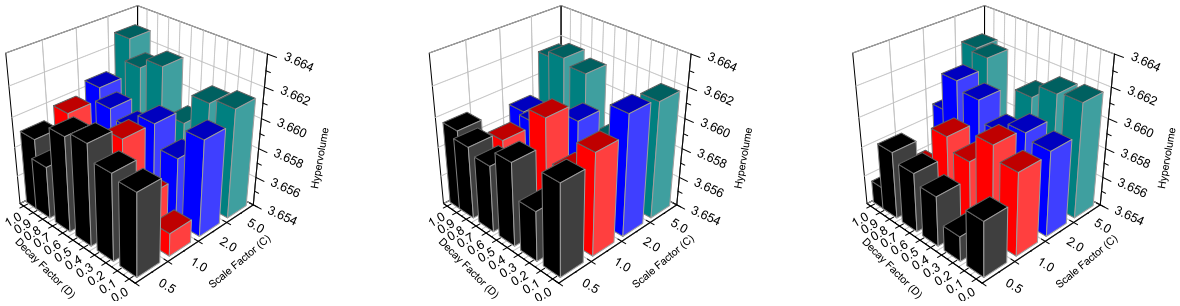
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 10: Median *IGD* metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 10 (*a to c*)



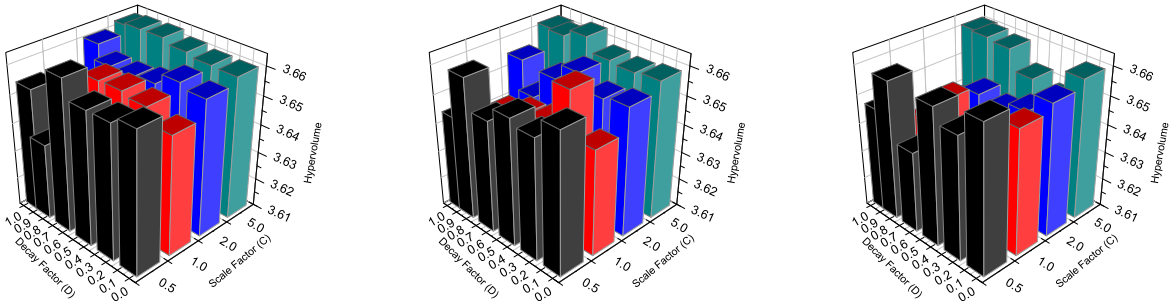
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 11: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 1 (*a to c*)



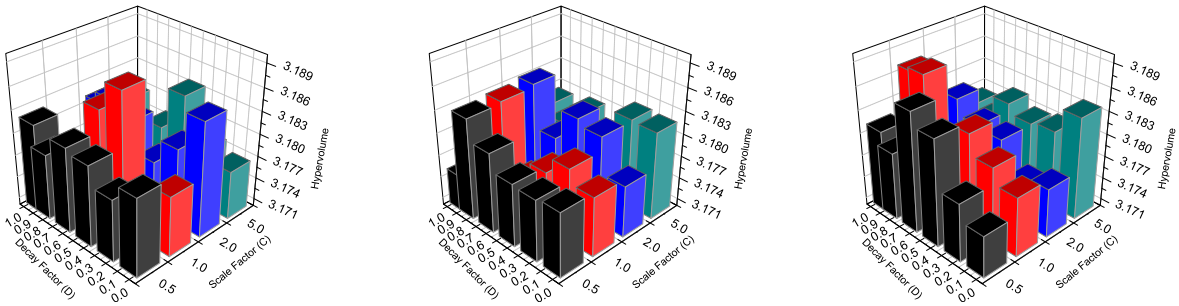
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 12: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 2 (*a to c*)



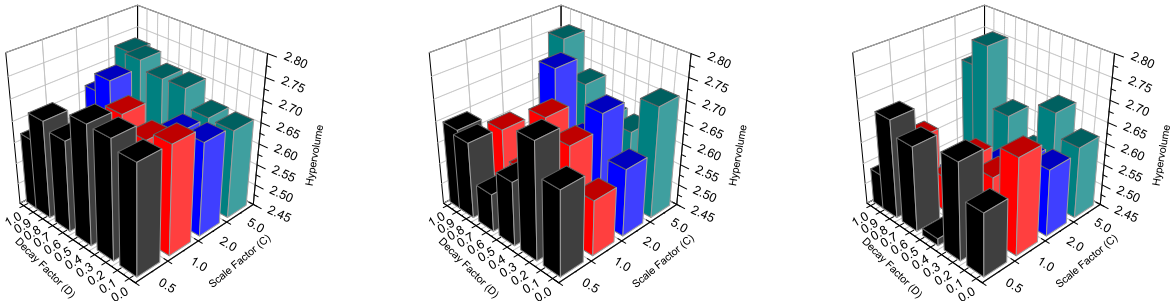
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 13: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 3 (*a to c*)



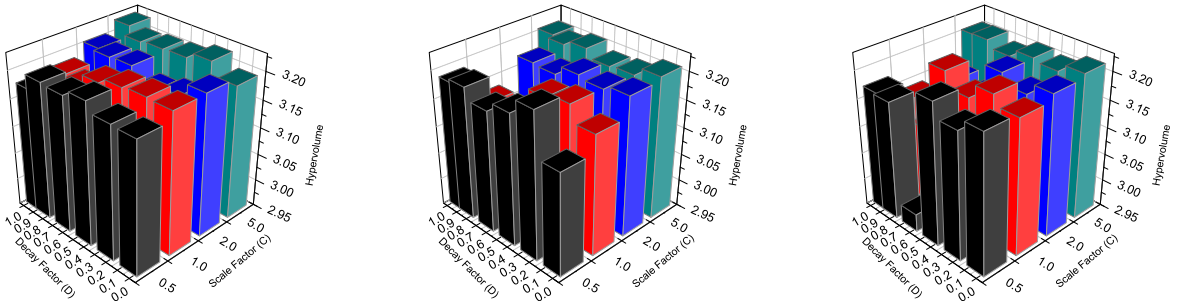
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 14: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 4 (*a to c*)



