Supplementary File of "A Fuzzy Decomposition based Multi/Many-objective Evolutionary Algorithm"

1. Supplementary Tables and Figures

TABLE A.I
FEATURES OF THE MAF, WFG, AND WFG4X TEST PROBLEMS

Test Problems	m	n	Parameter	Features
MaF1	3,5,8,10,15	m+k-1	k=10	Linear, Inverted
MaF2	3,5,8,10,15	m+k-1	k=10	Concave
MaF3	3,5,8,10,15	m+k-1	k=10	Convex, Multi-modal
MaF4	3,5,8,10,15	m+k-1	k=10	Concave, Multi-modal, Inverted, badly-scaled
MaF5	3,5,8,10,15	m+k-1	k=10	Convex, Biased, Badly-scaled
MaF6	3,5,8,10,15	m+k-1	k=10	Concave, Degenerate
MaF7	3,5,8,10,15	m+k-1	k=20	Mixed, Disconnected, Multi-modal
MaF8	3,5,8,10,15	2	——	Linear, Degenerate
MaF9	3,5,8,10,15	2	——	Linear, Degenerate
MaF10	3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex, Mixed
MaF11	3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex, Disconnected, Mixed
MaF12	3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Multi-modal, Deceptive
MaF13	3,5,8,10,15	5	——	Concave, Unimodal, Non-separable, Degenerate
WFG1	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex, Mixed
WFG2	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex, Disconnected, Mixed
WFG3	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Linear, Uni-modal
WFG4	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Deceptive
WFG5	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Deceptive
WFG6	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Multi-modal
WFG7	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Uni-modal
WFG8	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Uni-modal
WFG9	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Multi-modal, Deceptive
WFG41	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Deceptive
WFG42	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex
WFG43	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Sharply Concave
WFG44	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Sharply Convex
WFG45	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Mixed
WFG46	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Linear
WFG47	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Concave, Disconnected
WFG48	2, 3,5,8,10,15	k+l	$k=2\times(m\text{-}1)$, l=20	Convex, Disconnected

TABLE A. II
PARAMETERS SETTINGS OF ALL THE COMPARED ALGORITHMS

Algorithm	Parameters settings
NSGA-III	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
θ-DEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, θ=5.0
VaEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, $\sigma=\pi/2(N+1)$
MaOEA/C	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, ε=0.8
DDEA+NS	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
MOEA/D-LTD	$p_c=1.0$, $p_m=1/n$, $\eta_c=20$, $\eta_m=20$, T=20, $\delta=0.9$, $\psi_B=50\%$, $\psi_e=80\%$, τ=20
MOEA/AD	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, T=20, $\delta=0.9$
PaRP/EA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
SPEA2	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
MOEA/D-PaS	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
BCE-MOEA/D	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
RVEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$ α=2, $f_r=0.1$
KnEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, rate = 0.5
hpaEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$
MaOEA/IGD	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, DNPE = 100N
GFM-MOEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$, θ=0.2, $Fpee$ = 0.1
FDEA	$p_c=1.0$, $p_m=1/n$, $\eta_c=30$, $\eta_m=20$

TABLE A. III
SETTINGS OF THE POPULATION SIZE AND EVALUATIONS

Objectives (m)	Divisions (H)	Population Size	G_{max}	Evaluations
2	99	100	300	30000
3	14	120	500	60000
5	6	210	600	126000
8	(3,3)	240	800	192000
10	(3,2)	275	1000	275000
15	(2,2)	240	1500	360000

In the following Tables:

MOEA-set1 indicates the set of MOEAs that includes NSGA-III, θ-DEA , VaEA, MaOEA/C, DDEA+NS, MOEA/D-LTD/MOEA/AD, PaRP/EA, and FDEA

MOEA-set2 indicates the set of MOEAs that includes SPEA2, MOEA/D-PaS, BCE-MOEA/D, RVEA, KnEA, hpaEA, MaOEA/IGD, GFM-MOEA, and FDEA.

TABLE A. IV
PERFORMANCE OF MOEA-SET1 ON 2- AND 3-OBJECTIVE WFG AND WFG4X PROBLEMS WITH HV

Problems	m	NSGA-III	θ-DEA	VaEA	MaOEA/C	DDEA+NS	MOEA/D-LTD	PaRP/EA	FDEA
WFG1	2	3.324E-1(3.05E-2)−	3.479E-1(2.59E-2)−	3.336E-1(4.45E-2)−	3.372E-1(2.96E-2)−	**6.117E-1(2.18E-2)+**	6.028E-1(2.54E-2)+	3.560E-1(2.97E-2)−	3.640E-1(2.83E-2)
	3	4.948E-1(5.09E-2)−	5.464E-1(5.08E-2)−	5.448E-1(4.41E-2)−	5.708E-1(2.53E-2)−	8.179E-1(2.29E-2)+	**8.554E-1(1.93E-2)+**	4.888E-1(5.78E-2)−	6.371E-1(3.92E-2)
WFG2	2	6.184E-1(9.80E-3)−	6.167E-1(8.92E-3)−	6.132E-1(8.34E-3)−	6.161E-1(9.80E-3)−	**6.279E-1(1.76E-3)+**	6.129E-1(1.02E-2)−	6.172E-1(1.03E-2)−	6.267E-1(8.98E-3)
	3	8.633E-1(6.94E-2)−	8.517E-1(7.03E-2)−	8.761E-1(6.26E-2)−	8.632E-1(6.84E-2)−	8.697E-1(6.92E-2)−	8.908E-1(5.77E-2)~	8.917E-1(5.54E-2)~	**9.021E-1(6.26E-2)**
WFG3	2	5.738E-1(3.17E-3)~	5.745E-1(1.62E-3)~	5.739E-1(1.56E-3)~	5.781E-1(1.16E-3)~	5.772E-1(1.13E-3)~	5.758E-1(2.12E-3)~	5.744E-1(2.30E-3)~	**5.789E-1(8.35E-4)**
	3	6.164E-1(5.22E-3)−	6.198E-1(5.83E-3)−	6.013E-1(4.34E-3)−	6.290E-1(4.69E-3)~	6.255E-1(3.36E-3)~	6.297E-1(3.26E-3)~	5.988E-1(4.59E-3)−	**6.306E-1(2.15E-3)**
WFG41	2	3.436E-1(6.18E-4)~	3.438E-1(6.77E-4)~	3.430E-1(6.47E-4)~	3.442E-1(5.45E-4)~	**3.458E-1(3.15E-4)~**	3.426E-1(7.79E-4)~	3.430E-1(8.79E-4)~	3.441E-1(6.70E-4)
	3	5.467E-1(2.39E-3)+	5.491E-1(2.07E-3)+	5.322E-1(3.62E-3)~	5.451E-1(2.35E-3)~	**5.530E-1(1.81E-3)+**	5.482E-1(2.11E-3)~	5.366E-1(3.79E-3)~	5.410E-1(2.14E-3)
WFG42	2	8.152E-1(6.47E-4)−	8.152E-1(5.67E-4)−	8.093E-1(2.37E-3)−	8.145E-1(9.46E-4)−	8.147E-1(8.38E-4)−	8.145E-1(8.01E-4)−	8.143E-1(6.57E-4)−	**8.209E-1(4.09E-4)**
	3	9.646E-1(1.93E-3)~	9.635E-1(1.58E-3)~	9.498E-1(2.61E-3)−	9.541E-1(4.13E-3)−	9.587E-1(2.98E-3)−	9.673E-1(1.37E-3)~	9.566E-1(1.90E-3)−	**9.681E-1(1.50E-3)**
WFG43	2	2.197E-1(2.20E-3)~	2.203E-1(1.61E-3)~	2.196E-1(1.33E-3)~	2.214E-1(1.75E-3)~	**2.265E-1(5.19E-4)+**	2.256E-1(5.79E-4)+	2.208E-1(1.87E-3)~	2.198E-1(2.03E-3)
	3	3.410E-1(2.18E-3)+	3.429E-1(2.07E-3)+	3.350E-1(3.29E-3)~	3.340E-1(3.19E-3)~	3.436E-1(1.92E-3)+	**3.476E-1(1.44E-3)+**	3.351E-1(2.65E-3)~	3.305E-1(2.80E-3)
WFG44	2	9.376E-1(5.22E-4)−	9.376E-1(5.08E-4)−	9.272E-1(7.17E-3)−	9.369E-1(9.40E-4)−	9.374E-1(8.04E-4)−	9.368E-1(1.24E-3)−	9.376E-1(7.69E-4)−	**9.506E-1(3.12E-4)**
	3	9.909E-1(1.23E-3)−	9.899E-1(1.05E-3)−	9.846E-1(1.68E-3)−	9.900E-1(1.11E-3)−	9.907E-1(1.12E-3)−	9.948E-1(4.39E-4)−	9.889E-1(1.43E-3)−	**9.956E-1(6.19E-4)**
WFG45	2	4.583E-1(5.84E-4)~	4.584E-1(8.18E-4)~	4.573E-1(8.08E-4)~	**4.589E-1(4.97E-4)~**	4.588E-1(6.20E-4)~	4.576E-1(6.34E-4)~	4.573E-1(7.70E-4)~	4.584E-1(5.46E-4)
	3	6.528E-1(1.70E-3)+	**6.553E-1(1.91E-3)+**	6.374E-1(3.19E-3)−	6.532E-1(1.59E-3)+	6.521E-1(2.03E-3)+	6.551E-1(2.26E-3)+	6.383E-1(3.78E-3)−	6.454E-1(3.47E-3)
WFG46	2	5.784E-1(7.31E-4)−	5.786E-1(7.52E-4)−	5.772E-1(8.00E-4)−	**5.805E-1(3.99E-4)~**	5.790E-1(4.35E-4)~	5.770E-1(7.24E-4)−	5.766E-1(1.00E-3)−	5.802E-1(5.71E-4)
	3	8.303E-1(1.94E-3)−	8.326E-1(1.77E-3)~	8.105E-1(3.43E-3)−	8.284E-1(3.43E-3)−	8.215E-1(2.51E-3)−	8.299E-1(2.92E-3)−	8.134E-1(3.21E-3)−	**8.327E-1(2.50E-3)**
WFG47	2	4.956E-1(1.79E-2)−	4.969E-1(1.67E-2)−	4.982E-1(1.50E-2)~	4.958E-1(1.82E-2)−	4.977E-1(1.64E-2)−	4.659E-1(1.34E-2)−	4.906E-1(2.16E-2)~	**4.994E-1(1.22E-2)**
	3	6.625E-1(3.66E-2)+	6.593E-1(4.44E-2)~	6.462E-1(4.92E-2)−	**6.724E-1(1.50E-3)+**	6.605E-1(4.46E-2)~	6.608E-1(4.38E-2)~	6.404E-1(5.30E-2)−	6.584E-1(2.58E-2)
WFG48	2	6.353E-1(4.76E-2)−	6.472E-1(3.58E-2)−	6.439E-1(3.60E-2)−	6.321E-1(5.07E-2)−	6.402E-1(4.48E-2)−	4.769E-1(2.98E-2)−	**6.585E-1(9.28E-4)+**	6.519E-1(3.00E-2)
	3	9.203E-1(1.89E-3)−	9.143E-1(6.79E-2)−	8.202E-1(1.49E-1)−	8.942E-1(9.22E-2)−	8.722E-1(1.27E-1)−	9.128E-1(6.75E-2)−	9.002E-1(6.55E-2)−	**9.228E-1(2.58E-3)**
WFG9	2	3.235E-1(2.04E-2)~	3.161E-1(2.49E-2)−	3.229E-1(2.03E-2)~	3.198E-1(2.32E-2)−	3.130E-1(2.86E-2)−	3.099E-1(2.76E-2)−	3.162E-1(2.50E-2)−	**3.238E-1(2.06E-2)**
	3	4.926E-1(2.39E-2)−	4.923E-1(2.50E-2)−	4.936E-1(2.18E-2)−	4.942E-1(2.55E-2)−	4.858E-1(3.10E-2)−	4.697E-1(1.90E-2)−	4.871E-1(2.26E-2)−	**5.067E-1(1.91E-2)**
Best/All		0/24	1/24	0/24	3/24	5/24	2/24	0/24	**12/24**
+/−/~		4/14/6	3/14/7	0/16/8	2/14/8	7/11/6	5/12/7	1/14/9	——

TABLE A. V
PERFORMANCE OF MOEA-SET1 ON 5- TO 15-OBJECTIVE WFG PROBLEMS WITH IGD

Problems	m	NSGA-III	θ-DEA	VaEA	MaOEA/C	DDEA+NS	MOEA/D-LTD	PaRPEA	FDEA
WFG1	5	1.472E+0(9.28E-2)	1.128E+0(5.16E-2)	1.523E+0(7.85E-2)	1.282E+0(3.95E-2)	6.171E-1(5.26E-2)	**4.711E-1(2.88E-2)**	1.630E+0(9.94E-2)	1.032E+0(2.06E-2)
	8	1.637E+0(1.07E-1)	1.370E+0(4.06E-2)	1.465E+0(5.20E-2)	1.489E+0(2.91E-2)	**7.736E-1(5.28E-2)**	9.895E-1(7.95E-2)	1.661E+0(1.45E-1)	1.413E+0(1.95E-2)
	10	1.470E+0(5.51E-2)	1.385E+0(4.74E-2)	1.470E+0(5.46E-2)	1.490E+0(1.95E-2)	**8.989E-1(3.09E-2)**	1.333E+0(1.95E-1)	1.429E+0(4.39E-2)	1.526E+0(3.61E-2)
	15	2.346E+0(2.97E-2)	2.421E+0(6.22E-2)	2.257E+0(2.40E-2)	2.290E+0(5.49E-2)	**1.791E+0(1.44E-1)**	1.881E+0(5.36E-2)	2.210E+0(4.08E-2)	2.572E+0(8.30E-2)
WFG2	5	6.861E-1(1.93E-1)	7.611E-1(3.14E-1)	1.091E+0(5.92E-1)	8.568E-1(1.75E-1)	6.887E-1(2.98E-1)	6.553E-1(1.00E-1)	1.934E+0(1.43E+0)	**6.093E-1(2.03E-1)**
	8	3.148E+0(1.43E+0)	2.835E+0(9.18E-1)	2.779E+0(6.68E-1)	2.569E+0(3.17E-1)	2.618E+0(1.90E-1)	2.333E+0(3.08E-1)	4.400E+0(1.42E+0)	**2.096E+0(3.48E-1)**
	10	5.792E+0(3.08E+0)	5.272E+0(1.55E+0)	5.004E+0(8.13E-1)	3.976E+0(6.22E-1)	3.849E+0(3.93E-1)	3.545E+0(1.23E+0)	6.424E+0(1.52E+0)	**3.544E+0(1.93E-1)**
	15	6.846E+0(2.27E+0)	1.699E+1(3.22E+0)	8.679E+0(2.77E+0)	4.391E+0(1.44E+0)	5.198E+0(2.45E+0)	6.679E+0(3.98E+0)	1.017E+1(3.18E+0)	**4.223E+0(3.47E+0)**
WFG3	5	4.572E-1(4.72E-2)	4.020E-1(5.43E-2)	7.456E-1(9.84E-2)	**3.148E-1(3.25E-2)**	3.668E-1(2.31E-2)	4.930E-1(7.45E-2)	8.427E-1(1.04E-1)	3.181E-1(5.14E-2)
	8	7.860E-1(2.34E-1)	8.103E-1(3.13E-1)	1.684E+0(1.83E-1)	**3.980E-1(4.74E-2)**	4.565E-1(3.38E-2)	9.157E-1(9.12E-2)	1.961E+0(2.04E-1)	5.289E-1(4.71E-2)
	10	1.298E+0(5.21E-1)	8.897E-1(1.09E-1)	2.501E+0(3.10E-1)	**4.054E-1(3.84E-2)**	4.481E-1(1.99E-2)	1.150E+0(1.10E-1)	2.482E+0(4.21E-1)	6.544E-1(5.94E-2)
	15	1.536E+0(3.16E-1)	1.895E+0(2.09E-1)	4.163E+0(8.70E-1)	5.111E-1(7.03E-2)	4.710E-1(3.16E-2)	2.966E+0(2.07E-1)	4.742E+0(8.49E-1)	**4.127E-1 (4.27E-2)**
WFG4	5	9.880E-1(2.53E-3)	9.871E-1(2.93E-3)	9.400E-1(5.32E-3)	9.686E-1(7.42E-3)	**9.344E-1(7.70E-3)**	1.226E+0(4.67E-2)	9.324E-1(4.77E-3)	9.479E-1(4.63E-3)
	8	2.691E+0(1.58E-2)	**2.686E+0(9.29E-3)**	2.734E+0(1.72E-2)	2.949E+0(2.93E-2)	2.690E+0(1.29E-2)	2.927E+0(1.60E-2)	2.713E+0(1.43E-2)	2.766E+0(2.39E-2)
	10	4.324E+0(1.41E-2)	4.331E+0(1.27E-2)	4.086E+0(2.00E-2)	4.579E+0(5.37E-2)	**4.062E+0(1.89E-2)**	4.904E+0(4.43E-2)	4.090E+0(2.83E-2)	4.481E+0(6.37E-2)
	15	8.851E+0(1.60E-1)	8.707E+0(6.57E-2)	8.069E+0(1.07E-1)	1.010E+1(4.08E-1)	9.918E+0(3.87E-1)	9.874E+0(5.10E-1)	8.880E+0(4.87E-2)	**8.004E+0(5.56E-2)**
WFG5	5	9.838E-1(4.87E-3)	9.854E-1(5.47E-3)	9.595E-1(8.51E-3)	9.731E-1(8.62E-3)	9.600E-1(5.58E-3)	1.061E+0(2.30E-2)	9.593E-1(7.57E-3)	**9.580E-1(4.85E-3)**
	8	2.713E+0(1.08E-2)	2.707E+0(1.13E-2)	2.769E+0(2.16E-2)	2.969E+0(2.84E-2)	**2.665E+0(9.81E-3)**	2.922E+0(1.27E-2)	2.760E+0(2.58E-2)	2.798E+0(1.55E-2)
	10	4.323E+0(8.08E-3)	4.316E+0(1.10E-2)	4.124E+0(2.76E-2)	4.571E+0(5.07E-2)	4.113E+0(2.00E-2)	4.845E+0(2.21E-2)	4.148E+0(3.68E-2)	**4.028E+0(2.13E-2)**
	15	8.954E+0(1.34E-1)	9.174E+0(4.30E-2)	7.840E+0(3.18E-2)	9.673E+0(1.91E-1)	1.050E+1(4.07E-1)	9.642E+0(3.52E-1)	7.788E+0(3.93E-2)	**7.387E+0(7.00E-2)**
WFG6	5	9.893E-1(1.45E-3)	9.889E-1(1.55E-3)	9.780E-1(8.54E-3)	9.930E-1(1.13E-2)	9.718E-1(6.18E-3)	1.278E+0(1.33E-1)	9.766E-1(9.27E-3)	**9.651E-1(5.68E-3)**
	8	2.735E+0(5.93E-3)	**2.727E+0(4.88E-3)**	2.842E+0(2.38E-2)	3.058E+0(6.13E-2)	2.728E+0(1.90E-2)	3.031E+0(1.01E-2)	2.820E+0(3.33E-2)	2.887E+0(3.57E-2)
	10	4.351E+0(1.26E-2)	4.352E+0(1.24E-2)	4.238E+0(3.81E-2)	4.677E+0(1.05E-1)	**4.173E+0(2.63E-2)**	4.994E+0(3.33E-2)	4.283E+0(3.32E-2)	4.554E+0(4.41E-2)
	15	9.283E+0(1.89E-2)	9.274E+0(2.41E-2)	7.934E+0(4.61E-2)	8.960E+0(3.06E-1)	8.067E+0(1.23E-1)	9.558E+0(6.42E-2)	**7.857E+0(4.59E-2)**	8.440E+0(7.81E-2)
WFG7	5	9.985E-1(2.97E-3)	9.986E-1(3.34E-3)	9.683E-1(9.15E-3)	9.802E-1(8.05E-3)	9.682E-1(6.53E-3)	1.153E+0(5.10E-2)	9.646E-1(7.09E-3)	**9.615E-1(8.03E-3)**
	8	**2.698E+0(8.56E-3)**	2.689E+0(6.73E-3)	2.786E+0(2.92E-2)	2.956E+0(2.76E-2)	2.716E+0(1.54E-2)	2.953E+0(1.12E-2)	2.783E+0(3.12E-2)	2.823E+0(2.02E-2)
	10	4.387E+0(1.61E-2)	4.392E+0(1.32E-2)	**4.127E+0(1.81E-2)**	4.647E+0(5.26E-2)	4.134E+0(2.06E-2)	4.920E+0(2.92E-2)	4.130E+0(2.38E-2)	4.474E+0(3.21E-2)
	15	9.032E+0(6.82E-2)	9.105E+0(5.24E-2)	7.920E+0(6.81E-2)	9.538E+0(3.82E-1)	9.052E+0(3.59E-1)	1.006E+1(3.87E-1)	7.862E+0(4.92E-2)	**7.575E+0(1.31E-1)**
WFG8	5	1.018E+0(3.68E-3)	**1.011E+0(1.68E-3)**	1.073E+0(1.19E-2)	1.034E+0(7.94E-3)	1.015E+0(8.09E-3)	1.512E+0(5.23E-2)	1.048E+0(1.27E-2)	**1.011E+0(5.93E-3)**
	8	2.996E+0(2.70E-2)	2.936E+0(2.17E-2)	3.016E+0(2.48E-2)	3.012E+0(3.66E-2)	3.301E+0(1.95E-1)	3.081E+0(1.74E-2)	2.963E+0(2.14E-2)	**2.855E+0(1.57E-2)**
	10	4.503E+0(7.73E-2)	4.428E+0(3.10E-2)	4.367E+0(4.11E-2)	4.791E+0(1.70E-1)	5.222E+0(8.61E-2)	5.101E+0(7.47E-2)	**4.306E+0(2.96E-2)**	4.635E+0(1.57E-1)
	15	9.358E+0(3.00E-1)	1.035E+1(2.62E-1)	8.681E+0(1.02E-1)	1.074E+1(2.90E-1)	1.075E+1(3.74E-1)	1.162E+1(2.00E-1)	**8.656E+0(1.34E-1)**	9.621E+0(8.73E-2)
WFG9	5	9.266E-1(3.90E-3)	9.224E-1(2.81E-3)	9.532E-1(1.23E-2)	9.556E-1(9.98E-3)	9.368E-1(1.88E-2)	1.256E+0(5.92E-2)	9.466E-1(9.01E-3)	**9.218E-1(9.13E-3)**
	8	2.749E+0(4.84E-2)	2.708E+0(1.98E-2)	2.770E+0(2.78E-2)	2.819E+0(3.35E-2)	2.754E+0(3.87E-2)	2.954E+0(2.61E-2)	2.737E+0(1.53E-2)	**2.704E+0(1.39E-2)**
	10	4.243E+0(2.19E-2)	4.260E+0(1.34E-2)	4.084E+0(2.37E-2)	4.288E+0(6.52E-2)	4.110E+0(4.30E-2)	4.917E+0(5.96E-2)	4.068E+0(2.56E-2)	**4.045E+0(1.91E-2)**
	15	8.905E+0(2.08E-1)	8.814E+0(8.22E-2)	8.104E+0(9.62E-2)	9.430E+0(6.01E-1)	8.714E+0(2.55E-1)	9.502E+0(5.20E-2)	**7.891E+0(9.76E-2)**	8.092E+0(9.44E-2)
Best/All		1/36	3/36	1/36	3/36	7/36	1/36	4/36	16/36

TABLE A. VI
PERFORMANCE OF MOEA-SET1 ON 5- TO 15-OBJECTIVE WFG AND WFG4X PROBLEMS WITH HV

Problems	m	NSGA-III	θ-DEA	VaEA	MaOEA/C	DDEA+NS	MOEA/D-LTD	PaRPEA	FDEA
WFG1	5	3.871E-1(3.09E-2)-	5.717E-1(1.90E-2)$^-$	3.673E-1(3.49E-2)$^-$	6.792E-1(1.50E-2)$^-$	**7.604E-1(2.80E-2)+**	9.981E-1(1.30E-3)+	3.366E-1(2.85E-2)$^-$	7.174E-1(1.66E-2)
	8	4.725E-1(4.59E-2)-	8.063E-1(2.26E-2)$^-$	5.934E-1(3.36E-2)$^-$	7.729E-1(1.35E-2)$^-$	**8.880E-1(4.33E-2)+**	9.796E-1(1.94E-2)+	4.707E-1(5.34E-2)$^-$	8.219E-1(9.71E-3)
	10	7.623E-1(3.69E-2)-	8.687E-1(6.93E-3)~	7.990E-1(2.68E-2)$^-$	8.177E-1(1.18E-2)$^-$	**9.895E-1(1.57E-2)+**	9.998E-1(1.14E-4)+	7.396E-1(4.56E-2)$^-$	8.515E-1(7.84E-3)
	15	8.736E-1(5.73E-3)+	8.732E-1(4.66E-3)$^-$	8.708E-1(6.76E-3)+	8.468E-1(7.33E-3)$^-$	**9.966E-1(1.79E-3)+**	9.931E-1(2.00E-3)+	8.621E-1(6.96E-3)~	8.681E-1(6.75E-3)
WFG2	5	9.556E-1(6.01E-2)-	9.565E-1(6.01E-2)$^-$	9.557E-1(5.10E-2)$^-$	9.727E-1(3.12E-2)$^-$	9.837E-1(1.97E-3)~	9.758E-1(1.06E-3)$^-$	9.599E-1(5.25E-2)$^-$	**9.843E-1(3.24E-2)**
	8	9.516E-1(6.61E-2)-	8.840E-1(8.81E-2)$^-$	9.637E-1(5.25E-2)$^-$	9.752E-1(4.47E-2)+	9.890E-1(1.58E-3)$^-$	9.571E-1(7.92E-2)$^-$	9.745E-1(4.45E-2)$^-$	**9.931E-1(6.17E-2)**
	10	9.692E-1(5.39E-2)-	8.971E-1(8.58E-2)$^-$	9.701E-1(5.32E-2)$^-$	9.732E-1(5.41E-2)$^-$	9.907E-1(2.11E-3)~	9.623E-1(7.62E-2)$^-$	9.893E-1(3.36E-3)$^-$	**9.948E-1(7.91E-4)**
	15	9.473E-1(7.09E-2)-	7.968E-1(1.16E-2)$^-$	9.904E-1(2.26E-3)~	9.880E-1(3.27E-2)~	9.867E-1(5.38E-3)$^-$	8.782E-1(9.46E-2)$^-$	9.912E-1(2.66E-3)$^-$	**9.951E-1(4.55E-2)**
WFG3	5	6.161E-1(9.09E-3)~	6.342E-1(6.00E-3)+	5.737E-1(1.84E-2)$^-$	**6.412E-1(5.58E-3)+**	1.723E-1(1.38E-2)$^-$	6.348E-1(1.19E-2)+	5.430E-1(2.03E-2)$^-$	6.283E-1(1.25E-2)
	8	5.854E-1(3.46E-2)-	5.626E-1(4.21E-2)$^-$	5.819E-1(1.83E-2)$^-$	**6.603E-1(4.99E-3)+**	2.522E-2(1.24E-2)$^-$	5.528E-1(2.28E-2)$^-$	4.930E-1(3.02E-2)$^-$	6.211E-1(1.34E-2)
	10	6.012E-1(5.22E-2)-	6.165E-1(1.61E-2)$^-$	5.554E-1(3.01E-2)$^-$	**6.709E-1(5.00E-3)+**	0.00E+0(0.00E+0)$^-$	5.604E-1(1.87E-2)$^-$	4.798E-1(4.80E-2)$^-$	6.472E-1(1.38E-2)
	15	6.575E-1(1.93E-2)-	5.979E-1(1.99E-2)$^-$	5.468E-1(4.63E-2)$^-$	6.734E-1(5.32E-3)~	0.00E+0(0.00E+0)$^-$	4.751E-1(2.42E-2)$^-$	4.275E-1(8.66E-2)$^-$	**6.779E-1(1.33E-2)**
WFG4	5	7.535E-1(4.42E-3)-	7.580E-1(4.51E-3)~	7.118E-1(5.82E-3)-	7.610E-1(3.92E-3)+	7.586E-1(6.40E-3)~	**7.868E-1(4.58E-3)+**	7.205E-1(5.26E-3)-	7.545E-1(2.52E-3)
	8	7.851E-1(1.60E-2)-	8.042E-1(1.11E-2)-	8.113E-1(8.52E-3)-	**8.923E-1(4.70E-3)+**	8.561E-1(6.82E-3)-	8.484E-1(7.85E-3)-	8.109E-1(1.16E-2)-	8.619E-1(5.85E-3)
	10	8.854E-1(6.97E-3)-	8.961E-1(8.02E-3)-	8.436E-1(8.26E-3)-	**9.397E-1(5.49E-3)+**	8.884E-1(4.50E-3)-	9.308E-1(6.70E-3)+	8.452E-1(7.86E-3)-	9.187E-1(3.53E-3)
	15	8.041E-1(2.53E-2)-	8.682E-1(1.71E-2)-	8.452E-1(1.90E-2)-	9.371E-1(1.11E-2)-	9.162E-1(8.94E-3)-	8.323E-1(2.73E-2)-	8.608E-1(1.23E-2)-	**9.422E-1(9.16E-3)**
WFG5	5	7.309E-1(2.08E-3)~	7.340E-1(2.86E-3)~	6.966E-1(4.93E-3)-	7.309E-1(3.48E-3)~	7.035E-1(4.49E-3)-	**7.501E-1(3.47E-3)+**	7.058E-1(5.58E-3)-	7.303E-1(3.46E-3)
	8	7.965E-1(5.91E-3)-	7.994E-1(4.79E-3)-	7.975E-1(4.83E-3)-	**8.418E-1(5.01E-3)+**	7.867E-1(6.78E-3)-	7.915E-1(8.64E-3)-	8.072E-1(7.15E-3)-	8.396E-1(2.35E-3)
	10	8.691E-1(2.36E-3)-	8.700E-1(3.17E-3)-	8.262E-1(6.62E-3)-	8.**878E-1(3.03E-3)**~	8.057E-1(7.25E-3)-	8.667E-1(6.59E-3)-	8.356E-1(5.17E-3)-	8.831E-1(6.00E-4)
	15	8.147E-1(1.87E-2)-	8.612E-1(8.87E-3)-	8.430E-1(7.53E-3)-	8.737E-1(5.42E-3)-	7.839E-1(8.69E-3)-	7.176E-1(3.32E-2)-	8.507E-1(5.25E-3)-	**9.042E-1(2.49E-3)**
WFG6	5	7.399E-1(8.15E-3)+	**7.419E-1(6.50E-3)+**	7.010E-1(1.06E-2)-	7.350E-1(5.69E-3)-	7.408E-1(6.29E-3)+	7.300E-1(2.17E-2)-	7.037E-1(8.33E-3)-	7.361E-1(2.18E-3)
	8	8.186E-1(9.63E-3)-	8.226E-1(1.00E-2)-	8.188E-1(9.14E-3)-	8.450E-1(7.73E-3)-	8.473E-1(6.88E-3)-	7.635E-1(7.15E-3)-	8.272E-1(1.19E-2)-	**8.521E-1(6.53E-3)**
	10	8.890E-1(7.57E-3)-	8.895E-1(6.82E-3)-	8.542E-1(7.36E-3)-	8.880E-1(6.37E-3)-	8.808E-1(6.83E-3)-	8.414E-1(1.27E-2)-	8.617E-1(9.71E-3)-	**8.948E-1(8.16E-3)**
	15	8.999E-1(8.43E-3)-	9.033E-1(8.68E-3)-	8.773E-1(1.18E-2)-	8.998E-1(8.88E-3)-	9.120E-1(9.31E-3)~	8.083E-1(2.05E-2)-	8.768E-1(9.58E-3)-	**9.159E-1(4.51E-3)**
WFG7	5	7.859E-1(3.09E-3)~	7.910E-1(2.19E-3)+	7.478E-1(5.47E-3)-	7.866E-1(2.33E-3)+	7.864E-1(2.50E-3)~	**7.951E-1(5.22E-3)+**	7.532E-1(5.11E-3)-	7.822E-1(2.47E-3)
	8	8.459E-1(9.06E-3)-	8.614E-1(4.95E-3)-	8.760E-1(4.25E-3)-	**9.155E-1(1.91E-3)+**	9.034E-1(3.18E-3)~	8.555E-1(1.05E-2)-	8.763E-1(6.09E-3)-	9.022E-1(1.00E-3)
	10	9.336E-1(3.54E-3)-	9.398E-1(2.52E-3)-	9.069E-1(5.46E-3)-	**9.592E-1(1.10E-3)+**	9.347E-1(5.90E-3)-	9.399E-1(2.80E-3)-	9.071E-1(5.70E-3)-	9.485E-1(2.99E-3)
	15	9.020E-1(1.49E-2)-	9.369E-1(9.03E-3)-	9.214E-1(7.87E-3)-	9.586E-1(1.17E-2)-	9.496E-1(7.31E-3)-	8.164E-1(1.10E-2)-	9.232E-1(6.13E-3)-	**9.736E-1(2.25E-3)**
WFG8	5	6.621E-1(6.42E-3)+	**6.641E-1(3.86E-3)+**	5.989E-1(1.00E-2)-	6.579E-1(5.00E-3)+	6.491E-1(4.85E-3)~	6.318E-1(1.10E-2)-	6.235E-1(7.31E-3)-	6.478E-1(5.59E-3)
	8	6.730E-1(1.43E-2)-	6.779E-1(1.44E-2)-	6.348E-1(1.56E-2)-	7.683E-1(9.85E-3)-	7.481E-1(5.69E-3)-	7.316E-1(1.29E-2)-	6.786E-1(1.42E-2)-	**7.695E-1(8.98E-3)**
	10	7.909E-1(1.05E-2)-	7.995E-1(9.65E-3)-	6.728E-1(1.68E-2)-	**8.481E-1(6.88E-3)+**	8.120E-1(6.06E-3)-	8.149E-1(6.65E-3)-	6.947E-1(2.99E-2)-	8.398E-1(1.26E-2)
	15	7.997E-1(9.10E-2)-	8.627E-1(7.72E-3)-	7.816E-1(2.31E-2)-	9.112E-1(7.83E-3)-	8.892E-1(7.71E-3)-	7.528E-1(1.14E-2)-	7.995E-1(3.02E-2)-	**9.159E-1(3.19E-3)**
WFG9	5	6.602E-1(1.58E-2)$^-$	6.790E-1(2.45E-2)$^-$	6.386E-1(1.28E-2)$^-$	6.757E-1(2.69E-2)$^-$	6.586E-1(3.34E-2)$^-$	6.611E-1(2.96E-2)$^-$	6.359E-1(1.02E-2)$^-$	**7.033E-1(2.46E-2)**
	8	6.857E-1(2.75E-2)$^-$	7.152E-1(2.00E-2)$^-$	7.031E-1(2.04E-2)$^-$	7.374E-1(2.77E-2)$^-$	6.996E-1(2.10E-2)$^-$	7.216E-1(2.99E-2)$^-$	7.059E-1(1.77E-2)$^-$	**8.080E-1(2.46E-2)**
	10	7.435E-1(1.93E-2)$^-$	7.781E-1(2.61E-2)$^-$	7.120E-1(1.91E-2)$^-$	7.554E-1(3.05E-2)$^-$	7.088E-1(2.20E-2)$^-$	7.707E-1(3.47E-2)$^-$	7.361E-1(2.47E-2)$^-$	**8.100E-1(3.06E-2)**
	15	7.219E-1(3.02E-2)$^-$	7.435E-1(2.41E-2)$^-$	6.999E-1(2.77E-2)$^-$	7.545E-1(4.01E-2)$^-$	6.908E-1(1.18E-2)$^-$	7.152E-1(2.18E-2)$^-$	7.352E-1(3.05E-2)$^-$	**8.209E-1(2.80E-2)**
WFG41	5	7.552E-1(4.22E-3)+	**7.695E-1(4.15E-3)+**	7.110E-1(6.20E-3)$^-$	7.602E-1(4.51E-3)+	7.578E-1(4.42E-3)~	7.652E-1(3.78E-3)+	7.210E-1(5.45E-3)$^-$	7.540E-1(3.89E-3)
	8	7.898E-1(1.78E-2)$^-$	8.019E-1(1.30E-2)$^-$	8.139E-1(9.87E-3)$^-$	**8.934E-1(4.01E-3)+**	8.500E-1(7.37E-3)$^-$	8.377E-1(1.64E-2)$^-$	8.137E-1(8.72E-3)$^-$	8.692E-1(6.52E-3)
	10	8.867E-1(9.78E-3)$^-$	8.920E-1(8.82E-3)$^-$	8.439E-1(7.91E-3)$^-$	**9.385E-1(3.60E-3)+**	8.791E-1(8.33E-3)$^-$	9.286E-1(7.17E-3)~	8.489E-1(1.09E-2)$^-$	9.239E-1(4.47E-3)
	15	7.950E-1(2.73E-2)$^-$	8.636E-1(1.47E-2)$^-$	8.488E-1(1.65E-2)$^-$	9.388E-1(1.00E-2)$^-$	9.038E-1(1.02E-2)$^-$	8.267E-1(5.03E-2)$^-$	8.569E-1(1.68E-2)$^-$	**9.542E-1(7.27E-3)**
WFG42	5	9.831E-1(1.79E-3)$^-$	9.813E-1(1.93E-3)$^-$	9.697E-1(3.37E-3)$^-$	9.830E-1(2.07E-3)$^-$	9.832E-1(2.56E-3)$^-$	**9.990E-1(2.62E-4)+**	9.743E-1(4.30E-3)$^-$	9.929E-1(1.46E-3)
	8	9.905E-1(4.05E-3)$^-$	9.557E-1(1.46E-2)~	9.829E-1(3.66E-3)$^-$	9.892E-1(1.40E-3)$^-$	9.876E-1(2.12E-3)$^-$	9.957E-1(9.63E-4)~	9.776E-1(5.47E-3)$^-$	**9.958E-1(5.86E-4)**
	10	9.952E-1(1.87E-3)~	9.846E-1(5.29E-3)$^-$	9.901E-1(4.02E-3)~	9.924E-1(1.08E-3)$^-$	9.923E-1(2.37E-3)$^-$	**9.996E-1(2.12E-4)+**	9.849E-1(6.13E-3)+	9.979E-1(7.28E-4)
	15	9.843E-1(5.90E-3)$^-$	9.492E-1(1.78E-2)$^-$	9.972E-1(1.42E-3)$^-$	9.963E-1(6.63E-4)$^-$	9.937E-1(3.68E-3)$^-$	9.911E-1(3.46E-3)$^-$	9.956E-1(3.03E-3)$^-$	**9.990E-1(2.44E-4)**
WFG43	5	4.846E-1(1.25E-2)+	4.948E-1(5.19E-3)+	4.384E-1(6.93E-3)$^-$	4.471E-1(6.05E-3)~	4.953E-1(4.92E-3)+	**5.213E-1(5.70E-3)+**	4.436E-1(6.68E-3)~	4.491E-1(7.57E-3)
	8	4.236E-1(1.60E-2)$^-$	4.758E-1(1.28E-2)$^-$	4.696E-1(1.01E-2)$^-$	5.208E-1(1.29E-2)~	6.086E-1(2.09E-2)+	**6.627E-1(1.28E-2)+**	4.676E-1(1.24E-2)$^-$	5.261E-1(1.40E-2)
	10	5.020E-1(1.72E-2)~	5.518E-1(1.88E-2)+	4.622E-1(9.51E-3)$^-$	5.449E-1(1.14E-2)+	6.271E-1(1.77E-2)+	**7.049E-1(5.02E-2)+**	4.689E-1(1.51E-2)$^-$	5.475E-1(3.13E-2)
	15	4.316E-1(1.85E-2)+	5.098E-1(2.24E-2)+	4.589E-1(9.79E-3)$^-$	5.440E-1(1.18E-2)+	6.095E-1(3.18E-2)+	**6.803E-1(4.31E-2)+**	4.870E-1(1.59E-2)+	4.120E-1(1.94E-2)
WFG44	5	9.926E-1(1.06E-3)$^-$	9.929E-1(1.06E-3)$^-$	9.886E-1(1.80E-3)$^-$	9.954E-1(7.44E-4)$^-$	9.944E-1(1.21E-3)$^-$	9.989E-1(5.51E-05)~	9.923E-1(2.39E-3)$^-$	**9.990E-1(6.55E-4)**
	8	9.953E-1(1.48E-3)$^-$	9.890E-1(9.34E-3)$^-$	9.930E-1(1.69E-3)$^-$	9.972E-1(5.39E-4)$^-$	9.953E-1(1.46E-3)$^-$	9.992E-1(3.12E-4)$^-$	9.948E-1(1.51E-3)$^-$	**9.997E-1(5.60E-4)**
	10	9.981E-1(7.95E-4)~	9.968E-1(1.50E-3)~	9.965E-1(1.16E-3)$^-$	9.977E-1(4.58E-4)$^-$	9.964E-1(1.14E-3)$^-$	9.998E-1(1.11E-4)~	9.958E-1(9.68E-4)$^-$	**9.999E-1(2.52E-4)**
	15	9.941E-1(3.71E-3)$^-$	9.810E-1(1.39E-2)$^-$	9.988E-1(3.86E-4)$^-$	9.988E-1(2.42E-4)$^-$	9.957E-1(2.47E-3)$^-$	9.984E-1(5.27E-4)$^-$	9.980E-1(9.00E-4)$^-$	**9.999E-1(1.18E-4)**
WFG45	5	8.099E-1(3.22E-3)$^-$	8.161E-1(4.25E-3)~	7.717E-1(7.98E-3)$^-$	8.208E-1(2.74E-3)~	8.083E-1(4.89E-3)$^-$	**8.420E-1(5.79E-3)+**	7.821E-1(5.67E-3)~	8.181E-1(3.81E-3)
	8	8.252E-1(1.60E-2)$^-$	8.363E-1(8.93E-3)$^-$	8.421E-1(9.07E-3)$^-$	**9.140E-1(3.67E-3)+**	8.715E-1(7.74E-3)$^-$	8.832E-1(9.85E-3)$^-$	8.429E-1(9.43E-3)$^-$	8.978E-1(5.17E-3)
	10	9.014E-1(8.51E-3)$^-$	9.085E-1(6.29E-3)$^-$	8.619E-1(7.17E-3)$^-$	9.494E-1(2.85E-3)+	8.891E-1(6.81E-3)$^-$	**9.512E-1(4.28E-3)+**	8.635E-1(9.37E-3)$^-$	9.307E-1(5.11E-3)
	15	8.301E-1(2.08E-2)$^-$	8.846E-1(1.02E-2)$^-$	8.640E-1(1.42E-2)$^-$	9.524E-1(9.65E-3)$^-$	9.276E-1(6.40E-3)$^-$	8.686E-1(3.10E-2)$^-$	8.701E-1(1.33E-2)$^-$	**9.574E-1(8.02E-3)**
WFG46	5	9.407E-1(3.28E-3)$^-$	9.481E-1(2.52E-3)$^-$	9.113E-1(4.60E-3)$^-$	9.414E-1(6.47E-3)$^-$	9.356E-1(4.74E-3)$^-$	9.623E-1(1.60E-3)~	9.179E-1(5.56E-3)$^-$	**9.648E-1(2.60E-3)**
	8	9.032E-1(1.30E-2)$^-$	9.180E-1(1.04E-2)$^-$	9.368E-1(6.51E-3)$^-$	9.539E-1(5.83E-3)$^-$	9.471E-1(4.33E-3)$^-$	9.728E-1(4.02E-3)$^-$	9.306E-1(4.69E-3)$^-$	**9.852E-1(1.90E-3)**
	10	9.625E-1(5.33E-3)$^-$	9.693E-1(3.94E-3)$^-$	9.458E-1(4.94E-3)$^-$	9.575E-1(5.05E-3)$^-$	9.543E-1(7.25E-3)$^-$	9.852E-1(8.15E-4)$^-$	9.353E-1(5.84E-3)$^-$	**9.907E-1(1.35E-3)**
	15	9.319E-1(1.56E-2)$^-$	8.944E-1(2.08E-2)$^-$	9.585E-1(7.89E-3)$^-$	9.548E-1(5.78E-3)$^-$	**9.892E-1(2.57E-3)+**	9.330E-1(1.60E-2)$^-$	9.510E-1(5.34E-3)$^-$	9.688E-1(1.49E-2)
WFG47	5	8.140E-1(4.00E-3)$^-$	8.017E-1(7.05E-2)~	7.815E-1(6.40E-3)$^-$	**8.259E-1(2.71E-3)+**	8.203E-1(4.71E-3)~	8.423E-1(1.16E-2)+	7.746E-1(8.08E-3)$^-$	8.193E-1(7.03E-2)
	8	8.283E-1(1.37E-2)$^-$	8.398E-1(1.02E-2)$^-$	8.279E-1(1.00E-2)$^-$	**9.161E-1(5.11E-3)+**	8.780E-1(6.19E-3)$^-$	8.876E-1(9.28E-3)$^-$	8.122E-1(1.27E-2)$^-$	8.949E-1(5.38E-3)
	10	9.023E-1(7.13E-3)$^-$	9.118E-1(7.00E-3)$^-$	8.509E-1(1.08E-2)$^-$	**9.498E-1(3.69E-3)+**	8.969E-1(8.27E-3)$^-$	8.731E-1(1.72E-1)$^-$	8.417E-1(9.79E-3)$^-$	9.297E-1(4.95E-3)
	15	8.237E-1(2.27E-2)$^-$	8.614E-1(9.07E-2)$^-$	8.698E-1(1.11E-2)$^-$	9.517E-1(1.10E-2)$^-$	9.181E-1(6.89E-2)$^-$	7.592E-1(2.04E-1)$^-$	8.623E-1(1.17E-2)$^-$	**9.561E-1(8.49E-3)**
WFG48	5	9.792E-1(2.10E-3)$^-$	9.817E-1(2.05E-3)~	9.500E-1(7.47E-2)$^-$	9.765E-1(2.86E-3)$^-$	9.764E-1(2.55E-3)$^-$	9.868E-1(7.54E-4)~	9.665E-1(4.51E-3)$^-$	**9.893E-1(1.20E-3)**
	8	9.841E-1(6.86E-3)$^-$	9.638E-1(8.23E-3)$^-$	9.765E-1(3.64E-3)$^-$	9.878E-1(1.27E-3)$^-$	9.852E-1(1.96E-3)$^-$	9.939E-1(1.29E-3)~	9.712E-1(5.15E-3)$^-$	**9.941E-1(1.12E-3)**
	10	9.936E-1(3.34E-3)$^-$	9.841E-1(6.08E-3)$^-$	9.711E-1(7.86E-2)$^-$	9.910E-1(1.34E-3)$^-$	9.903E-1(2.81E-3)$^-$	**9.996E-1(1.76E-4)~**	9.812E-1(8.79E-3)$^-$	**9.996E-1(9.56E-4)**
	15	9.795E-1(7.96E-3)$^-$	9.489E-1(1.70E-2)$^-$	9.964E-1(1.43E-3)~	9.956E-1(8.33E-4)$^-$	9.950E-1(1.92E-3)~	9.911E-1(3.04E-3)$^-$	9.937E-1(4.24E-3)$^-$	**9.988E-1(2.75E-4)**
Best/All		0/68	3/68	0/68	16/68	5/68	12/48	0/68	32/68
+/−/~		6/56/6	8/52/8	2/63/3	23/38/7	10/48/10	20/40/8	3/62/3	——