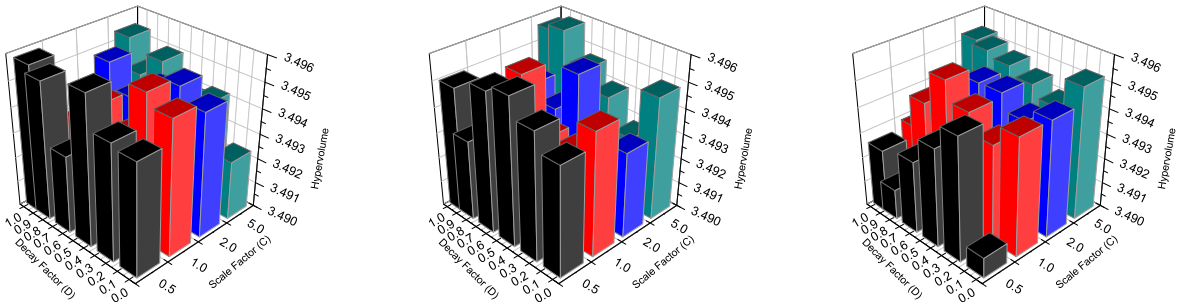
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 15: Median I_H metric values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 5 (*a to c*)



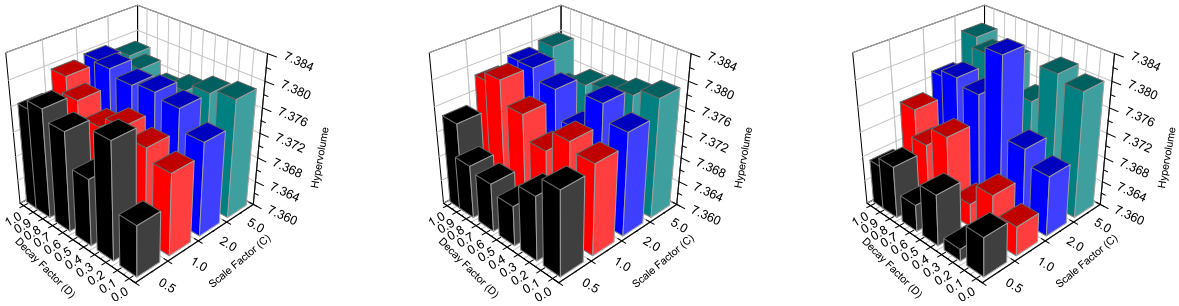
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 16: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 6 (*a to c*)



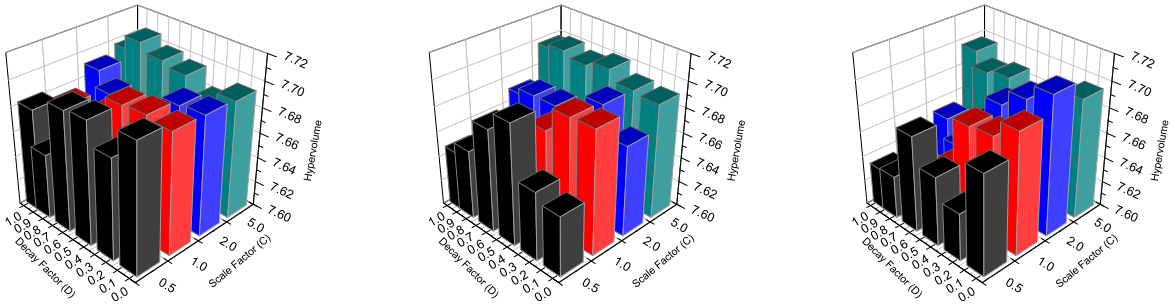
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 17: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 7 (*a to c*)



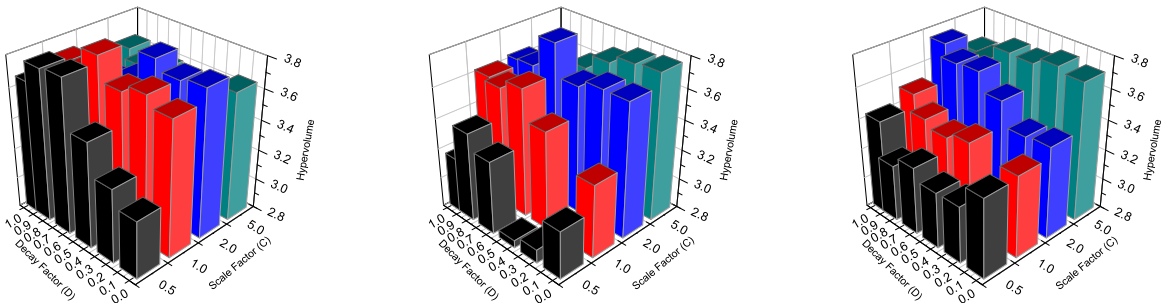
(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 18: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 8 (*a to c*)



(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 19: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 9 (*a to c*)



(a) $W = 0.5 \times NP$ (b) $W = NP$ (c) $W = 2 \times NP$

Figure 20: Median I_H values found by MOEA/D-FRRMAB with 72 different combinations of C, D and W on UF 10 (*a to c*)