TABLE A. VII
PERFORMANCE OF MOEA-SET1 ON 3- TO 15-OBJECTIVE MAF PROBLEMS WITH HV

Problems	m	NSGA-III	θ-DEA	VaEA	MaOEA/C	MOEA/AD	DDEA+NS	PaRPEA	FDEA
MaF1	3	2.102E-1(1.09E-3)$^-$	1.980E-1(4.51E-4)$^-$	2.215E-1(9.03E-4)$^-$	2.220E-1(7.56E-4)$\sim$	2.226E-1(1.05E-3)$\sim$	2.210E-1(1.08E-3)$^-$	2.243E-1(3.98E-4)$\sim$	**2.251E-1(5.74E-4)**
	5	7.496E-3(3.97E-4)$^-$	5.616E-3(1.64E-4)$^-$	1.108E-2(2.54E-4)$^-$	1.280E-2(1.49E-4)$^-$	1.263E-2(3.68E-4)$^-$	1.292E-2(1.20E-4)$\sim$	1.067E-2(1.96E-4)$^-$	**1.312E-2(7.97E-5)**
	8	2.625E-5(1.92E-6)$^-$	2.935E-5(1.03E-6)$^-$	2.693E-5(1.38E-6)$^-$	4.074E-5(1.53E-6)$^-$	4.240E-5(8.24E-6)$^-$	4.271E-5(2.04E-6)$^-$	2.357E-5(1.28E-6)$^-$	**4.325E-5(1.20E-6)**
	10	4.352E-7(1.76E-8)$^-$	3.132E-7(5.29E-8)$^-$	3.565E-7(2.06E-8)$^-$	5.801E-7(2.42E-8)$^-$	4.759E-7(7.00E-8)$^-$	**7.440E-7(9.77E-8)+**	3.394E-7(2.01E-8)$^-$	6.035E-7(1.88E-8)
	15	5.04E-12(6.7E-13)+	5.61E-12(1.3E-12)+	0.00E+0(0.00E+0)$\sim$	0.00E+0(0.00E+0)$\sim$	3.34E-12(2.7E-13)+	**1.16E-11(2.3E-11)+**	0.00E+0(0.00E+0)$\sim$	0.00E+0(0.00E+0)
MaF2	3	2.440E-1(8.30E-4)$\sim$	2.453E-1(6.14E-4)$\sim$	2.453E-1(1.03E-3)$\sim$	2.489E-1(4.36E-4)$\sim$	2.427E-1(5.85E-4)$^-$	2.398E-1(1.76E-3)$^-$	2.437E-1(1.02E-3)$^-$	**2.499E-1(4.23E-4)**
	5	2.449E-1(2.39E-3)$^-$	2.319E-1(2.60E-3)$^-$	2.373E-1(3.19E-3)$^-$	2.603E-1(1.22E-3)$\sim$	2.511E-1(1.17E-3)$^-$	1.909E-1(2.01E-3)$^-$	2.367E-1(2.83E-3)$^-$	**2.604E-1(1.66E-3)**
	8	2.040E-1(5.37E-3)$^-$	1.725E-1(1.37E-2)$^-$	2.015E-1(6.04E-3)$^-$	**2.407E-1(2.30E-3)+**	2.196E-1(3.15E-3)$^-$	2.254E-1(2.54E-3)$^-$	2.111E-1(4.85E-3)$^-$	2.297E-1(3.15E-3)
	10	2.119E-1(4.50E-3)$^-$	1.930E-1(7.94E-3)$^-$	2.019E-1(7.31E-3)$^-$	**2.431E-1(1.91E-3)+**	2.017E-1(1.90E-3)$^-$	2.224E-1(3.20E-3)$\sim$	2.061E-1(4.79E-3)$^-$	2.252E-1(4.17E-3)
	15	1.328E-1(1.04E-2)$^-$	1.320E-1(8.43E-3)$^-$	1.917E-1(5.75E-3)+	**2.279E-1(7.07E-3)+**	1.364E-1(2.14E-3)$^-$	2.112E-1(3.06E-3)+	1.752E-1(4.91E-3)$^-$	1.827E-1(4.91E-3)
MaF3	3	9.411E-1(2.44E-2)$^-$	9.561E-1(2.09E-3)$^-$	9.554E-1(3.10E-3)$^-$	8.595E-1(9.75E-3)$^-$	8.346E-1(1.96E-1)$^-$	8.552E-1(1.25E-1)$^-$	9.537E-1(1.25E-2)$^-$	**9.616E-1(1.03E-2)**
	5	9.914E-1(1.03E-2)$^-$	9.927E-1(1.60E-3)$^-$	9.975E-1(7.20E-4)$^-$	9.798E-1(1.81E-2)$^-$	9.925E-1(8.21E-3)$^-$	7.712E-1(2.32E-1)$^-$	9.993E-1(2.11E-4)$\sim$	**9.995E-1(2.74E-4)**
	8	9.898E-1(3.85E-2)$^-$	9.910E-1(2.59E-3)$^-$	9.998E-1(1.77E-4)$^-$	9.870E-1(9.32E-3)$^-$	9.945E-1(1.03E-2)$^-$	3.238E-1(9.73E-2)$^-$	0.00E+0(0.00E+0)$^-$	**1.000E+0(2.10E-6)**
	10	9.996E-1(7.81E-4)$^-$	9.899E-1(6.91E-3)$^-$	9.996E-1(6.57E-4)$^-$	9.871E-1(1.22E-2)$^-$	9.300E-1(1.52E-1)$^-$	6.146E-1(2.10E-1)$^-$	0.00E+0(0.00E+0)$^-$	**1.000E+0(4.56E-5)**
	15	7.558E-1(3.18E-1)$^-$	7.875E-1(1.71E-1)$^-$	9.359E-1(4.21E-2)$^-$	7.543E-1(2.11E-1)$^-$	8.428E-1(1.80E-1)$^-$	7.445E-1(1.82E-1)$^-$	0.00E+0(0.00E+0)$^-$	**9.800E-1(2.04E-2)**
MaF4	3	5.200E-1(6.31E-3)$^-$	5.205E-1(4.55E-3)$^-$	5.292E-1(6.02E-3)$\sim$	5.104E-1(1.54E-2)$^-$	5.158E-1(7.28E-3)$^-$	5.318E-1(5.90E-3)$\sim$	5.309E-1(6.25E-3)$\sim$	**5.367E-1(4.08E-3)**
	5	8.277E-2(4.45E-3)$^-$	7.262E-2(1.09E-2)$^-$	1.181E-1(3.33E-3)$^-$	1.192E-1(7.04E-3)$^-$	9.365E-2(2.21E-2)$^-$	1.322E-1(1.55E-3)$\sim$	1.131E-1(4.31E-3)$\sim$	**1.328E-1(1.56E-3)**
	8	2.186E-3(2.36E-4)$^-$	1.392E-3(5.52E-4)$^-$	2.405E-3(2.09E-4)$^-$	5.357E-3(3.55E-4)$\sim$	1.753E-3(9.30E-4)$^-$	**5.891E-3(1.78E-4)+**	1.774E-3(3.25E-4)$^-$	5.484E-3(1.80E-4)
	10	2.366E-4(2.06E-5)$^-$	2.311E-4(2.51E-5)$^-$	1.464E-4(1.31E-5)$^-$	4.871E-4(3.67E-5)+	1.340E-4(1.57E-5)$^-$	**5.143E-4(1.87E-5)+**	9.125E-5(1.74E-5)$^-$	4.233E-4(1.97E-5)
	15	2.098E-7(1.29E-8)$^-$	1.450E-7(1.74E-8)$^-$	8.783E-8(6.48E-8)$^-$	2.569E-7(4.85E-8)+	1.475E-7(7.84E-9)$^-$	**3.657E-7(3.03E-8)+**	2.092E-8(3.16E-8)$^-$	2.389E-7(3.14E-8)
MaF5	3	5.499E-1(8.67E-2)$^-$	5.500E-1(8.67E-2)$^-$	5.384E-1(9.32E-2)$^-$	5.593E-1(1.68E-3)$\sim$	**5.627E-1(1.23E-3)$\sim$**	5.454E-1(5.39E-2)$^-$	5.618E-1(1.33E-3)$\sim$	5.611E-1(9.02E-4)
	5	8.121E-1(1.31E-4)+	**8.126E-1(4.32E-5)+**	7.912E-1(2.91E-3)$^-$	7.995E-1(2.01E-3)$\sim$	8.078E-1(1.81E-3)$\sim$	8.008E-1(1.42E-3)$\sim$	7.964E-1(2.39E-3)$\sim$	8.000E-1(1.85E-3)
	8	9.255E-1(1.71E-4)$^-$	9.262E-1(6.63E-5)$^-$	9.117E-1(2.52E-3)$^-$	9.276E-1(2.52E-3)$\sim$	9.252E-1(2.86E-3)$^-$	9.291E-1(1.40E-3)$\sim$	9.238E-1(2.61E-3)$^-$	**9.305E-1(1.46E-3)**
	10	9.697E-1(7.90E-5)$\sim$	**9.698E-1(2.52E-5)+**	9.428E-1(3.64E-3)$^-$	9.580E-1(2.76E-3)$\sim$	9.690E-1(1.80E-3)+	9.648E-1(7.51E-4)$\sim$	9.573E-1(6.22E-3)$\sim$	9.668E-1(7.47E-4)
	15	9.913E-1(5.08E-5)$\sim$	9.914E-1(1.99E-5)$\sim$	9.713E-1(3.11E-3)$^-$	9.752E-1(3.43E-3)$^-$	9.897E-1(6.56E-4)$\sim$	9.904E-1(3.22E-4)$\sim$	5.613E-1(4.26E-1)$^-$	**9.918E-1(3.27E-4)**
MaF6	3	1.949E-1(1.03E-3)$^-$	1.862E-1(1.49E-3)$^-$	2.001E-1(1.97E-4)$^-$	1.999E-1(3.54E-4)$^-$	1.834E-1(2.10E-3)$^-$	1.998E-1(1.54E-4)$^-$	**2.004E-1(1.82E-4)+**	2.002E-1(4.94E-4)
	5	1.242E-1(1.83E-3)$^-$	1.159E-1(1.72E-3)$^-$	1.300E-1(6.64E-5)$\sim$	1.299E-1(1.16E-4)$^-$	1.149E-1(1.13E-3)$^-$	1.299E-1(3.50E-4)$^-$	**1.301E-1(2.16E-5)+**	1.300E-1(4.82E-4)
	8	9.438E-2(3.20E-2)$^-$	8.547E-2(3.17E-2)$^-$	9.947E-2(2.39E-2)$^-$	1.062E-1(1.84E-4)$\sim$	1.006E-1(1.35E-3)$^-$	6.965E-2(4.16E-2)$^-$	2.485E-2(4.58E-2)$^-$	**1.064E-1(1.12E-4)**
	10	3.042E-2(2.77E-2)+	5.063E-2(2.76E-2)+	7.622E-2(2.06E-2)+	**1.008E-1(1.35E-4)+**	9.460E-2(2.05E-3)+	5.251E-2(2.78E-2)+	0.00E+0(0.00E+0)$^-$	1.303E-3(5.90E-3)
	15	7.639E-3(1.49E-2)+	8.623E-2(4.45E-3)+	8.888E-2(4.66E-3)+	**9.394E-2(1.49E-3)+**	9.196E-2(7.96E-4)+	8.115E-2(7.54E-3)+	0.00E+0(0.00E+0)$^-$	2.529E-4(3.03E-4)
MaF7	3	3.193E-1(1.41E-3)$^-$	3.134E-1(1.34E-2)$^-$	3.201E-1(1.08E-2)$^-$	3.197E-1(1.05E-2)$^-$	2.849E-1(5.08E-2)$^-$	2.786E-1(7.32E-3)$^-$	**3.224E-1(1.07E-3)$\sim$**	**3.224E-1(1.05E-2)**
	5	3.055E-1(1.97E-3)$^-$	2.802E-1(1.04E-2)$^-$	3.031E-1(2.82E-3)$^-$	3.137E-1(7.75E-3)$^-$	3.183E-1(2.12E-3)$\sim$	2.704E-1(2.79E-3)$^-$	2.999E-1(2.97E-3)$^-$	**3.184E-1(2.17E-3)**
	8	2.391E-1(2.67E-3)$\sim$	2.187E-1(2.88E-2)$^-$	2.256E-1(3.68E-3)$^-$	2.392E-1(3.62E-3)$^-$	2.186E-1(7.70E-3)$^-$	2.286E-1(2.48E-3)$^-$	2.002E-1(5.39E-3)$^-$	**2.451E-1(5.50E-3)**
	10	2.354E-1(3.93E-3)$\sim$	2.271E-1(1.01E-2)$^-$	1.921E-1(7.47E-3)$^-$	1.987E-1(1.07E-2)$^-$	2.341E-1(1.10E-2)$^-$	2.111E-1(2.62E-3)$^-$	1.325E-1(5.83E-3)$^-$	**2.369E-1(5.50E-3)**
	15	1.137E-1(6.79E-2)$^-$	1.142E-1(1.20E-2)$^-$	1.328E-1(2.24E-3)$^-$	1.657E-1(1.29E-2)+	1.507E-1(2.00E-2)$\sim$	**1.704E-1(5.52E-3)+**	8.428E-2(5.29E-3)$^-$	1.591E-1(3.95E-3)
MaF8	3	2.690E-1(2.93E-3)-	2.459E-1(1.72E-2)-	2.810E-1(1.53E-3)$\sim$	2.712E-1(3.19E-3)-	2.599E-1(2.72E-3)-	2.785E-1(3.07E-3)-	2.830E-1(5.10E-4)-	**2.830E-1(1.02E-3)**
	5	1.111E-1(1.50E-3)-	8.091E-2(7.74E-3)-	1.283E-1(1.82E-4)$\sim$	1.200E-1(7.34E-4)-	1.203E-1(8.89E-4)-	1.285E-1(4.37E-4)$\sim$	1.285E-1(9.19E-5)$\sim$	**1.288E-1(1.02E-4)**
	8	2.505E-2(1.24E-3)-	1.595E-2(2.85E-3)-	3.137E-2(5.16E-5)$\sim$	2.649E-2(4.31E-4)-	2.850E-2(1.87E-4)-	**3.163E-2(5.01E-5)$\sim$**	3.146E-2(3.93E-5)-	3.162E-2(4.24E-5)
	10	9.276E-3(2.69E-4)-	5.049E-3(8.81E-4)-	**1.109E-2(1.50E-5)+**	8.874E-3(1.65E-4)-	9.664E-3(7.26E-5)$\sim$	7.721E-4(9.62E-6)-	7.609E-4(9.76E-6)-	9.733E-3(8.57E-6)
	15	3.550E-6(6.07E-7)-	1.920E-6(5.91E-7)-	2.895E-6(5.39E-7)-	1.936E-6(3.84E-7)-	2.504E-6(3.68E-7)-	4.505E-6(4.98E-7)$\sim$	3.292E-6(7.30E-7)-	**4.569E-6(3.70E-7)**
MaF9	3	7.142E-1(9.54E-3)$\sim$	7.130E-1(1.11E-2)-	7.120E-1(2.64E-3)-	7.019E-1(6.64E-3)-	5.639E-1(1.14E-1)-	4.195E-1(4.64E-2)-	7.143E-1(2.23E-3)$\sim$	**7.244E-1(1.75E-3)**
	5	2.456E-1(1.52E-2)-	2.390E-1(5.19E-3)-	2.492E-1(7.26E-3)-	3.235E-1(3.36E-3)-	1.392E-1(3.16E-2)-	3.282E-1(3.16E-2)-	1.372E-1(3.20E-2)-	**3.283E-1(3.91E-4)**
	8	4.647E-2(2.43E-4)-	2.055E-2(1.83E-3)-	7.823E-3(2.41E-8)-	1.400E-2(1.96E-2)-	2.497E-3(4.19E-3)-	4.985E-2(7.19E-4)-	1.302E-2(1.00E-2)-	**6.883E-2(1.01E-4)**
	10	1.588E-2(1.44E-4)-	4.307E-3(1.72E-3)-	2.300E-3(1.75E-6)-	1.529E-2(1.70E-3)-	0.000E+0(0.0E+0)-	1.600E-2(2.44E-4)-	5.750E-3(1.18E-3)-	**1.601E-2(1.03E-4)**
	15	1.481E-5(6.86E-7)-	1.700E-4(9.17E-5)-	1.478E-4(4.98E-5)-	1.281E-3(4.80E-6)-	1.021E-3(1.44E-4)-	5.443E-3(1.65E-5)-	9.320E-5(1.18E-4)-	**7.557E-3(5.66E-6)**
MaF10	3	4.948E-1(5.09E-2)$^-$	5.464E-1(5.08E-2)$^-$	5.448E-1(4.41E-2)$^-$	5.708E-1(2.53E-2)$^-$	8.179E-1(2.29E-2)+	**8.554E-1(1.93E-2)+**	4.888E-1(5.78E-2)$^-$	6.371E-1(3.92E-2)
	5	3.871E-1(3.09E-2)$^-$	5.717E-1(1.90E-2)$^-$	3.673E-1(3.49E-2)$^-$	6.792E-1(1.50E-2)$^-$	**7.604E-1(2.80E-2)+**	9.981E-1(1.30E-3)+	3.366E-1(2.85E-2)$^-$	7.174E-1(1.66E-2)
	8	4.725E-1(4.59E-2)$^-$	8.063E-1(2.26E-2)$^-$	5.934E-1(3.36E-2)$^-$	7.729E-1(1.35E-2)$^-$	**8.880E-1(4.33E-2)+**	9.796E-1(1.94E-2)+	4.707E-1(5.34E-2)$^-$	8.219E-1(9.71E-3)
	10	7.623E-1(3.69E-2)$^-$	8.687E-1(6.93E-3)$\sim$	7.990E-1(2.68E-2)$^-$	8.177E-1(1.18E-2)$^-$	**9.895E-1(1.57E-2)+**	9.998E-1(1.14E-4)+	7.396E-1(4.56E-2)$^-$	8.515E-1(7.84E-3)
	15	8.736E-1(5.73E-3)+	8.732E-1(4.66E-3)$^-$	8.708E-1(6.76E-3)+	8.468E-1(7.33E-3)$^-$	**9.966E-1(1.79E-3)+**	9.931E-1(2.00E-3)+	8.621E-1(6.96E-3)$\sim$	8.681E-1(6.75E-3)
MaF11	3	8.633E-1(6.94E-2)$^-$	8.517E-1(7.03E-2)$^-$	8.761E-1(6.26E-2)$^-$	8.632E-1(6.84E-2)$^-$	8.697E-1(6.92E-2)$^-$	8.908E-1(5.77E-2)$\sim$	8.917E-1(5.54E-2)$\sim$	**9.021E-1(6.26E-2)**
	5	9.556E-1(6.01E-2)$^-$	9.565E-1(6.01E-2)$^-$	9.557E-1(5.10E-2)$^-$	9.727E-1(3.12E-2)$^-$	9.837E-1(1.97E-3)$\sim$	9.758E-1(1.06E-3)$^-$	9.599E-1(5.25E-2)$^-$	**9.843E-1(3.24E-2)**
	8	9.516E-1(6.61E-2)$^-$	8.840E-1(8.81E-2)$^-$	9.637E-1(5.25E-2)$^-$	9.752E-1(4.47E-2)+	9.890E-1(1.58E-3)$^-$	9.571E-1(7.92E-2)$^-$	9.745E-1(4.45E-2)$^-$	**9.931E-1(6.17E-2)**
	10	9.692E-1(5.39E-2)$^-$	8.971E-1(8.58E-2)$^-$	9.701E-1(5.32E-2)$^-$	9.732E-1(5.41E-2)$^-$	9.907E-1(2.11E-3)$\sim$	9.623E-1(7.62E-2)$^-$	9.893E-1(3.36E-3)$^-$	**9.948E-1(7.91E-4)**
	15	9.473E-1(7.09E-2)$^-$	7.968E-1(1.16E-2)$^-$	9.904E-1(2.26E-3)$\sim$	9.880E-1(3.27E-2)$\sim$	9.867E-1(5.38E-3)$^-$	8.782E-1(9.46E-2)$^-$	9.912E-1(2.66E-3)$^-$	**9.951E-1(4.55E-2)**
MaF12	3	4.926E-1(2.39E-2)$^-$	4.923E-1(2.50E-2)$^-$	4.936E-1(2.18E-2)$^-$	4.942E-1(2.55E-2)$^-$	4.858E-1(3.10E-2)$^-$	4.697E-1(1.90E-2)$^-$	4.871E-1(2.26E-2)$^-$	**5.067E-1(1.91E-2)**
	5	6.602E-1(1.58E-2)$^-$	6.790E-1(2.45E-2)$^-$	6.386E-1(1.28E-2)$^-$	6.757E-1(2.69E-2)$^-$	6.586E-1(3.34E-2)$^-$	6.611E-1(2.96E-2)$^-$	6.359E-1(1.02E-2)$^-$	**7.033E-1(2.46E-2)**
	8	6.857E-1(2.75E-2)$^-$	7.152E-1(2.00E-2)$^-$	7.031E-1(2.04E-2)$^-$	7.374E-1(2.77E-2)$^-$	6.996E-1(2.10E-2)$^-$	7.216E-1(2.99E-2)$^-$	7.059E-1(1.77E-2)$^-$	**8.080E-1(2.46E-2)**
	10	7.435E-1(1.93E-2)$^-$	7.781E-1(2.61E-2)$^-$	7.120E-1(1.91E-2)$^-$	7.554E-1(3.05E-2)$^-$	7.088E-1(2.20E-2)$^-$	7.707E-1(3.47E-2)$^-$	7.361E-1(2.47E-2)$^-$	**8.100E-1(3.06E-2)**
	15	7.219E-1(3.02E-2)$^-$	7.435E-1(2.41E-2)$^-$	6.999E-1(2.77E-2)$^-$	7.545E-1(4.01E-2)$^-$	6.908E-1(1.18E-2)$^-$	7.152E-1(2.18E-2)$^-$	7.352E-1(3.05E-2)$^-$	**8.209E-1(2.80E-2)**
MaF13	3	4.869E-1(1.40E-2)-	4.921E-1(1.62E-2)-	5.019E-1(1.25E-2)-	5.012E-1(1.65E-2)-	4.891E-1(1.38E-2)-	5.057E-1(1.34E-2)-	5.099E-1(9.15E-3)-	**5.253E-1(5.17E-3)**
	5	1.863E-1(4.15E-2)-	1.361E-1(3.89E-2)-	**2.660E-1(6.55E-3)+**	2.408E-1(3.17E-3)-	2.616E-1(1.47E-2)$\sim$	2.347E-1(2.43E-2)-	2.585E-1(1.13E-2)$\sim$	2.625E-1(4.56E-3)
	8	6.692E-2(4.51E-2)-	9.692E-3(1.16E-2)-	**1.581E-1(4.78E-3)$\sim$**	1.251E-1(1.01E-2)-	1.442E-1(6.73E-3)-	1.442E-1(1.25E-2)-	1.513E-1(1.17E-2)$\sim$	1.571E-1(5.10E-3)
	10	7.143E-2(3.60E-2)-	5.734E-3(1.18E-2)-	1.231E-1(6.44E-3)$\sim$	9.285E-2(1.37E-2)-	1.101E-1(6.59E-3)-	1.153E-1(1.08E-2)-	1.192E-1(1.35E-2)-	**1.236E-1(5.76E-3)**
	15	1.730E-2(3.40E-2)-	7.464E-5(9.40E-5)-	6.555E-2(4.59E-3)-	4.188E-2(1.04E-2)-	6.766E-2(4.72E-3)-	6.661E-2(9.93E-3)-	6.875E-2(1.99E-3)-	**7.516E-2(8.11E-3)**
Best/All		0/65	2/65	3/65	5/65	5/65	8/65	3/65	39/65
+/−/$\sim$		5/54/6	6/56/3	6/49/10	10/44/11	10/45/10	15/39/11	2/48/15	——

TABLE A. VIII
PERFORMANCE OF MOEA-SET1 ON 3- TO 15-OBJECTIVE MAF PROBLEMS WITH IGD

Problems	m	NSGA-III	θ-DEA	VaEA	MaOEA/C	MOEA/AD	DDEA+NS	PaRPEA	FDEA
MaF1	3	5.115E-2(1.29E-3)	6.878E-2(5.08E-4)	3.806E-2(5.15E-4)	3.802E-2(5.044E-4)	3.740E-2(3.67E-4)	3.747E-2(6.97E-4)	3.745E-2(2.03E-4)	**3.734E-2(3.04E-4)**
	5	1.598E-1(7.04E-3)	2.124E-1(6.74E-3)	1.099E-1(1.59E-3)	1.048E-1(1.85E-3)	1.072E-1(4.15E-3)	1.008E-1(1.01E-3)	**9.968E-2(1.54E-3)**	1.027E-1(6.40E-4)
	8	2.618E-1(7.41E-3)	2.486E-1(7.68E-3)	1.907E-1(1.59E-3)	1.833E-1(2.33E-3)	1.779E-1(1.96E-2)	1.770E-1(1.30E-3)	**1.519E-1(2.27E-3)**	1.788E-1(6.02E-4)
	10	2.785E-1(4.83E-3)	3.130E-1(1.41E-2)	2.233E-1(1.63E-3)	2.128E-1(3.02E-3)	2.140E-1(1.65E-2)	2.011E-1(1.50E-3)	**1.783E-1(4.51E-3)**	2.123E-1(2.13E-3)
	15	3.849E-1(5.80E-3)	3.804E-1(9.48E-3)	3.061E-1(1.97E-3)	3.040E-1(8.47E-3)	2.695E-1(8.97E-3)	2.774E-1(2.24E-3)	**1.961E-1(1.79E-3)**	2.857E-1(2.83E-3)
MaF2	3	3.050E-2(4.49E-4)	3.156E-2(2.86E-4)	2.683E-2(3.13E-4)	2.798E-2(6.72E-4)	3.743E-2(1.24E-3)	2.588E-2(2.80E-4)	5.340E-2(1.24E-2)	**2.456E-2(6.48E-4)**
	5	1.112E-1(2.66E-3)	1.248E-1(2.42E-3)	9.839E-2(1.76E-3)	9.521E-2(1.46E-3)	1.383E-1(1.73E-3)	8.402E-2(1.13E-3)	**7.360E-2(1.95E-3)**	9.906E-2(1.94E-3)
	8	1.566E-1(6.24E-3)	1.614E-1(5.26E-3)	1.578E-1(2.78E-3)	1.885E-1(1.08E-2)	4.109E-1(3.17E-2)	2.117E-1(1.39E-2)	1.842E+4(1.17E+4)	**1.524E-1(1.58E-3)**
	10	1.907E-1(1.65E-2)	2.100E-1(1.30E-2)	1.724E-1(4.83E-3)	2.563E-1(2.46E-2)	5.637E-1(2.70E-2)	2.510E-1(1.48E-2)	2.454E+4(1.62E+4)	**1.458E-1(1.39E-2)**
	15	2.751E-1(5.53E-2)	2.729E-1(2.11E-2)	2.959E-1(3.25E-3)	4.651E-1(4.90E-2)	6.964E-1(2.10E-2)	3.134E-1(2.45E-2)	1.614E+4(9.68E+3)	**2.292E-1(1.18E-2)**
MaF3	3	6.322E-2(2.73E-2)	4.706E-2(1.62E-3)	5.090E-2(3.26E-3)	1.832E-1(2.50E-2)	1.120E-1(7.53E-2)	1.659E-1(1.19E-1)	5.340E-2(1.24E-2)	**3.350E-2(3.51E-3)**
	5	1.068E-1(3.38E-2)	9.560E-2(1.61E-3)	1.226E-1(2.00E-2)	1.454E-1(2.09E-2)	1.465E-1(2.97E-2)	3.140E-1(2.00E-1)	1.949E+0(6.39E-2)	**5.333E-2(1.30E-3)**
	8	**1.153E-1(4.53E-2)**	1.261E-1(1.50E-3)	1.242E-1(7.39E-3)	1.568E-1(1.91E-2)	1.781E-1(5.75E-2)	7.401E-1(1.05E-1)	1.665E+1(9.85E-1)	1.557E-1(6.28E-2)
	10	**9.572E-2(1.68E-2)**	1.401E-1(4.48E-2)	1.210E-1(7.66E-3)	1.514E-1(1.41E-2)	2.610E-1(1.51E-1)	4.908E-1(1.68E-1)	5.501E+1(2.85E+0)	1.792E-1(2.42E-2)
	15	1.161E+0(2.58E+0)	3.337E-1(1.40E-1)	2.542E-1(5.59E-2)	3.798E-1(1.85E-1)	3.408E-1(1.58E-1)	3.653E-1(1.50E-1)	1.089E+3(1.26E+2)	**2.076E-1(1.92E-2)**
MaF4	3	2.971E-1(1.73E-2)	3.209E-1(2.11E-2)	2.900E-1(1.54E-2)	5.001E-1(9.67E-2)	2.937E-1(9.85E-2)	3.472E-1(5.11E-2)	2.721E-1(1.21E-2)	**2.720E-1(2.37E-2)**
	5	2.396E+0(1.39E-1)	2.916E+0(1.56E-1)	1.910E+0(4.66E-2)	2.707E+0(2.49E-1)	2.053E+0(5.54E-1)	2.249E+0(1.30E-1)	**1.748E+0(2.59E-2)**	2.085E+0(3.17E-2)
	8	2.811E+1(2.68E+0)	3.256E+1(2.97E+0)	1.611E+1(1.01E+0)	2.431E+1(2.26E+0)	2.207E+1(1.79E+0)	2.000E+1(1.63E+0)	**1.314E+1(3.60E-1)**	1.714E+1(2.17E+0)
	10	9.741E+1(7.44E+0)	1.230E+2(1.24E+1)	5.388E+1(2.23E+0)	9.360E+1(9.94E+0)	9.323E+1(5.78E+0)	7.222E+1(6.64E+0)	**4.896E+1(1.08E+1)**	6.120E+1(4.55E+0)
	15	3.117E+3(2.44E+2)	3.829E+3(3.04E+2)	**1.205E+3(7.53E+1)**	3.910E+3(6.79E+2)	3.833E+3(2.19E+2)	2.302E+3(2.25E+2)	1.489E+3(4.68E+2)	1.876E+3(2.88E+2)
MaF5	3	3.784E-1(8.52E-1)	3.784E-1(8.52E-1)	4.269E-1(8.74E-1)	2.425E-1(6.93E-3)	2.772E-1(2.47E-2)	3.496E-1(4.54E-1)	**2.254E-1(3.43E-3)**	2.300E-1(3.07E-3)
	5	2.045E+0(2.44E-3)	2.044E+0(1.81E-3)	1.749E+0(2.68E-2)	1.827E+0(3.11E-2)	3.900E+0(3.25E-1)	1.734E+0(2.17E-2)	**2.656E-1(1.15E-2)**	1.792E+0(4.13E-2)
	8	1.856E+1(9.48E-2)	1.857E+1(3.63E-2)	1.351E+1(3.61E-1)	1.439E+1(7.31E-1)	3.620E+1(3.56E+0)	1.316E+1(2.70E-1)	**2.539E+0(3.72E+0)**	1.385E+1(5.01E-1)
	10	8.635E+1(1.87E+0)	8.717E+1(9.42E-1)	4.792E+1(1.41E+0)	5.865E+1(8.66E+0)	1.344E+2(1.11E+1)	4.814E+1(8.07E-1)	**4.012E+0(4.03E+0)**	5.015E+1(6.33E-1)
	15	3.377E+3(3.93E+2)	3.498E+3(2.43E+1)	1.088E+3(7.70E+1)	1.082E+3(8.50E+1)	6.214E+3(2.74E+2)	9.917E+2(4.57E+1)	3.705E+1(4.68E+1)	1.131E+3(1.33E+2)
MaF6	3	1.186E-2(1.40E-3)	2.804E-2(2.80E-3)	4.717E-3(3.98E-4)	4.947E-3(1.09E-3)	4.027E-2(1.24E-2)	4.270E-3(2.05E-4)	5.901E-2(1.69E-3)	**3.247E-3(3.32E-4)**
	5	1.806E-2(5.80E-3)	9.305E-2(3.26E-2)	4.225E-3(7.66E-4)	3.276E-3(9.41E-4)	7.617E-2(1.35E-2)	3.568E-3(2.23E-4)	2.761E-1(5.80E-3)	**2.664E-3(1.25E-4)**
	8	5.503E-2(1.15E-1)	1.527E-1(9.87E-2)	3.871E-2(1.02E-1)	**3.695E-3(1.18E-3)**	6.655E-2(1.51E-2)	1.649E-1(1.69E-1)	6.877E-1(1.65E-2)	3.021E+0(4.72E+0)
	10	3.213E-1(8.09E-2)	3.052E-1(7.33E-2)	2.454E-1(1.28E-1)	**4.426E-3(1.59E-3)**	8.711E-2(2.39E-2)	3.183E-1(8.94E-2)	1.205E+0(3.14E-2)	2.673E+0(2.95E+0)
	15	5.718E-1(2.01E-1)	2.778E-1(8.43E-2)	2.837E-1(8.93E-2)	**1.218E-1(1.05E-1)**	1.528E-1(3.71E-2)	3.127E-1(3.54E-2)	2.474E+0(2.29E-1)	1.299E+0(7.12E-1)
MaF7	3	6.491E-2(2.10E-3)	9.999E-2(7.16E-2)	6.978E-2(5.47E-2)	6.495E-2(5.43E-2)	2.751E-1(3.29E-1)	6.458E-2(5.60E-2)	6.263E-2(1.42E-3)	**5.052E-2(1.11E-3)**
	5	2.883E-1(8.48E-3)	3.121E-1(4.35E-2)	2.755E-1(6.36E-3)	3.089E-1(7.41E-2)	3.269E-1(7.14E-3)	2.965E-1(4.20E-2)	8.268E-2(1.23E-3)	**2.156E-1(1.03E-2)**
	8	7.170E-1(2.96E-2)	7.863E-1(7.93E-2)	6.624E-1(1.35E-2)	1.026E+0(1.61E-1)	1.727E+0(6.93E-1)	1.041E+0(1.70E-1)	6.061E-1(9.01E-4)	**5.099E-1(4.28E-2)**
	10	1.133E+0(9.68E-2)	9.930E-1(1.39E-1)	9.630E-1(2.86E-2)	2.114E+0(5.33E-1)	1.529E+0(1.36E-1)	1.560E+0(2.77E-1)	**1.127E-1(1.99E-3)**	1.152E+0(1.69E-1)
	15	4.889E+0(1.29E+0)	3.885E+0(1.03E+0)	2.153E+0(2.26E-1)	6.929E+0(1.78E+0)	4.794E+0(1.53E+0)	6.583E+0(9.02E-1)	**1.505E-1(2.57E-3)**	2.167E+0(5.27E-1)
MaF8	3	9.377E-2(7.00E-3)	1.415E-1(4.78E-2)	6.588E-2(2.94E-3)	8.123E-2(6.91E-3)	6.451E-2(3.18E-3)	6.565E-2(5.80E-3)	6.261E-2(1.16E-3)	**6.141E-2(1.69E-3)**
	5	1.657E-1(8.32E-3)	3.204E-1(4.33E-2)	8.374E-2(1.88E-3)	1.283E-1(5.50E-3)	1.145E-1(3.21E-3)	8.395E-2(4.81E-3)	4.857E-1(5.65E-1)	**8.165E-2(3.19E-3)**
	8	3.790E-1(5.97E-2)	5.987E-1(8.01E-2)	1.104E-1(2.19E-3)	2.204E-1(1.45E-2)	1.496E-1(2.53E-3)	1.129E-1(4.29E-3)	1.948E+0(1.90E-1)	**1.088E-1(3.13E-3)**
	10	2.830E-1(4.53E-2)	7.995E-1(1.46E-1)	**1.156E-1(2.13E-3)**	2.640E-1(1.47E-2)	1.688E-1(2.51E-3)	1.211E-1(5.58E-3)	1.878E+0(6.17E-2)	**1.156E-1(4.97E-3)**
	15	3.384E-1(3.35E-2)	9.293E-1(2.08E-1)	1.574E-1(2.41E-3)	4.477E-1(3.59E-2)	**1.551E-1(1.94E-3)**	1.655E-1(8.53E-3)	1.728E+0(6.38E-1)	**1.551E-1(1.01E-2)**
MaF9	3	5.96E-2(9.23E-3)	6.26E-2(1.21E-2)	6.071E-2(2.54E-3)	6.770E-2(4.96E-3)	2.392E-1(1.46E-1)	3.856E-1(7.29E-2)	9.194E-1(8.38E-2)	**5.569E-2(4.53E-4)**
	5	2.679E-1(4.10E-2)	2.565E-1(1.42E-2)	2.819E-1(2.23E-2)	7.690E-2(4.89E-3)	6.590E-1(1.69E-1)	4.223E-1(1.20E-1)	1.762E+0(7.05E-2)	**1.835E-1(5.59E-2)**
	8	1.793E-1(1.25E-3)	6.333E-1(6.61E-2)	1.266E+0(2.07E-6)	2.179E+0(1.91E+0)	4.469E+0(3.30E+0)	8.204E-1(1.81E-1)	3.114E+0(1.75E-1)	**1.750E-1(3.94E-3)**
	10	2.414E-1(5.06E-3)	1.061E+0(3.64E-1)	1.442E+0(4.59E-4)	1.826E-1(4.21E-2)	1.222E+2(1.34E+2)	1.092E+0(6.70E-1)	5.364E+0(7.60E-2)	**1.551E-1(3.88E-2)**
	15	2.728E+0(1.14E-2)	1.672E+0(3.50E-1)	1.739E+0(1.14E-1)	1.396E-1(4.65E-3)	4.484E-1(1.80E-1)	9.300E+0(9.17E-1)	8.917E+0(1.74E-2)	**3.244E-1(5.15E-2)**
MaF10	3	9.389E-1(8.41E-2)	9.006E-1(1.02E-1)	8.324E-1(9.72E-2)	1.104E+0(1.26E-1)	2.805E-1(4.39E-2)	**2.385E-1(2.91E-2)**	9.194E-1(8.38E-2)	7.225E-1(1.06E-1)
	5	1.472E+0(9.28E-2)	1.128E+0(5.16E-2)	1.523E+0(7.85E-2)	1.282E+0(3.95E-2)	6.171E-1(5.26E-2)	**4.711E-1(2.88E-2)**	1.630E+0(9.94E-2)	1.032E+0(2.06E-2)
	8	1.637E+0(1.07E-1)	1.370E+0(4.06E-2)	1.465E+0(5.20E-2)	1.489E+0(2.91E-2)	**7.736E-1(5.28E-2)**	9.895E-1(7.95E-2)	1.661E+0(1.45E-1)	1.413E+0(1.95E-2)
	10	1.470E+0(5.51E-2)	1.385E+0(4.74E-2)	1.470E+0(5.46E-2)	1.490E+0(1.95E-2)	**8.989E-1(3.09E-2)**	1.333E+0(1.95E-1)	1.429E+0(4.39E-2)	1.526E+0(3.61E-2)
	15	2.346E+0(2.97E-2)	2.421E+0(6.22E-2)	2.257E+0(2.40E-2)	2.290E+0(5.49E-2)	**1.791E+0(1.44E-1)**	1.881E+0(5.36E-2)	2.210E+0(4.08E-2)	2.572E+0(8.30E-2)
MaF11	3	2.29E-1(7.42E-2)	2.46E-1(6.92E-2)	2.730E-1(6.98E-2)	2.957E-1(5.37E-2)	3.842E-1(5.35E-2)	2.443E-1(6.51E-2)	2.230E-1(2.31E-2)	**1.707E-1(5.41E-3)**
	5	6.861E-1(1.93E-1)	7.611E-1(3.14E-1)	1.091E+0(5.92E-1)	8.568E-1(1.75E-1)	6.887E-1(2.98E-1)	6.553E-1(1.00E-1)	1.934E+0(1.43E+0)	**6.093E-1(2.03E-1)**
	8	3.148E+0(1.43E+0)	2.835E+0(9.18E-1)	2.779E+0(6.68E-1)	2.569E+0(3.17E-1)	2.618E+0(1.90E-1)	2.333E+0(3.08E-1)	4.400E+0(1.42E+0)	**2.096E+0(3.48E-1)**
	10	5.792E+0(3.08E+0)	5.272E+0(1.55E+0)	5.004E+0(8.13E-1)	3.976E+0(6.22E-1)	3.849E+0(3.93E-1)	3.545E+0(1.23E+0)	6.424E+0(1.52E+0)	**3.544E+0(1.93E-1)**
	15	6.846E+0(2.27E+0)	1.699E+1(3.22E+0)	8.679E+0(2.77E+0)	4.391E+0(1.44E+0)	5.198E+0(2.45E+0)	6.679E+0(3.98E+0)	1.017E+1(3.18E+0)	**4.223E+0(3.47E+0)**
MaF12	3	2.147E-1(2.33E-2)	2.155E-1(2.36E-2)	2.205E-1(2.16E-2)	2.248E-1(2.32E-2)	2.272E-1(2.88E-2)	2.495E-1(1.60E-2)	2.130E-1(2.31E-2)	**2.080E-1(1.88E-2)**
	5	9.266E-1(3.90E-3)	9.224E-1(2.81E-3)	9.532E-1(1.23E-2)	9.556E-1(9.98E-3)	9.368E-1(1.88E-2)	1.256E+0(5.92E-2)	9.466E-1(9.01E-3)	**9.218E-1(9.13E-3)**
	8	2.749E+0(4.84E-2)	2.708E+0(1.98E-2)	2.770E+0(2.78E-2)	2.819E+0(3.35E-2)	2.754E+0(3.87E-2)	2.954E+0(2.61E-2)	2.737E+0(1.53E-2)	**2.704E+0(1.39E-2)**
	10	4.243E+0(2.19E-2)	4.260E+0(1.34E-2)	4.084E+0(2.37E-2)	4.288E+0(6.52E-2)	4.110E+0(4.30E-2)	4.917E+0(5.96E-2)	4.068E+0(2.56E-2)	**4.045E+0(1.91E-2)**
	15	8.905E+0(2.08E-1)	8.814E+0(8.22E-2)	8.104E+0(9.62E-2)	9.430E+0(6.01E-1)	8.714E+0(2.55E-1)	9.502E+0(5.20E-2)	**7.891E+0(9.76E-2)**	8.092E+0(9.44E-2)
MaF13	3	9.00E-2(1.29E-2)	9.15E-2(1.90E-2)	7.698E-2(7.96E-3)	8.400E-2(1.15E-2)	1.502E-1(2.66E-2)	7.975E-2(1.01E-2)	**2.699E-2(4.57E-4)**	6.777E-2(3.65E-3)
	5	1.94E-1(3.27E-2)	2.70E-1(4.56E-2)	**8.865E-2(7.92E-3)**	1.192E-1(2.07E-3)	1.640E-1(2.29E-2)	1.356E-1(2.57E-2)	9.968E-2(1.54E-3)	1.218E-1(1.60E-2)
	8	2.59E-1(6.42E-2)	5.31E-1(1.13E-1)	**9.179E-2(4.08E-3)**	2.079E-1(1.86E-2)	2.905E-1(3.93E-2)	1.465E-1(2.10E-2)	1.519E-1(2.27E-3)	1.317E-1(2.21E-2)
	10	2.47E-1(4.81E-2)	5.74E-1(1.46E-1)	**9.084E-2(3.35E-3)**	2.344E-1(7.88E-3)	3.430E-1(3.25E-2)	1.398E-1(1.86E-2)	1.783E-1(4.51E-3)	1.187E-1(8.16E-3)
	15	3.20E-1(9.96E-2)	7.72E-1(2.81E-1)	**1.102E-1(3.37E-3)**	3.706E-1(4.34E-2)	4.326E-1(4.12E-2)	1.626E-1(2.19E-2)	1.961E-1(1.79E-3)	1.322E-1(9.53E-3)
Best/All		0/28	2/28	0/28	5/28	0/28	6/28	1/28	14/28

TABLE A. IX
PERFORMANCE OF MOEA-SET2 ON 3- TO 15-OBJECTIVE WFG AND WFG4X PROBLEMS WITH HV

Problem	m	SPEA2	MOEA/D-PaS	RVEA	BCE-MOEA/D	hpaEA	KnEA	GFM-MOEA	MaOEA-IGD	FDEA
WFG1	3	7.271E-1(1.88E-2)	3.679E-1(2.17E-2)	5.894E-1(3.33E-2)	8.816E-1(1.18E-2)	5.056E-1(9.15E-2)	8.211E-1(1.66E-2)	**9.271E-1(2.83E-2)**	5.881E-2(5.33E-2)	6.371E-1(3.92E-2)
	5	4.954E-1(1.10E-2)	9.218E-1(4.63E-2)	6.103E-1(3.59E-2)	**9.986E-1(2.29E-4)**	5.416E-1(1.12E-1)	7.871E-1(2.67E-2)	9.965E-1(1.19E-3)	1.963E-1(1.12E-1)	7.174E-1(1.66E-2)
	8	3.816E-1(2.69E-2)	3.512E-1(3.25E-2)	5.551E-1(4.46E-2)	9.796E-1(3.96E-2)	5.013E-1(5.19E-2)	8.534E-1(5.37E-2)	**9.994E-1(6.02E-4)**	4.219E-1(2.89E-1)	8.219E-1(9.71E-3)
	10	3.619E-1(2.55E-2)	9.418E-1(4.12E-2)	6.766E-1(1.07E-1)	**1.0E+0(2.82E-06)**	5.683E-1(2.13E-2)	9.562E-1(3.24E-2)	9.950E-1(9.24E-3)	3.959E-1(1.96E-1)	8.515E-1(7.84E-3)
	15	5.149E-1(3.43E-2)	5.743E-1(3.29E-1)	8.922E-1(1.09E-1)	9.993E-1(2.72E-4)	5.604E-1(9.53E-2)	9.969E-1(1.06E-3)	**1.00E+0(3.09E-5)**	7.864E-1(1.14E-1)	8.681E-1(6.75E-3)
WFG2	3	8.560E-1(7.92E-2)	9.003E-1(9.04E-3)	8.434E-1(7.64E-2)	9.006E-1(2.99E-3)	9.003E-1(6.64E-3)	8.559E-1(8.10E-2)	8.995E-1(7.23E-2)	6.187E-1(1.04E-2)	**9.021E-1(6.26E-2)**
	5	9.413E-1(8.53E-2)	9.444E-1(2.86E-3)	9.706E-1(8.56E-3)	9.827E-1(1.27E-3)	9.720E-1(2.30E-3)	9.386E-1(8.62E-2)	9.511E-1(8.96E-2)	8.086E-1(5.70E-2)	**9.843E-1(3.24E-2)**
	8	9.762E-1(5.71E-3)	9.637E-2(4.31E-3)	9.118E-1(8.38E-2)	9.809E-1(1.15E-2)	9.551E-1(6.28E-3)	9.846E-1(1.73E-3)	9.873E-1(1.91E-3)	8.074E-1(9.56E-2)	**9.931E-1(6.17E-2)**
	10	9.776E-1(1.63E-3)	2.988E-1(2.37E-1)	9.534E-1(1.42E-2)	9.852E-1(1.37E-3)	9.727E-1(2.95E-3)	9.855E-1(2.13E-3)	9.853E-1(3.71E-3)	8.042E-1(2.38E-2)	**9.948E-1(7.91E-4)**
	15	9.768E-1(1.15E-2)	1.722E-1(1.63E-1)	8.915E-1(7.57E-2)	9.852E-1(4.69E-3)	8.720E-1(9.68E-2)	9.887E-1(1.83E-3)	9.470E-1(8.64E-2)	8.344E-1(8.98E-2)	**9.951E-1(4.55E-2)**
WFG3	3	6.176E-1(4.06E-3)	6.259E-1(5.97E-3)	5.961E-1(5.90E-3)	6.284E-1(4.53E-3)	6.073E-1(7.39E-3)	6.125E-1(1.08E-2)	6.206E-1(6.62E-3)	9.543E-2(2.26E-2)	**6.306E-1(2.15E-3)**
	5	5.795E-1(2.20E-2)	5.946E-1(1.16E-2)	5.788E-1(2.99E-2)	6.212E-1(1.61E-2)	6.096E-1(6.36E-3)	5.660E-1(1.02E-2)	6.153E-1(2.23E-2)	8.894E-2(6.63E-3)	6.283E-1(1.25E-2)
	8	4.252E-1(1.79E-2)	9.085E-2(5.06E-5)	2.464E-1(3.11E-2)	5.197E-1(4.20E-2)	5.928E-1(1.82E-2)	5.139E-1(8.60E-3)	**6.453E-1(1.72E-2)**	7.526E-2(3.02E-3)	6.211E-1(1.34E-2)
	10	3.138E-1(5.24E-2)	9.088E-2(1.23E-5)	1.595E-1(1.18E-2)	5.780E-1(3.84E-2)	5.887E-1(2.64E-2)	4.651E-1(1.41E-2)	**6.582E-1(3.49E-2)**	7.726E-2(4.08E-3)	6.472E-1(1.38E-2)
	15	2.199E-1(3.48E-2)	9.085E-2(5.13E-5)	1.170E-1(5.42E-3)	4.357E-1(5.93E-2)	6.057E-1(1.14E-2)	3.955E-1(3.72E-2)	9.978E-2(1.64E-2)	1.397E-1(1.44E-1)	**6.779E-1(1.33E-2)**
WFG4	3	5.272E-1(6.84E-3)	4.813E-1(7.59E-3)	5.389E-1(4.04E-3)	**5.551E-1(2.55E-3)**	5.131E-1(1.02E-2)	5.386E-1(2.17E-3)	5.537E-1(2.80E-3)	9.059E-2(5.76E-5)	5.410E-1(2.14E-3)
	5	6.788E-1(4.50E-3)	4.417E-1(1.41E-2)	7.693E-1(2.76E-3)	7.707E-1(1.15E-2)	6.215E-1(2.03E-2)	7.650E-1(3.95E-3)	**7.741E-1(2.07E-3)**	9.077E-2(3.53E-5)	7.540E-1(3.89E-3)
	8	6.924E-1(1.36E-2)	5.558E-1(2.89E-1)	7.717E-1(3.11E-2)	8.503E-1(1.25E-2)	5.325E-1(2.72E-2)	**8.998E-1(1.62E-3)**	8.753E-1(1.69E-2)	9.051E-2(7.43E-4)	8.692E-1(6.52E-3)
	10	6.862E-1(2.43E-2)	9.258E-2(3.40E-3)	8.641E-1(3.02E-2)	9.233E-1(7.59E-3)	5.891E-1(2.33E-2)	**9.432E-1(1.06E-3)**	9.157E-1(2.76E-2)	8.838E-2(3.29E-3)	9.239E-1(4.47E-3)
	15	6.432E-1(7.60E-3)	9.692E-2(1.20E-2)	7.534E-1(1.11E-1)	8.182E-1(6.99E-2)	4.972E-1(1.81E-2)	9.506E-1(1.50E-3)	7.898E-1(3.26E-2)	1.443E-1(3.65E-2)	**9.542E-1(7.27E-3)**
WFG5	3	5.037E-1(1.92E-3)	4.860E-1(4.10E-4)	5.105E-1(1.53E-3)	5.111E-1(1.74E-3)	5.093E-1(4.87E-3)	5.082E-1(4.39E-3)	**5.192E-1(3.93E-3)**	7.145E-2(5.51E-3)	5.146E-1(5.51E-3)
	5	6.630E-1(8.48E-3)	4.752E-1(1.41E-2)	**7.386E-1(1.84E-3)**	7.331E-1(3.89E-3)	7.177E-1(3.38E-3)	7.357E-1(2.62E-3)	7.366E-1(3.83E-3)	1.098E-1(3.33E-2)	7.303E-1(3.46E-3)
	8	6.493E-1(1.14E-2)	3.161E-1(2.60E-1)	8.384E-1(2.54E-3)	8.145E-1(1.04E-2)	6.786E-1(3.25E-2)	**8.544E-1(2.92E-3)**	8.338E-1(1.41E-3)	1.339E-1(3.75E-2)	8.396E-1(2.35E-3)
	10	6.388E-1(1.13E-2)	8.121E-2(2.02E-3)	8.932E-1(2.87E-4)	8.732E-1(2.29E-3)	7.208E-1(7.53E-3)	**8.956E-1(8.80E-4)**	8.574E-1(6.05E-3)	8.116E-2(1.53E-3)	8.831E-1(6.00E-4)
	15	5.151E-1(4.52E-2)	7.902E-2(8.28E-9)	9.009E-1(1.49E-3)	7.887E-1(1.54E-2)	5.243E-1(1.59E-2)	9.006E-1(5.98E-4)	7.828E-1(9.00E-2)	7.954E-2(1.96E-3)	**9.042E-1(2.49E-3)**
WFG6	3	5.079E-1(3.11E-3)	4.832E-1(1.09E-2)	5.049E-1(3.67E-3)	**5.273E-1(5.26E-3)**	5.198E-1(3.02E-3)	5.100E-1(4.22E-3)	5.257E-1(5.54E-3)	1.142E-1(6.94E-2)	5.137E-1(5.54E-3)
	5	6.710E-1(9.64E-3)	6.417E-1(6.95E-2)	7.430E-1(1.03E-2)	7.292E-1(7.32E-3)	7.223E-1(7.05E-3)	7.395E-1(4.43E-3)	**7.516E-1(6.19E-3)**	1.133E-1(6.23E-2)	7.361E-1(2.18E-3)
	8	6.648E-1(1.96E-2)	8.029E-1(1.02E-3)	8.367E-1(4.91E-3)	7.824E-1(7.97E-3)	7.328E-1(2.23E-2)	8.433E-1(1.74E-3)	8.481E-1(3.07E-2)	9.737E-2(3.27E-2)	**8.521E-1(6.53E-3)**
	10	6.287E-1(1.67E-2)	3.610E-1(3.32E-1)	8.905E-1(5.83E-3)	8.774E-1(1.24E-2)	7.989E-1(7.58E-3)	8.879E-1(1.25E-2)	8.788E-1(7.62E-3)	1.164E-1(3.99E-2)	**8.948E-1(8.16E-3)**
	15	5.237E-1(3.99E-2)	1.291E-1(7.03E-2)	7.575E-1(3.15E-2)	8.048E-1(2.73E-2)	5.762E-1(2.15E-2)	9.122E-1(2.25E-2)	8.653E-1(6.35E-2)	1.135E-1(3.95E-2)	**9.159E-1(4.51E-3)**
WFG7	3	5.466E-1(9.23E-4)	5.294E-1(5.16E-3)	5.509E-1(2.14E-3)	5.599E-1(2.17E-3)	5.559E-1(2.21E-3)	5.526E-1(7.02E-4)	**5.611E-1(4.60E-4)**	1.276E-1(7.39E-2)	5.599E-1(4.60E-4)
	5	6.317E-1(2.75E-2)	5.232E-1(5.14E-2)	**7.963E-1(7.00E-4)**	7.925E-1(3.52E-3)	7.570E-1(1.09E-2)	7.900E-1(3.03E-3)	7.911E-1(2.45E-3)	8.993E-2(1.77E-3)	7.822E-1(2.47E-3)
	8	6.172E-1(2.90E-2)	1.402E-1(9.85E-2)	8.224E-1(5.44E-2)	8.766E-1(1.19E-2)	6.692E-1(2.73E-2)	9.001E-1(1.04E-3)	8.775E-1(2.23E-2)	1.277E-1(4.56E-2)	**9.022E-1(1.00E-3)**
	10	6.068E-1(2.72E-2)	9.030E-2(7.72E-4)	8.829E-1(4.79E-2)	9.502E-1(6.38E-4)	7.225E-1(1.54E-2)	9.367E-1(4.97E-4)	9.177E-1(1.49E-2)	1.045E-1(3.71E-2)	**9.485E-1(2.99E-3)**
	15	5.728E-1(4.24E-2)	9.090E-2(4.77E-6)	7.350E-1(4.35E-1)	6.552E-1(1.36E-1)	5.770E-1(1.94E-2)	9.729E-1(2.72E-4)	9.076E-1(7.69E-2)	1.214E-1(4.48E-2)	**9.736E-1(2.25E-3)**
WFG8	3	4.625E-1(2.37E-3)	4.336E-1(7.08E-3)	4.634E-1(1.28E-2)	4.769E-1(2.95E-3)	4.649E-1(4.26E-3)	4.636E-1(1.61E-3)	**4.785E-1(9.00E-4)**	2.142E-4(2.71E-4)	4.762E-1(9.00E-4)
	5	5.745E-1(8.79E-3)	3.065E-1(4.70E-2)	**6.587E-1(8.80E-3)**	6.032E-1(2.30E-2)	6.481E-1(5.15E-3)	6.554E-1(6.54E-3)	6.270E-1(3.57E-2)	1.354E-2(2.71E-2)	6.478E-1(5.59E-3)
	8	6.197E-1(2.02E-2)	1.044E-1(1.80E-2)	5.401E-1(2.93E-2)	6.802E-1(6.23E-2)	6.188E-1(2.88E-2)	7.237E-1(3.65E-2)	7.489E-1(4.39E-2)	8.391E-2(1.49E-3)	**7.695E-1(8.98E-3)**
	10	6.299E-1(1.42E-2)	8.291E-2(1.51E-3)	5.135E-1(5.12E-2)	7.540E-1(3.58E-2)	6.976E-1(7.91E-3)	7.551E-1(1.32E-1)	7.291E-1(3.35E-2)	1.230E-1(4.33E-2)	**8.398E-1(1.26E-2)**
	15	5.306E-1(2.68E-2)	9.073E-2(3.40E-4)	7.133E-2(5.61E-2)	7.555E-1(3.23E-2)	6.001E-1(1.33E-2)	7.181E-1(4.43E-2)	7.005E-1(1.45E-1)	8.751E-2(5.09E-3)	**9.159E-1(3.19E-3)**
WFG9	3	4.738E-1(2.43E-2)	4.477E-1(3.23E-3)	4.842E-1(1.79E-2)	4.891E-1(3.00E-2)	4.940E-1(2.74E-2)	4.927E-1(2.93E-2)	**5.093E-1(1.68E-3)**	7.292E-2(9.20E-3)	5.067E-1(1.91E-2)
	5	6.175E-1(8.47E-3)	3.300E-1(9.01E-3)	6.997E-1(1.14E-2)	6.115E-1(6.31E-3)	6.581E-1(3.49E-3)	**7.105E-1(2.97E-2)**	7.051E-1(5.44E-3)	2.335E-1(2.51E-1)	7.033E-1(2.46E-2)
	8	6.536E-1(9.03E-3)	3.730E-1(3.32E-1)	7.403E-1(1.83E-2)	7.166E-1(1.62E-2)	5.793E-1(2.18E-2)	8.076E-1(7.14E-3)	7.745E-1(1.67E-2)	5.812E-1(4.54E-2)	**8.080E-1(2.46E-2)**
	10	6.392E-1(3.66E-2)	7.429E-2(3.23E-4)	7.973E-1(2.10E-2)	7.552E-1(2.65E-2)	6.930E-1(5.08E-2)	8.089E-1(9.50E-3)	8.046E-1(1.20E-2)	6.192E-1(4.17E-2)	**8.100E-1(3.06E-2)**
	15	5.904E-1(3.31E-2)	7.355E-2(1.26E-9)	7.117E-1(3.46E-2)	6.510E-1(8.47E-2)	5.407E-1(1.49E-2)	8.192E-1(5.91E-3)	6.155E-1(5.53E-3)	5.415E-1(2.65E-2)	**8.209E-1(2.80E-2)**
WFG41	3	5.326E-1(4.64E-3)	4.807E-1(1.03E-2)	5.390E-1(2.61E-3)	**5.546E-1(3.45E-3)**	5.356E-1(7.18E-3)	5.439E-1(2.31E-3)	5.527E-1(1.01E-3)	8.987E-2(1.35E-3)	5.410E-1(2.14E-3)
	5	6.843E-1(4.80E-3)	3.947E-1(4.45E-2)	7.666E-1(1.70E-3)	7.604E-1(1.00E-2)	6.171E-1(1.23E-2)	**7.706E-1(3.52E-3)**	7.681E-1(4.90E-3)	1.085E-1(3.54E-2)	7.540E-1(3.89E-3)
	8	7.144E-1(1.37E-2)	2.637E-1(3.12E-1)	7.769E-1(4.29E-2)	8.539E-1(5.52E-3)	5.356E-1(4.06E-2)	**8.954E-1(3.94E-3)**	8.801E-1(1.34E-2)	1.066E-1(3.15E-2)	8.692E-1(6.52E-3)
	10	6.986E-1(1.46E-2)	9.083E-2(1.53E-5)	8.365E-1(4.91E-2)	9.271E-1(6.44E-3)	5.847E-1(1.82E-2)	**9.402E-1(4.61E-3)**	9.042E-1(1.44E-2)	1.034E-1(3.15E-2)	9.239E-1(4.47E-3)
	15	6.314E-1(1.64E-2)	1.059E-1(2.99E-2)	7.315E-1(7.81E-2)	8.299E-1(3.99E-2)	4.968E-1(2.73E-2)	9.527E-1(3.78E-3)	8.707E-1(7.52E-2)	1.087E-1(4.10E-2)	**9.542E-1(7.27E-3)**
WFG42	3	9.615E-1(2.08E-3)	9.214E-1(3.73E-3)	9.586E-1(2.04E-3)	9.618E-1(1.36E-3)	9.515E-1(3.21E-3)	9.585E-1(1.52E-3)	9.677E-1(7.47E-4)	6.964E-1(2.69E-2)	**9.681E-1(1.50E-3)**
	5	9.753E-1(3.79E-3)	9.377E-1(5.90E-3)	9.791E-1(4.44E-3)	**9.994E-1(6.23E-5)**	9.751E-1(2.25E-3)	9.809E-1(1.93E-3)	9.985E-1(1.87E-4)	8.793E-1(3.56E-2)	9.929E-1(1.46E-3)
	8	9.681E-1(2.64E-3)	8.537E-1(8.94E-2)	9.617E-1(4.70E-3)	9.950E-1(1.16E-3)	9.682E-1(5.23E-3)	9.876E-1(1.57E-3)	9.954E-1(5.88E-5)	9.689E-1(7.62E-3)	**9.958E-1(5.86E-4)**
	10	9.712E-1(3.41E-3)	7.752E-1(2.83E-1)	9.761E-1(2.69E-3)	**9.999E-1(2.69E-5)**	9.801E-1(2.64E-3)	9.912E-1(1.77E-3)	9.995E-1(1.53E-4)	9.800E-1(1.12E-3)	9.979E-1(7.28E-4)
	15	9.776E-1(3.37E-3)	4.941E-1(1.94E-1)	9.767E-1(4.63E-3)	9.967E-1(1.81E-3)	9.826E-1(2.51E-3)	9.400E-1(1.29E-2)	9.990E-1(2.15E-4)	9.494E-1(1.34E-2)	**9.990E-1(2.44E-4)**
WFG43	3	3.437E-1(6.89E-4)	3.128E-1(1.01E-2)	3.276E-1(3.22E-3)	**3.526E-1(3.28E-4)**	2.912E-1(7.80E-3)	3.390E-1(3.17E-3)	3.316E-1(1.52E-2)	8.989E-2(6.38E-5)	3.305E-1(2.80E-3)
	5	4.501E-1(1.28E-2)	2.903E-1(2.02E-2)	5.013E-1(4.74E-3)	5.055E-1(1.43E-2)	2.862E-1(7.17E-3)	4.895E-1(2.68E-3)	**5.072E-1(2.76E-2)**	9.078E-2(4.74E-5)	4.491E-1(7.57E-3)
	8	4.107E-1(1.26E-2)	9.288E-2(4.12E-3)	5.979E-1(1.11E-2)	**6.445E-1(1.39E-2)**	2.630E-1(6.50E-3)	5.732E-1(1.76E-2)	5.400E-1(9.73E-3)	8.955E-2(2.80E-4)	5.261E-1(1.40E-2)
	10	3.730E-1(3.15E-2)	9.064E-2(4.77E-4)	6.268E-1(3.60E-2)	7.086E-1(2.12E-2)	2.529E-1(2.04E-2)	**7.023E-1(1.90E-2)**	5.499E-1(7.13E-2)	8.991E-2(6.73E-4)	5.475E-1(3.13E-2)
	15	2.260E-1(1.94E-2)	9.091E-2(2.13E-7)	6.650E-1(7.92E-2)	**6.818E-1(4.07E-2)**	2.454E-1(8.53E-3)	3.784E-1(3.99E-2)	5.492E-1(4.56E-2)	9.003E-2(5.89E-4)	4.120E-1(1.94E-2)
WFG44	3	9.941E-1(6.23E-4)	9.701E-1(1.93E-3)	9.881E-1(2.56E-4)	9.953E-1(2.28E-4)	9.835E-1(2.72E-3)	9.869E-1(1.08E-3)	9.949E-1(2.06E-4)	9.569E-1(7.46E-3)	**9.956E-1(6.19E-4)**
	5	9.958E-1(6.48E-4)	9.929E-1(2.82E-3)	9.907E-1(3.18E-3)	9.966E-1 (2.44E-5)	9.858E-1(1.74E-3)	9.910E-1(7.02E-4)	9.990E-1(8.66E-5)	9.822E-1(3.85E-3)	**9.990E-1(6.55E-4)**
	8	9.950E-1(1.38E-3)	9.782E-1(6.47E-3)	9.878E-1(4.74E-4)	9.984E-1(2.84E-4)	9.838E-1(2.11E-3)	9.939E-1(1.46E-3)	9.996E-1(6.18E-5)	9.918E-1(3.16E-3)	**9.997E-1(5.60E-4)**
	10	9.956E-1(1.09E-3)	8.656E-1(6.14E-2)	9.908E-1(1.28E-3)	9.998E-1 (3.78E-5)	9.913E-1(4.41E-4)	9.962E-1(9.92E-4)	**9.999E-1(9.14E-5)**	9.898E-1(4.87E-3)	**9.999E-1(2.52E-4)**
	15	9.962E-1(1.46E-3)	7.882E-1(4.19E-2)	9.928E-1(1.13E-3)	9.988E-1(8.62E-4)	9.964E-1(9.28E-4)	9.880E-1(3.42E-3)	**9.999E+0(1.78E-6)**	9.944E-1(1.31E-3)	**9.999E-1(1.18E-4)**
WFG45	3	6.287E-1(7.73E-3)	5.909E-1(9.88E-3)	6.474E-1(2.28E-3)	**6.585E-1(2.14E-3)**	6.367E-1(8.78E-3)	6.526E-1(1.49E-3)	6.516E-1(1.76E-3)	9.146E-2(1.28E-3)	6.454E-1(3.47E-3)
	5	7.332E-1(8.34E-3)	4.466E-1(4.06E-2)	8.171E-1(6.58E-4)	8.274E-1(1.94E-2)	7.203E-1(2.17E-2)	**8.284E-1(5.00E-3)**	8.270E-1(2.10E-3)	1.284E-1(4.33E-2)	8.181E-1(3.81E-3)
	8	7.324E-1(3.29E-3)	2.409E-1(1.19E-1)	7.473E-1(9.30E-2)	8.944E-1(1.28E-2)	6.443E-1(2.83E-2)	**9.098E-1(3.26E-3)**	8.836E-1(3.82E-2)	1.070E-1(3.23E-2)	8.978E-1(5.17E-3)
	10	7.165E-1(3.04E-2)	1.706E-1(9.30E-2)	8.711E-1(1.76E-2)	9.359E-1(7.73E-3)	6.712E-1(1.41E-2)	**9.482E-1(6.72E-3)**	8.823E-1(7.62E-2)	1.255E-1(4.02E-2)	9.307E-1(5.11E-3)
	15	6.810E-1(1.71E-2)	1.063E-1(3.08E-2)	7.143E-1(4.84E-2)	8.667E-1(2.16E-2)	5.930E-1(2.13E-2)	9.573E-1(8.25E-3)	9.106E-1(7.41E-2)	8.785E-2(2.59E-3)	**9.574E-1(8.02E-3)**
WFG46	3	8.089E-1(6.43E-3)	7.769E-1(2.30E-3)	8.226E-1(1.49E-3)	8.349E-1(2.78E-3)	8.002E-1(1.13E-2)	8.363E-1(1.51E-3)	**8.393E-1(5.48E-4)**	4.222E-1(8.12E-2)	8.327E-1(2.50E-3)
	5	8.934E-1(8.23E-3)	7.835E-1(4.41E-2)	9.453E-1(5.16E-3)	9.586E-1(2.18E-3)	8.863E-1(9.51E-3)	9.626E-1(1.85E-3)	9.647E-1(1.40E-3)	5.580E-1(9.89E-2)	**9.648E-1(2.60E-3)**
	8	8.907E-1(8.25E-3)	3.456E-1(1.05E-1)	9.054E-1(1.54E-2)	9.764E-1(4.28E-3)	8.108E-1(8.30E-3)	9.843E-1(3.73E-4)	9.833E-1(7.60E-4)	1.168E-1(2.94E-2)	**9.852E-1(1.90E-3)**
	10	8.888E-1(8.55E-3)	2.027E-1(7.48E-2)	9.288E-1(3.85E-3)	9.906E-1(7.38E-4)	8.504E-1(2.73E-2)	9.902E-1(1.56E-4)	9.907E-1(1.42E-3)	3.092E-1(1.68E-1)	**9.907E-1(1.35E-3)**
	15	8.906E-1(1.23E-2)	2.557E-1(2.23E-1)	8.727E-1(3.53E-2)	9.448E-1(9.21E-3)	8.053E-1(1.62E-2)	**9.984E-1(1.39E-4)**	9.941E-1(2.27E-3)	2.029E-1(1.64E-1)	9.688E-1(1.49E-2)
WFG47	3	6.660E-1(1.34E-3)	6.275E-1(4.93E-3)	6.575E-1(3.07E-3)	6.444E-1(7.57E-2)	5.735E-1(5.03E-2)	**6.710E-1(2.46E-3)**	5.955E-1(7.59E-2)	4.323E-1(5.31E-2)	6.584E-1(2.58E-2)
	5	7.620E-1(7.00E-3)	5.342E-1(4.27E-2)	8.147E-1(7.51E-3)	**8.291E-1(1.33E-2)**	6.678E-1(3.34E-2)	6.780E-1(1.51E-1)	6.197E-1(1.53E-1)	4.271E-1(7.30E-2)	8.193E-1(7.03E-2)
	8	6.855E-1(1.17E-2)	3.441E-1(1.51E-1)	8.142E-1(4.27E-2)	7.975E-1(1.64E-1)	6.166E-1(3.27E-2)	8.764E-1(8.05E-3)	8.290E-1(1.70E-1)	4.364E-1(5.40E-2)	**8.949E-1(5.38E-3)**
	10	6.874E-1(2.06E-2)	1.157E-1(1.42E-2)	8.658E-1(2.04E-2)	9.284E-1(1.02E-2)	6.353E-1(2.20E-2)	8.936E-1(1.51E-2)	8.152E-1(1.83E-1)	3.983E-1(8.54E-2)	**9.297E-1(4.95E-3)**
	15	6.214E-1(2.70E-2)	1.822E-1(1.82E-1)	8.032E-1(5.51E-2)	8.608E-1(1.37E-2)	5.879E-1(4.28E-2)	8.371E-1(2.62E-2)	6.236E-1(1.38E-1)	1.421E-1(8.96E-3)	**9.561E-1(8.49E-3)**
WFG48	3	9.250E-1(2.36E-3)	8.875E-1(2.52E-3)	9.154E-1(1.12E-3)	8.377E-1(1.89E-1)	8.852E-1(1.30E-2)	9.176E-1(4.03E-3)	8.734E-1(7.33E-2)	4.767E-1(7.56E-2)	**9.228E-1(2.58E-3)**
	5	9.685E-1(2.38E-3)	9.322E-1(1.70E-2)	9.728E-1(4.34E-3)	9.880E-1(2.54E-4)	9.669E-1(1.16E-3)	9.791E-1(8.23E-4)	9.869E-1(1.35E-2)	6.920E-1(1.87E-1)	**9.893E-1(1.20E-3)**
	8	9.648E-1(4.34E-3)	5.487E-1(3.23E-3)	9.661E-1(3.21E-3)	9.940E-1(1.89E-3)	9.448E-1(9.37E-3)	9.797E-1(4.35E-3)	9.883E-1(1.40E-3)	6.281E-1(1.86E-1)	**9.941E-1(1.12E-3)**
	10	9.686E-1(4.54E-3)	5.465E-1(2.92E-3)	9.752E-1(5.73E-3)	9.992E-1(8.42E-5)	9.644E-1(1.06E-2)	9.847E-1(5.81E-3)	9.996E-1(2.07E-4)	6.589E-1(2.15E-1)	**9.996E-1(9.56E-4)**
	15	9.701E-1(4.38E-3)	3.394E-1(1.47E-1)	9.735E-1(4.03E-3)	9.973E-1(4.75E-4)	9.605E-1(5.72E-3)	9.404E-1(2.03E-2)	9.980E-1(1.38E-3)	7.514E-1(2.29E-1)	**9.988E-1(2.75E-4)**
Best/All		0/85	0/85	3/85	12/85	0/85	14/85	15/85	0/85	41/85

TABLE A. X
PERFORMANCE OF MOEA-SET2 ON 3- TO 15-OBJECTIVE MAF PROBLEMS WITH HV

Problems	m	SPEA2	MOEA/D-PaS	RVEA	BCE-MOEA/D	hpaEA	KnEA	GFM-MOEA	MaOEA-IGD	FDEA
MaF1	3	2.222E-1(8.14E-4)	1.919E-1(1.19E-3)	1.964E-1(2.54E-4)	2.246E-1(4.34E-4)	2.246E-1(3.90E-4)	2.203E-1(1.01E-3)	2.250E-1(1.88E-4)	1.448E-1(5.30E-4)	**2.251E-1(5.74E-4)**
	5	1.061E-2(3.81E-4)	5.441E-3(1.85E-5)	3.925E-3(5.68E-4)	1.172E-2(1.42E-4)	1.254E-2(3.10E-5)	1.256E-2(2.20E-4)	1.288E-2(7.63E-5)	3.795E-3(7.41E-5)	**1.312E-2(7.97E-5)**
	8	1.186E-5(8.07E-7)	2.983E-5(1.34E-6)	7.856E-7(6.39E-7)	3.721E-5(4.11E-7)	3.530E-5(3.12E-7)	3.313E-5(1.05E-6)	3.292E-5(5.46E-7)	9.537E-6(4.24E-7)	**4.325E-5(1.20E-6)**
	10	0.00E+0(0.00E+0)	5.162E-7(2.48E-8)	5.572E-9(2.02E-9)	3.028E-7(1.67E-7)	2.050E-7(4.10E-7)	4.532E-7(4.79E-8)	4.710E-8(9.42E-8)	1.275E-7(1.18E-8)	**6.035E-7(1.88E-8)**
	15	0.00E+0(0.00E+0)	**4.86E-12(4.7E-13)**	2.81E-14(1.8E-14)	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	3.07E-13(6.1E-13)	1.12E-12(4.3E-13)	0.00E+0(0.00E+0)
MaF2	3	2.438E-1(1.09E-3)	2.390E-1(9.82E-4)	2.361E-1(9.96E-4)	2.480E-1(5.31E-4)	2.467E-1(8.12E-4)	2.490E-1(1.97E-4)	2.466E-1(7.06E-4)	1.384E-1(6.25E-2)	**2.499E-1(4.23E-4)**
	5	2.223E-1(2.69E-3)	1.643E-1(2.78E-3)	2.324E-1(1.62E-3)	2.538E-1(2.22E-3)	2.485E-1(1.30E-3)	2.599E-1(1.87E-3)	2.472E-1(3.10E-3)	1.423E-1(6.59E-2)	**2.604E-1(1.66E-3)**
	8	1.767E-1(3.91E-3)	1.031E-1(2.17E-2)	1.628E-1(9.72E-3)	2.134E-1(2.06E-3)	2.133E-1(3.01E-3)	2.224E-1(3.20E-3)	2.202E-1(1.93E-3)	1.859E-1(7.90E-3)	**2.297E-1(3.15E-3)**
	10	1.730E-1(3.52E-3)	4.961E-2(6.69E-3)	1.680E-1(5.14E-3)	1.977E-1(3.62E-3)	2.244E-1(1.70E-3)	1.898E-1(8.50E-3)	2.098E-1(2.01E-3)	1.773E-1(7.60E-4)	**2.252E-1(4.17E-3)**
	15	1.242E-1(5.05E-3)	4.271E-2(1.58E-5)	4.925E-2(2.18E-2)	1.144E-1(6.11E-3)	1.817E-1(2.33E-3)	9.940E-2(2.79E-3)	1.814E-1(3.74E-3)	1.347E-1(7.40E-3)	**1.827E-1(4.91E-3)**
MaF3	3	9.611E-1(1.48E-3)	2.386E-1(4.77E-1)	6.952E-1(4.65E-1)	9.540E-1(8.62E-3)	9.605E-1(8.44E-4)	9.279E-1(1.53E-2)	9.616E-1(1.70E-3)	0.00E+0(0.00E+0)	**9.616E-1(1.03E-2)**
	5	9.983E-1(6.64E-4)	3.463E-1(4.67E-1)	9.952E-1(7.75E-3)	9.929E-1(3.72E-3)	9.994E-1(6.80E-5)	9.515E-1(1.41E-2)	9.987E-1(1.49E-3)	6.909E-2(1.38E-1)	**9.995E-1(2.74E-4)**
	8	0.00E+0(0.00E+0)	4.955E-1(5.21E-1)	9.993E-1(5.10E-4)	8.386E-1(1.72E-2)	6.353E-2(1.27E-1)	0.00E+0(0.00E+0)	6.594E-1(3.45E-1)	4.177E-1(3.41E-1)	**1.000E+0(2.10E-6)**
	10	0.00E+0(0.00E+0)	2.557E-1(4.53E-1)	9.985E-1(1.12E-3)	3.714E-1(2.17E-1)	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	7.545E-1(3.19E-1)	6.060E-1(3.15E-1)	**1.000E+0(4.56E-5)**
	15	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	9.785E-1(1.33E-3)	6.854E-1(4.57E-1)	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	6.304E-1(3.31E-1)	5.582E-1(4.10E-1)	**9.800E-1(2.04E-2)**
MaF4	3	5.281E-1(4.91E-3)	5.101E-1(1.67E-2)	5.167E-1(3.47E-3)	5.176E-1(5.68E-3)	5.306E-1(3.55E-3)	5.054E-1(1.74E-2)	5.351E-1(2.32E-3)	5.245E-3(1.05E-2)	**5.367E-1(4.08E-3)**
	5	7.069E-2(7.29E-3)	5.532E-2(2.73E-3)	2.737E-2(6.31E-3)	3.163E-2(1.84E-2)	1.140E-1(2.25E-3)	1.214E-1(2.99E-3)	7.466E-3(1.29E-3)	6.136E-3(4.53E-3)	**1.328E-1(1.56E-3)**
	8	3.089E-4(5.39E-5)	3.432E-3(3.26E-5)	6.749E-6(2.89E-6)	4.291E-4(2.90E-4)	1.487E-3(8.76E-5)	3.080E-3(3.95E-4)	3.462E-6(1.02E-6)	5.511E-6(7.48E-6)	**5.484E-3(1.80E-4)**
	10	6.279E-6(4.03E-6)	2.975E-4(6.87E-6)	8.510E-8(1.28E-8)	4.398E-6(4.51E-6)	1.171E-4(9.15E-6)	1.129E-4(4.53E-5)	3.021E-8(9.72E-9)	9.920E-8(6.93E-8)	**4.233E-4(1.97E-5)**
	15	0.00E+0(0.00E+0)	3.336E-7(3.61E-9)	2.24E-13(1.2E-13)	0.00E+0(0.00E+0)	7.703E-8(1.54E-7)	0.00E+0(0.00E+0)	1.83E-13(2.6E-14)	9.15E-13(7.5E-13)	**2.389E-7(3.14E-8)**
MaF5	3	5.061E-1(1.06E-1)	5.521E-1(4.43E-4)	**5.657E-1(3.11E-4)**	5.621E-1(1.57E-3)	4.528E-1(1.25E-1)	5.502E-1(1.26E-3)	4.560E-1(1.25E-1)	4.317E-1(1.10E-1)	5.611E-1(9.02E-4)
	5	7.664E-1(4.79E-3)	7.691E-1(1.45E-2)	7.875E-1(4.97E-2)	**8.028E-1(1.11E-3)**	7.529E-1(1.25E-1)	7.973E-1(2.47E-3)	8.017E-1(7.53E-4)	6.371E-1(3.40E-2)	8.000E-1(1.85E-3)
	8	1.768E-1(3.52E-1)	9.022E-1(9.53E-3)	9.184E-1(1.48E-3)	7.199E-1(4.11E-2)	9.215E-1(4.87E-3)	9.163E-1(4.17E-3)	7.245E-1(6.45E-2)	6.843E-1(1.98E-2)	**9.305E-1(1.46E-3)**
	10	0.00E+0(0.00E+0)	9.577E-1(3.04E-3)	9.539E-1(2.77E-3)	8.264E-1(5.31E-2)	**9.682E-1(4.49E-4)**	9.582E-1(2.00E-3)	6.202E-1(8.54E-2)	6.681E-1(4.10E-2)	9.668E-1(7.47E-4)
	15	0.00E+0(0.00E+0)	9.837E-1(5.66E-3)	9.368E-1(7.59E-3)	9.199E-1(1.77E-2)	9.854E-1(1.55E-3)	9.917E-1(3.61E-4)	4.488E-1(9.55E-2)	5.947E-1(7.12E-2)	**9.918E-1(3.27E-4)**
MaF6	3	2.005E-1(3.87E-5)	1.923E-1(1.06E-3)	1.777E-1(5.55E-3)	**2.006E-1(2.74E-5)**	2.004E-1(3.24E-5)	1.849E-1(1.49E-2)	2.005E-1(1.55E-5)	7.319E-2(4.35E-2)	2.002E-1(4.94E-4)
	5	1.300E-1(1.72E-5)	1.086E-1(1.40E-4)	1.154E-1(2.31E-3)	1.301E-1(8.42E-6)	**1.301E-1(1.72E-5)**	1.294E-1(6.02E-5)	1.300E-1(9.94E-6)	7.329E-2(4.88E-2)	1.300E-1(4.82E-4)
	8	7.976E-2(5.32E-2)	8.567E-2(4.98E-3)	9.651E-2(4.18E-4)	1.064E-1(7.27E-6)	**1.065E-1(7.77E-6)**	5.306E-2(6.13E-2)	1.063E-1(4.83E-6)	9.183E-2(3.33E-4)	1.064E-1(1.12E-4)
	10	0.00E+0(0.00E+0)	8.493E-2(9.32E-3)	9.328E-2(1.09E-3)	**1.010E-1(1.24E-5)**	2.526E-2(5.05E-2)	0.00E+0(0.00E+0)	9.405E-2(8.54E-3)	9.148E-2(1.28E-4)	1.303E-3(5.90E-3)
	15	0.00E+0(0.00E+0)	2.267E-2(4.53E-2)	9.205E-2(7.46E-4)	**9.556E-2(3.55E-5)**	0.00E+0(0.00E+0)	0.00E+0(0.00E+0)	6.781E-2(2.95E-2)	4.538E-2(5.24E-2)	2.529E-4(3.03E-4)
MaF7	3	3.103E-1(2.87E-2)	2.486E-1(5.52E-2)	3.136E-1(3.01E-3)	**3.250E-1(8.88E-4)**	3.144E-1(9.18E-3)	3.244E-1(8.53E-4)	3.224E-1(2.63E-3)	2.128E-1(4.14E-3)	3.224E-1(1.05E-2)
	5	3.069E-1(3.31E-3)	2.619E-1(4.19E-2)	2.679E-1(1.20E-3)	**3.050E-1(2.30E-3)**	3.148E-1(7.78E-3)	3.220E-1(3.38E-3)	2.783E-1(6.58E-2)	2.159E-1(2.12E-4)	**3.184E-1(2.17E-3)**
	8	1.092E-1(1.50E-2)	1.713E-1(1.43E-2)	2.128E-1(8.80E-3)	2.450E-1(1.68E-3)	2.575E-1(1.93E-3)	2.087E-1(1.44E-2)	2.385E-1(7.11E-4)	7.786E-2(1.53E-2)	**2.451E-1(5.50E-3)**
	10	1.861E-3(7.88E-4)	1.973E-1(1.29E-2)	1.497E-1(2.38E-2)	2.329E-1(1.37E-3)	2.301E-1(2.21E-3)	1.842E-1(1.14E-2)	2.142E-1(4.02E-3)	7.857E-2(1.29E-2)	**2.369E-1(5.50E-3)**
	15	4.121E-5(4.14E-5)	0.00E+0(0.00E+0)	5.317E-2(6.23E-2)	4.104E-2(2.77E-2)	1.547E-1(4.48E-2)	1.160E-2(7.22E-3)	1.395E-1(5.27E-2)	4.365E-3(2.48E-3)	**1.591E-1(3.95E-3)**
MaF8	3	2.854E-1(6.05E-4)	0.00E+0(0.00E+0)	2.515E-1(1.63E-3)	2.858E-1(2.78E-4)	2.733E-1(1.95E-2)	1.934E-1(1.69E-2)	**2.859E-1(3.50E-4)**	1.316E-1(1.92E-2)	2.830E-1(1.02E-3)
	5	1.275E-1(2.04E-4)	0.00E+0(0.00E+0)	8.154E-2(6.58E-3)	1.276E-1(3.34E-4)	1.290E-1(2.18E-4)	1.199E-1(3.76E-3)	**1.296E-1(1.48E-4)**	4.879E-2(1.74E-2)	1.288E-1(1.02E-4)
	8	3.057E-2(5.96E-5)	0.00E+0(0.00E+0)	1.393E-2(1.21E-3)	3.060E-2(1.01E-4)	3.154E-2(4.61E-5)	2.983E-2(5.63E-4)	3.147E-2(3.92E-4)	1.070E-2(3.32E-3)	**3.162E-2(4.24E-5)**
	10	6.755E-4(5.31E-6)	0.00E+0(0.00E+0)	1.981E-4(8.09E-5)	6.787E-4(1.28E-5)	7.872E-4(4.53E-6)	6.887E-4(2.67E-5)	**8.217E-4(7.23E-6)**	2.806E-4(2.15E-5)	7.733E-4(8.57E-6)
	15	2.240E-6(2.71E-7)	0.00E+0(0.00E+0)	9.123E-7(3.72E-7)	2.710E-6(3.99E-7)	3.745E-6(1.13E-6)	3.272E-6(1.33E-7)	**5.145E-6(3.96E-7)**	3.926E-7(7.43E-7)	4.569E-6(3.70E-7)
MaF9	3	5.113E-2(5.92E-2)	6.876E-1(2.04E-2)	7.190E-1(3.05E-3)	6.725E-1(1.28E-2)	7.140E-1(1.40E-2)	4.207E-1(6.93E-2)	7.206E-1(4.78E-4)	8.543E-2(1.41E-1)	**7.244E-1(1.75E-3)**
	5	3.171E-1(5.43E-3)	2.456E-1(1.52E-2)	2.390E-1(5.19E-3)	2.492E-1(7.26E-3)	3.235E-1(3.36E-3)	1.392E-1(3.16E-2)	3.282E-1(3.16E-2)	1.372E-1(3.20E-2)	**3.283E-1(3.91E-4)**
	8	4.481E-4(8.96E-4)	4.647E-2(2.43E-4)	2.055E-2(1.83E-3)	7.823E-3(2.41E-8)	1.400E-2(1.96E-2)	2.497E-3(4.19E-3)	4.985E-2(7.19E-4)	1.302E-2(1.00E-2)	**6.883E-2(1.01E-4)**
	10	8.577E-5(9.94E-5)	1.588E-2(1.44E-4)	4.307E-3(1.72E-3)	2.300E-3(1.75E-6)	1.529E-2(1.70E-3)	0.000E+0(0.0E+0)	1.600E-2(2.44E-4)	5.750E-3(1.18E-3)	**1.601E-2(1.03E-4)**
	15	4.972E-4(5.70E-5)	1.481E-5(6.86E-7)	1.700E-4(9.17E-5)	1.478E-4(4.98E-5)	1.281E-3(4.80E-6)	1.021E-3(1.44E-4)	5.443E-3(1.65E-5)	9.320E-5(1.18E-4)	**7.557E-3(5.66E-6)**
MaF10	3	7.271E-1(1.88E-2)	3.679E-1(2.17E-2)	5.894E-1(3.33E-2)	8.816E-1(1.18E-2)	5.056E-1(9.15E-2)	8.211E-1(1.66E-2)	**9.271E-1(2.83E-2)**	5.881E-2(5.33E-2)	6.371E-1(3.92E-2)
	5	4.954E-1(1.10E-2)	9.218E-1(4.63E-2)	6.103E-1(3.59E-2)	**9.986E-1(2.29E-4)**	5.416E-1(1.12E-1)	7.871E-1(2.67E-2)	9.965E-1(1.19E-3)	1.963E-1(1.12E-1)	7.174E-1(1.66E-2)
	8	3.816E-1(2.69E-2)	3.512E-1(3.25E-2)	5.551E-1(4.46E-2)	9.796E-1(3.96E-2)	5.013E-1(5.19E-2)	8.534E-1(5.37E-2)	**9.994E-1(6.02E-4)**	4.219E-1(2.89E-1)	8.219E-1(9.71E-3)
	10	3.619E-1(2.55E-2)	9.418E-1(4.12E-2)	6.766E-1(1.07E-1)	**1.0E+0(2.82E-06)**	5.683E-1(2.13E-2)	9.562E-1(3.24E-2)	9.950E-1(9.24E-3)	3.959E-1(1.96E-1)	8.515E-1(7.84E-3)
	15	5.149E-1(3.43E-2)	5.743E-1(3.29E-1)	8.922E-1(1.09E-1)	9.993E-1(2.72E-4)	5.604E-1(9.53E-2)	9.969E-1(1.06E-3)	**1.00E+0(3.09E-5)**	7.864E-1(1.14E-1)	8.681E-1(6.75E-3)
MaF11	3	8.560E-1(7.92E-2)	9.003E-1(9.04E-3)	8.434E-1(7.64E-2)	9.006E-1(2.99E-3)	9.003E-1(6.64E-3)	8.559E-1(8.10E-2)	8.995E-1(7.23E-2)	6.187E-1(1.04E-2)	**9.021E-1(6.26E-2)**
	5	9.413E-1(8.53E-2)	9.444E-1(2.86E-3)	9.706E-1(8.56E-3)	9.827E-1(1.27E-3)	9.720E-1(2.30E-3)	9.386E-1(8.62E-2)	9.511E-1(8.96E-2)	8.086E-1(5.70E-2)	**9.843E-1(3.24E-2)**
	8	9.762E-1(5.71E-3)	9.637E-2(4.31E-3)	9.118E-1(8.38E-2)	9.809E-1(1.15E-2)	9.551E-1(6.28E-3)	9.846E-1(1.73E-3)	9.873E-1(1.91E-3)	8.074E-1(9.56E-2)	**9.931E-1(6.17E-2)**
	10	9.776E-1(1.63E-3)	2.988E-1(2.37E-1)	9.534E-1(1.42E-2)	9.852E-1(1.37E-3)	9.727E-1(2.95E-3)	9.855E-1(2.13E-3)	9.853E-1(3.71E-3)	8.042E-1(2.38E-2)	**9.948E-1(7.91E-4)**
	15	9.768E-1(1.15E-2)	1.722E-1(1.63E-1)	8.915E-1(7.57E-2)	9.852E-1(4.69E-3)	8.720E-1(9.68E-2)	9.887E-1(1.83E-3)	9.470E-1(8.64E-2)	8.344E-1(8.98E-2)	**9.951E-1(4.55E-2)**
MaF12	3	4.738E-1(2.43E-2)	4.477E-1(3.23E-3)	4.842E-1(1.79E-2)	4.891E-1(3.00E-2)	4.940E-1(2.74E-2)	4.927E-1(2.93E-2)	**5.093E-1(1.68E-3)**	7.292E-2(9.20E-3)	5.067E-1(1.91E-2)
	5	6.175E-1(8.47E-3)	3.300E-1(9.01E-3)	6.997E-1(1.14E-2)	6.115E-1(6.31E-3)	6.581E-1(3.49E-3)	**7.105E-1(2.97E-2)**	7.051E-1(5.44E-3)	2.335E-1(2.51E-1)	7.033E-1(2.46E-2)
	8	6.536E-1(9.03E-3)	3.730E-1(3.32E-1)	7.403E-1(1.83E-2)	7.166E-1(1.62E-2)	5.793E-1(2.18E-2)	8.076E-1(7.14E-3)	7.745E-1(1.67E-2)	5.812E-1(4.54E-2)	**8.080E-1(2.46E-2)**
	10	6.392E-1(3.66E-2)	7.429E-2(3.23E-4)	7.973E-1(2.10E-2)	7.552E-1(2.65E-2)	6.930E-1(5.08E-2)	8.089E-1(9.50E-3)	8.046E-1(1.20E-2)	6.192E-1(4.17E-2)	**8.100E-1(3.06E-2)**
	15	5.904E-1(3.31E-2)	7.355E-2(1.26E-9)	7.117E-1(3.46E-2)	6.510E-1(8.47E-2)	5.407E-1(1.49E-2)	8.192E-1(5.91E-3)	6.155E-1(5.53E-3)	5.415E-1(2.65E-2)	**8.209E-1(2.80E-2)**
MaF13	3	5.114E-1(1.79E-2)	5.076E-1(2.68E-2)	4.770E-1(2.07E-2)	5.040E-1(1.02E-2)	2.246E-1(3.90E-4)	4.552E-1(1.27E-2)	4.713E-1(4.07E-2)	2.741E-1(1.21E-1)	**5.253E-1(5.17E-3)**
	5	2.662E-1(3.88E-3)	2.292E-1(3.27E-4)	2.031E-1(1.07E-2)	**2.705E-1(4.20E-3)**	1.254E-2(3.10E-5)	2.468E-1(3.12E-3)	2.701E-1(7.89E-3)	1.369E-1(9.26E-3)	2.625E-1(4.56E-3)
	8	1.178E-1(5.11E-2)	9.522E-2(0.0E+0)	9.164E-2(1.56E-2)	1.588E-1(4.05E-3)	3.530E-5(3.12E-7)	1.414E-1(1.16E-2)	**1.657E-1(2.67E-3)**	8.437E-2(2.38E-2)	1.571E-1(5.10E-3)
	10	1.044E-1(2.53E-2)	8.471E-2(0.0E+0)	7.710E-2(1.85E-2)	1.213E-1(2.00E-3)	2.050E-7(4.10E-7)	1.193E-1(1.02E-2)	**1.262E-1(4.44E-3)**	6.055E-2(1.66E-2)	1.236E-1(5.76E-3)
	15	7.151E-2(1.09E-2)	6.323E-2(0.0E+0)	6.479E-2(7.81E-3)	**7.845E-2(5.29E-3)**	0.00E+0(0.00E+0)	7.817E-2(7.95E-3)	8.447E-2(4.09E-3)	4.376E-2(1.33E-2)	7.516E-2(8.11E-3)
Best/All		0/65	1/65	1/65	10/65	3/65	1/65	10/65	0/65	39/65

TABLE A. XI
PERFORMANCE OF MOEA-SET2 ON 3- TO 15-OBJECTIVE WFG AND MAF PROBLEMS WITH IGD

Problems	m	SPEA2	MOEA/D-PaS	RVEA	BCE-MOEA/D	hpaEA	KnEA	GFM-MOEA	MaOEA-IGD	FDEA
MaF1	3	3.795E-2(6.32E-4)	8.266E-2(1.49E-3)	7.039E-2(1.30E-4)	3.777E-2(3.96E-4)	3.760E-2(3.93E-4)	4.026E-2(7.07E-4)	**3.394E-2(2.21E-5)**	2.852E+2(3.23E+0)	3.734E-2(3.04E-4)
	5	1.145E-1(1.93E-3)	2.258E-1(1.21E-3)	2.560E-1(1.78E-2)	1.130E-1(1.12E-3)	1.096E-1(4.20E-4)	1.054E-1(1.29E-3)	1.941E-3(1.20E-5)	7.198E+3(1.76E+0)	1.027E-1(6.40E-4)
	8	2.275E-1(1.12E-3)	2.535E-1(7.99E-3)	5.457E-1(3.09E-2)	2.048E-1(2.06E-3)	1.937E-1(1.13E-3)	1.871E-1(1.57E-3)	1.795E-3(1.30E-5)	6.039E-1(1.98E-1)	1.788E-1(6.02E-4)
	10	2.797E-1(3.67E-3)	2.733E-1(4.45E-3)	6.480E-1(5.12E-2)	2.343E-1(4.29E-3)	2.185E-1(1.49E-3)	2.244E-1(3.52E-3)	**1.034E-1(1.18E-1)**	5.576E-1(2.00E-1)	2.123E-1(2.13E-3)
	15	3.994E-1(5.63E-3)	3.870E-1(2.75E-3)	6.902E-1(4.58E-2)	4.201E-1(4.28E-3)	3.175E-1(3.55E-3)	2.991E-1(1.39E-3)	**2.240E-1(6.89E-2)**	6.886E-1(3.91E-4)	2.857E-1(2.83E-3)
MaF2	3	2.942E-2(6.46E-4)	4.655E-2(2.68E-3)	3.697E-2(5.43E-4)	2.660E-2(4.19E-4)	2.765E-2(4.93E-4)	2.981E-2(5.19E-4)	8.242E-2(1.32E-2)	4.143E-1(1.90E-1)	**2.456E-2(6.48E-4)**
	5	1.065E-1(1.76E-3)	2.298E-1(7.58E-3)	1.208E-1(4.89E-4)	**9.498E-2(2.59E-4)**	9.802E-2(1.53E-3)	1.072E-1(2.57E-3)	4.916E-1(3.57E-1)	7.353E-1(1.37E-2)	9.906E-2(1.94E-3)
	8	1.542E-1(1.77E-3)	7.320E-1(4.35E-2)	1.873E-1(1.79E-2)	1.858E-1(6.42E-3)	2.561E-1(5.65E-3)	1.335E-1(9.02E-4)	5.733E-1(1.15E-3)	5.820E-1(1.21E-2)	**1.524E-1(1.58E-3)**
	10	1.682E-1(1.53E-3)	8.530E-1(1.35E-2)	2.401E-1(4.37E-3)	1.746E-1(4.66E-3)	3.249E-1(3.74E-3)	1.490E-1(6.11E-4)	7.965E-1(6.97E-3)	6.720E-1(6.98E-4)	**1.458E-1(1.39E-2)**
	15	2.140E-1(7.81E-3)	8.976E-1(1.85E-5)	7.857E-1(5.27E-2)	1.957E-1(1.77E-3)	4.193E-1(1.83E-2)	**1.946E-1(1.03E-3)**	2.218E+0(1.33E+0)	1.202E+0(2.39E-2)	2.292E-1(1.18E-2)
MaF3	3	5.146E-2(1.21E-3)	4.747E+0(3.65E+0)	3.953E-1(6.51E-1)	5.108E-2(2.12E-2)	3.595E-2(9.62E-4)	8.814E-2(1.59E-2)	5.557E-2(1.35E-3)	1.408E+0(3.87E-2)	**3.350E-2(3.51E-3)**
	5	9.057E-2(9.82E-3)	3.599E+2(7.06E+2)	9.322E-2(5.07E-2)	1.005E-1(1.27E-2)	6.202E-2(1.54E-3)	1.727E-1(2.33E-2)	8.463E-2(2.06E-3)	2.235E+0(9.89E-2)	**5.333E-2(1.30E-3)**
	8	1.56E+12(3.2E+11)	4.910E+1(9.72E+1)	**9.603E-2(8.64E-3)**	2.257E-1(3.04E-3)	1.103E+1(1.72E+1)	1.925E+6(2.56E+6)	1.525E-1(3.59E-2)	4.942E-1(6.21E-2)	1.557E-1(6.28E-2)
	10	2.17E+12(2.9E+11)	1.009E+1(1.32E+1)	**7.616E-2(1.96E-3)**	6.706E-1(2.61E-1)	3.988E+2(2.14E+2)	3.240E+8(6.40E+8)	1.959E-1(4.48E-2)	8.227E-1(1.60E-1)	1.792E-1(2.42E-2)
	15	3.33E+12(6.8E+11)	3.539E+8(7.08E+8)	3.075E-1(9.18E-3)	2.954E+7(5.91E+7)	2.506E+2(1.45E+2)	3.556E+9(7.11E+9)	3.568E-1(1.29E-1)	1.088E+0(1.59E-1)	**2.076E-1(1.92E-2)**
MaF4	3	3.295E-1(3.30E-3)	3.516E-1(1.82E-2)	3.410E-1(8.99E-3)	3.242E-1(3.51E-2)	2.947E-1(8.92E-3)	5.386E-1(5.95E-2)	**5.387E-2(3.12E-4)**	1.205E+0(2.27E-2)	2.720E-1(2.37E-2)
	5	1.748E+0(4.67E-2)	3.872E+0(1.24E-1)	3.645E+0(3.38E-1)	3.457E+0(5.67E-1)	1.967E+0(5.52E-2)	2.109E+0(8.98E-3)	**7.027E-2(5.13E-4)**	1.852E+0(1.56E-1)	2.085E+0(3.17E-2)
	8	1.559E+1(9.87E-2)	2.586E+1(2.86E-1)	4.667E+1(1.73E+1)	1.768E+1(2.52E+0)	1.621E+1(2.38E-1)	1.926E+1(2.23E+0)	**9.666E-2(1.21E-2)**	1.403E+0(1.07E+0)	1.714E+1(2.17E+0)
	10	6.391E+1(1.68E+0)	1.035E+2(5.22E+0)	1.905E+2(3.18E+1)	8.214E+1(1.38E+1)	5.421E+1(1.92E+0)	7.509E+1(1.63E+1)	**1.108E-1(7.62E-3)**	7.018E-1(2.36E-1)	6.120E+1(4.55E+0)
	15	1.917E+3(1.98E+2)	3.569E+3(2.72E+2)	8.264E+3(6.96E+2)	6.748E+3(1.25E+3)	1.258E+3(7.56E+1)	1.759E+3(7.12E+1)	5.947E+0(6.72E+0)	1.568E+0(1.50E+0)	1.876E+3(2.88E+2)
MaF5	3	5.403E-1(6.34E-1)	2.915E-1(7.51E-3)	2.229E-1(5.71E-5)	2.246E-1(4.23E-3)	8.713E-1(7.20E-1)	2.759E-1(6.82E-3)	**1.404E-1(2.88E-2)**	9.951E-1(1.51E-1)	2.300E-1(3.07E-3)
	5	1.749E+0(1.62E-2)	2.540E+0(3.35E-1)	2.412E+0(7.28E-1)	1.774E+0(9.00E-3)	2.944E+0(2.16E+0)	2.033E+0(4.22E-2)	**3.831E-1(7.64E-3)**	4.328E+0(5.15E+0)	1.792E+0(4.13E-2)
	8	3.416E+1(1.35E+1)	2.110E+1(1.30E+0)	1.918E+1(1.13E-1)	2.877E+1(2.89E+0)	1.500E+1(5.01E-1)	2.013E+1(1.35E+0)	**1.082E+0(5.07E-1)**	2.704E+0(2.74E-2)	1.385E+1(5.01E-1)
	10	1.867E+2(1.55E+1)	8.282E+1(3.75E+0)	1.161E+2(3.32E+0)	1.079E+2(1.65E+1)	5.859E+1(3.14E+0)	8.376E+1(5.02E+0)	**1.654E+0(1.04E+0)**	3.830E+0(6.70E-1)	5.015E+1(6.33E-1)
	15	6.109E+3(7.35E+2)	3.378E+3(3.33E+2)	3.736E+3(8.48E+2)	2.499E+3(3.19E+1)	1.756E+3(2.78E+2)	1.920E+3(2.44E+2)	**2.263E+0(7.72E-1)**	5.888E+0(4.21E+0)	1.131E+3(1.33E+2)
MaF6	3	3.396E-3(2.06E-5)	1.989E-2(1.79E-3)	**3.247E-2(5.90E-3)**	3.493E-3(3.60E-5)	3.826E-3(8.36E-5)	2.103E-2(1.98E-2)	1.903E-1(7.37E-2)	7.109E+0(2.00E+0)	**3.247E-3(3.32E-4)**
	5	**1.946E-3(1.89E-5)**	8.797E-2(4.81E-3)	8.882E-2(2.02E-2)	2.080E-3(1.06E-5)	2.591E-3(4.65E-5)	3.108E-3(2.50E-4)	3.579E-1(1.40E-1)	5.346E+0(3.68E-1)	2.664E-3(1.25E-4)
	8	2.586E-1(5.14E-1)	7.444E-1(2.20E-3)	9.095E-2(1.23E-2)	**1.937E-3(3.20E-5)**	3.129E-3(8.23E-5)	2.931E+0(3.79E+0)	9.853E-1(2.39E-1)	1.561E+0(8.63E-1)	3.021E+0(4.72E+0)
	10	6.879E+1(1.02E+2)	7.448E-1(4.29E-3)	1.211E-1(1.77E-2)	**1.740E-3(1.99E-5)**	3.447E-1(2.40E-1)	1.199E+1(6.32E+0)	3.435E+0(8.16E-1)	3.936E+0(7.83E-1)	2.673E+0(2.95E+0)
	15	2.288E+2(3.16E+0)	1.879E+2(1.25E+2)	3.248E-1(2.69E-1)	**2.134E-3(3.69E-5)**	1.215E+1(1.13E+1)	2.462E+1(5.83E+0)	1.033E+1(2.18E+0)	6.472E+0(2.26E+0)	1.299E+0(7.12E-1)
MaF7	3	1.264E-1(1.46E-1)	5.202E-1(3.37E-1)	9.165E-2(2.66E-3)	5.199E-2(8.93E-4)	6.954E-2(1.88E-2)	5.884E-2(3.10E-3)	1.850E-1(1.34E-3)	1.382E+1(2.54E+0)	**5.052E-2(1.11E-3)**
	5	2.426E-1(4.01E-3)	8.105E-1(4.97E-1)	4.985E-1(3.22E-3)	2.545E-1(4.27E-3)	2.676E-1(1.74E-2)	2.378E-1(1.48E-2)	8.981E-1(2.42E-3)	2.292E+1(2.90E+0)	**2.156E-1(1.03E-2)**
	8	7.975E-1(3.66E-2)	3.767E+0(4.75E-1)	1.266E+0(4.25E-2)	5.866E-1(9.89E-3)	6.327E-1(8.52E-3)	5.806E-1(1.06E-2)	2.695E+0(2.00E-2)	3.880E+0(1.01E-1)	**5.099E-1(4.28E-2)**
	10	1.527E+0(1.80E-2)	3.302E+0(6.04E-1)	2.608E+0(7.17E-2)	**8.252E-1(2.88E-3)**	8.801E-1(2.12E-2)	8.512E-1(7.50E-3)	4.145E+0(1.89E-1)	5.854E+0(3.13E+0)	1.152E+0(1.69E-1)
	15	2.286E+0(2.99E-2)	3.976E+1(6.41E+0)	4.002E+0(6.09E-1)	2.658E+0(2.64E-1)	5.887E+0(1.81E+0)	2.733E+0(3.50E-1)	1.236E+1(4.95E-2)	3.448E+0(7.08E-2)	**2.167E+0(5.27E-1)**
MaF8	3	6.950E-2(1.07E-3)	3.323E+1(2.10E+1)	1.198E-1(4.35E-3)	6.986E-2(1.06E-3)	8.665E-2(5.34E-2)	3.149E-1(5.29E-2)	9.192E-2(1.92E-2)	4.657E+0(1.82E-2)	**6.141E-2(1.69E-3)**
	5	8.440E-2(7.04E-4)	3.621E+1(2.18E+1)	3.258E-1(6.32E-2)	8.421E-2(6.80E-4)	8.808E-2(1.37E-3)	1.481E-1(4.14E-2)	9.241E-2(1.34E-2)	8.865E+0(5.54E-1)	**8.165E-2(3.19E-3)**
	8	9.398E-2(8.99E-4)	3.632E+1(3.89E+1)	8.101E-1(7.81E-2)	9.398E-2(5.18E-4)	1.089E-1(5.53E-3)	1.538E-1(7.13E-3)	1.379E-1(4.70E-2)	5.777E-1(1.96E-1)	**1.088E-1(3.13E-3)**
	10	9.939E-2(4.59E-4)	5.935E+1(3.78E+1)	8.885E-1(1.15E-1)	**9.911E-2(8.39E-4)**	1.084E-1(3.86E-3)	1.353E-1(5.23E-3)	1.697E-1(3.73E-2)	7.708E-1(6.91E-2)	1.156E-1(4.97E-3)
	15	1.622E-1(1.32E-4)	2.307E+1(1.56E+1)	1.355E+0(1.39E-1)	1.622E-1(7.87E-4)	1.681E-1(2.52E-3)	1.786E-1(3.09E-3)	1.902E-1(3.62E-2)	1.194E+0(7.49E-2)	**1.551E-1(1.01E-2)**
MaF9	3	1.297E+0(4.84E-1)	8.358E-2(1.83E-2)	5.451E-2(2.06E-3)	8.825E-2(1.18E-2)	6.271E-2(1.44E-2)	4.177E-1(5.40E-2)	8.395E-2(7.59E-3)	1.349E+0(3.07E-2)	**5.569E-2(4.53E-4)**
	5	8.966E-2(9.68E-3)	2.679E-1(4.10E-2)	2.565E-1(1.42E-2)	2.819E-1(2.23E-2)	7.690E-2(4.89E-3)	6.590E-1(1.69E-1)	4.223E-1(1.20E-1)	1.762E+0(7.05E-2)	**1.835E-1(5.59E-2)**
	8	5.857E+0(4.95E+0)	1.793E-1(1.25E-3)	6.333E-1(6.61E-2)	1.266E+0(2.07E-6)	2.179E+0(1.91E+0)	4.469E+0(3.30E+0)	8.204E-1(1.81E-1)	3.114E+0(1.75E-1)	**1.750E-1(3.94E-3)**
	10	4.811E+0(2.98E+0)	2.414E-1(5.06E-3)	1.061E+0(3.64E-1)	1.442E+0(4.59E-4)	1.826E-1(4.21E-2)	1.222E+2(1.34E+2)	1.092E+0(6.70E-1)	5.364E+0(7.60E-2)	**1.551E-1(3.88E-2)**
	15	4.621E-1(1.28E-2)	2.728E+0(1.14E-2)	1.672E+0(3.50E-1)	1.739E+0(1.14E-1)	1.396E-1(4.65E-3)	4.484E-1(1.80E-1)	9.300E+0(9.17E-1)	8.917E+0(1.74E-2)	**3.244E-1(5.15E-2)**
MaF10	3	4.828E-1(3.83E-2)	1.385E+0(5.92E-2)	8.208E-1(6.26E-2)	2.066E-1(1.08E-2)	1.825E+0(1.58E-1)	2.815E-1(2.21E-2)	**1.925E-1(2.24E-3)**	1.115E+1(7.45E-2)	7.225E-1(1.06E-1)
	5	1.403E+0(4.27E-2)	1.787E+0(4.60E-1)	1.029E+0(9.26E-2)	**4.083E-1(6.01E-3)**	1.549E+0(3.48E-1)	6.031E-1(3.61E-2)	9.197E-1(3.59E-3)	1.384E+1(6.31E+0)	1.032E+0(2.06E-2)
	8	2.308E+0(8.97E-2)	2.672E+0(1.59E-1)	1.465E+0(1.15E-1)	8.083E-1(3.29E-2)	1.805E+0(2.31E-1)	**8.740E-1(3.72E-2)**	2.673E+0(1.07E-2)	4.057E+0(2.40E-3)	1.413E+0(1.95E-2)
	10	2.712E+0(1.10E-1)	2.398E+0(1.49E-1)	1.243E+0(2.11E-1)	1.118E+0(1.18E-1)	1.669E+0(7.48E-2)	**9.817E-1(3.08E-2)**	4.275E+0(3.87E-1)	6.453E+0(9.02E-5)	1.526E+0(3.61E-2)
	15	3.259E+0(2.13E-1)	4.756E+0(1.40E+0)	2.118E+0(1.43E-1)	**1.803E+0(6.74E-2)**	2.741E+0(6.04E-1)	1.681E+0(3.22E-2)	1.265E+1(3.55E-1)	1.083E+1(1.98E+0)	2.572E+0(8.30E-2)
MaF11	3	2.261E-1(7.52E-2)	2.632E-1(1.43E-2)	2.692E-1(6.25E-2)	1.764E-1(5.00E-3)	4.339E-1(1.32E-1)	2.529E-1(8.95E-2)	2.021E-1(1.06E-3)	1.563E+1(4.07E+0)	**1.707E-1(5.41E-3)**
	5	7.092E-1(6.19E-2)	1.356E+0(1.60E-1)	1.526E+0(1.30E-1)	6.220E-1(2.95E-2)	1.284E+0(1.14E-1)	6.331E-1(7.26E-2)	9.137E-1(4.95E-3)	2.591E+1(1.87E+0)	**6.093E-1(2.03E-1)**
	8	2.369E+0(7.08E-2)	1.013E+1(5.16E-2)	3.899E+0(1.03E+0)	2.205E+0(1.17E-1)	3.592E+0(5.24E-1)	2.243E+0(7.87E-2)	2.667E+0(1.56E-2)	3.974E+0(5.27E-2)	**2.096E+0(3.48E-1)**
	10	1.555E+0(1.53E-1)	7.810E+0(2.59E+0)	9.403E+0(1.41E+0)	1.741E+0(2.76E-1)	6.620E+0(7.97E-1)	2.459E+0(7.60E-2)	4.054E+0(3.24E-2)	6.392E+0(1.32E+0)	**3.544E+0(1.93E-1)**
	15	**2.898E+0(1.63E-1)**	1.897E+1(1.83E+0)	1.424E+1(3.43E+0)	3.252E+0(2.37E+0)	1.401E+1(6.66E-1)	9.937E+0(1.30E+0)	1.122E+1(1.71E+0)	1.167E+1(2.19E+0)	4.223E+0(3.47E+0)
MaF12	3	2.337E-1(2.38E-2)	3.030E-1(4.86E-3)	2.231E-1(1.73E-2)	2.241E-1(2.38E-2)	2.098E-1(2.54E-2)	2.205E-1(2.26E-2)	**2.027E-1(4.75E-3)**	1.750E+1(1.39E+0)	2.080E-1(1.88E-2)
	5	9.639E-1(1.00E-2)	2.437E+0(9.04E-2)	9.339E-1(1.07E-3)	1.066E+0(2.08E-2)	9.333E-1(1.46E-2)	9.508E-1(8.91E-3)	9.270E-1(4.16E-3)	2.943E+1(1.85E+0)	**9.218E-1(9.13E-3)**
	8	2.931E+0(6.45E-2)	8.731E+0(6.42E+0)	2.780E+0(9.96E-3)	2.745E+0(3.55E-2)	3.576E+0(8.89E-2)	2.880E+0(1.26E-2)	2.878E+0(3.62E-1)	3.481E+0(1.05E+0)	**2.704E+0(1.39E-2)**
	10	4.374E+0(2.84E-2)	1.893E+1(2.54E-2)	4.230E+0(9.77E-3)	4.197E+0(4.29E-2)	4.941E+0(4.53E-1)	4.619E+0(4.84E-2)	4.186E+0(2.09E-2)	6.843E+0(1.08E+0)	**4.045E+0(1.91E-2)**
	15	9.343E+0(1.63E-1)	3.062E+1(1.19E-6)	8.384E+0(1.09E-1)	8.875E+0(6.44E-1)	1.395E+1(4.24E-1)	8.927E+0(9.53E-2)	9.287E+0(1.51E+0)	1.362E+1(1.78E+0)	8.092E+0(9.44E-2)
MaF13	3	7.458E-2(5.21E-3)	1.060E-1(3.50E-2)	8.934E-2(1.14E-2)	8.180E-2(1.10E-2)	**6.668E-2(4.96E-3)**	1.444E-1(8.40E-3)	1.911E-1(1.08E-3)	1.710E+1(1.77E+0)	6.777E-2(3.65E-3)
	5	9.446E-2(7.95E-3)	3.355E-1(5.25E-3)	3.286E-1(3.60E-2)	1.010E-1(5.00E-3)	**8.398E-2(7.90E-3)**	1.298E-1(5.94E-3)	9.232E-1(5.93E-3)	2.838E+1(2.81E+0)	1.218E-1(1.60E-2)
	8	4.478E-1(6.23E-1)	1.380E+0(8.6E-11)	5.844E-1(2.29E-1)	1.127E-1(4.47E-3)	**9.498E-2(2.91E-3)**	1.337E-1(1.32E-2)	2.668E+0(2.33E-2)	3.501E+0(1.05E+0)	1.317E-1(2.21E-2)
	10	8.192E-1(8.47E-1)	1.561E+0(8.2E-11)	5.552E-1(1.50E-1)	1.077E-1(5.39E-3)	**9.450E-2(6.57E-3)**	1.319E-1(1.12E-2)	4.132E+0(5.87E-2)	6.887E+0(8.69E-1)	1.187E-1(8.16E-3)
	15	5.606E-1(9.09E-1)	1.938E+0(9.3E-11)	8.488E-1(4.04E-1)	1.422E-1(1.83E-3)	1.915E-1(2.43E-2)	1.341E-1(9.68E-3)	9.538E+0(1.74E+0)	1.306E+1(2.03E+0)	**1.322E-1(9.53E-3)**
WFG3	3	1.160E-1(1.32E-2)	8.541E-2(1.59E-2)	2.061E-1(2.52E-2)	9.303E-2(1.23E-2)	1.509E-1(3.67E-2)	1.191E-1(4.03E-2)	2.522E-1(1.24E-3)	1.828E+1(1.76E+0)	**7.040E-2(4.80E-3)**
	5	6.140E-1(6.63E-2)	7.617E-1(7.30E-2)	5.829E-1(1.00E-1)	5.776E-1(1.37E-1)	4.182E-1(4.91E-2)	5.982E-1(5.85E-2)	9.681E-1(1.73E-2)	2.861E+1(2.51E+0)	**3.181E-1(5.14E-2)**
	8	1.983E+0(1.10E-1)	8.886E+0(7.16E-5)	3.516E+0(6.70E-1)	1.734E+0(1.92E-1)	9.844E-1(5.08E-1)	1.541E+0(3.14E-1)	2.681E+0(5.21E-2)	3.723E+0(7.99E-2)	**8.289E-1(4.71E-2)**
	10	3.235E+0(2.82E-1)	1.119E+1(1.39E-5)	4.426E+0(6.55E-1)	1.692E+0(2.03E-1)	2.113E+0(9.56E-1)	2.689E+0(6.83E-1)	4.197E+0(1.69E-1)	4.697E+0(1.58E-1)	**7.544E-1(5.94E-2)**
	15	5.495E+0(2.17E-1)	1.695E+1(3.78E-5)	9.550E+0(1.62E+0)	3.654E+0(1.62E-1)	2.979E+0(7.43E-1)	4.328E+0(4.12E-1)	1.066E+1(1.24E+0)	1.481E+1(1.30E-3)	**1.127E+0(4.27E-1)**
WFG4	3	2.040E-1(4.77E-3)	3.091E-1(8.27E-3)	2.004E-1(2.63E-3)	1.941E-1(2.74E-3)	3.337E-1(4.26E-2)	2.135E-1(3.37E-3)	**3.394E-3(2.21E-5)**	1.661E+1(2.46E+0)	1.582E-2(7.79E-4)
	5	9.352E-1(6.79E-3)	2.514E+0(1.44E-1)	9.964E-1(2.00E-3)	9.708E-1(1.37E-2)	1.645E+0(1.09E-1)	1.011E+0(7.97E-3)	**1.941E-3(1.20E-5)**	2.878E+1(1.34E+0)	9.479E-1(4.63E-3)
	8	2.767E+0(2.73E-2)	5.968E+0(5.27E+0)	2.717E+0(2.79E-2)	2.709E+0(4.97E-2)	6.023E+0(3.44E-1)	3.129E+0(4.39E-2)	**1.705E-3(1.30E-5)**	2.852E+2(3.23E+0)	2.766E+0(2.39E-2)
	10	4.210E+0(1.01E-2)	1.904E+1(2.52E-1)	4.355E+0(3.17E-2)	4.109E+0(6.40E-2)	8.501E+0(4.08E-1)	4.976E+0(3.15E-2)	**1.034E-1(1.18E-1)**	7.198E+3(1.76E+0)	4.481E+0(6.37E-2)
	15	9.470E+0(1.87E-1)	3.057E+1(4.52E-1)	9.083E+0(6.15E-1)	7.888E+0(4.77E-1)	1.928E+1(9.24E-1)	8.957E+0(9.52E-2)	**2.240E-1(6.89E-2)**	6.039E-1(1.98E-1)	8.604E+0(5.56E-2)
WFG5	3	2.089E-1(6.20E-4)	2.664E-1(3.60E-3)	2.086E-1(1.69E-3)	2.080E-1(3.27E-3)	2.157E-1(1.91E-2)	2.187E-1(1.88E-3)	8.242E-2(1.32E-2)	5.576E-1(2.00E-1)	**2.142E-2(1.32E-2)**
	5	9.200E-1(6.04E-3)	2.206E+0(1.85E-1)	9.866E-1(4.92E-4)	9.609E-1(9.72E-3)	1.006E+0(2.27E-2)	1.003E+0(4.79E-3)	**4.916E-1(3.57E-1)**	6.886E-1(3.91E-4)	9.580E-1(4.85E-3)
	8	2.750E+0(2.63E-2)	1.016E+1(4.80E+0)	2.694E+0(5.94E-3)	2.695E+0(6.45E-3)	3.532E+0(3.18E-1)	3.062E+0(4.51E-2)	5.733E-1(1.15E-3)	**4.143E-1(1.90E-1)**	2.798E+0(1.55E-2)
	10	4.197E+0(1.79E-2)	1.878E+1(9.06E-2)	4.397E+0(4.92E-2)	4.172E+0(3.16E-2)	5.563E+0(2.30E-1)	4.931E+0(4.39E-2)	7.965E-1(6.97E-3)	**7.353E-1(1.37E-2)**	4.428E+0(2.13E-2)
	15	9.347E+0(1.27E-1)	3.053E+1(2.95E-6)	8.330E+0(7.02E-2)	7.469E+0(6.61E-2)	1.513E+1(5.27E-1)	8.847E+0(6.84E-2)	2.218E+0(1.33E+0)	**5.820E-1(1.21E-2)**	8.387E+0(7.00E-2)
WFG6	3	2.192E-1(2.18E-3)	2.691E-1(8.02E-4)	2.248E-1(4.09E-3)	2.045E-1(4.15E-3)	2.052E-1(3.45E-3)	2.342E-1(7.22E-3)	**5.557E-2(1.35E-3)**	6.720E-1(6.98E-4)	2.188E-1(2.82E-3)
	5	9.475E-1(3.36E-3)	1.494E+0(5.79E-1)	9.981E-1(1.04E-3)	9.864E-1(1.06E-2)	9.887E-1(1.61E-2)	1.069E+0(1.53E-2)	**8.463E-2(2.06E-3)**	1.202E+0(2.39E-2)	9.651E-1(5.68E-3)
	8	2.768E+0(1.96E-2)	3.122E+0(2.24E-2)	2.747E+0(3.57E-2)	2.804E+0(6.94E-2)	3.126E+0(1.15E-1)	3.278E+0(2.53E-2)	**1.525E-1(3.59E-2)**	1.408E+0(3.87E-2)	2.887E+0(3.57E-2)
	10	4.205E+0(1.81E-2)	1.371E+1(6.07E+0)	4.405E+0(4.01E-2)	4.156E+0(3.52E-2)	4.804E+0(1.24E-1)	4.993E+0(6.19E-2)	**1.959E-1(4.48E-2)**	2.235E+0(9.89E-2)	4.554E+0(4.41E-2)
	15	8.938E+0(1.12E-1)	2.782E+1(2.24E+0)	8.990E+0(2.91E-1)	7.526E+0(6.93E-2)	1.360E+1(7.03E-1)	1.019E+1(5.57E-1)	**3.568E-1(1.29E-1)**	4.942E-1(6.21E-2)	8.440E+0(7.81E-2)
WFG7	3	1.956E-1(8.52E-4)	2.654E-1(3.17E-3)	1.952E-1(1.38E-3)	1.893E-1(1.28E-3)	1.850E-1(1.13E-3)	2.088E-1(2.82E-3)	**5.387E-2(3.12E-4)**	8.227E-1(1.60E-1)	1.960E-1(2.82E-3)
	5	9.830E-1(1.49E-2)	2.426E+0(3.30E-1)	1.003E+0(1.70E-3)	9.867E-1(2.97E-2)	1.113E+0(5.57E-2)	1.024E+0(1.45E-2)	**7.027E-2(5.13E-4)**	1.088E+0(1.59E-1)	9.615E-1(8.03E-3)
	8	2.804E+0(2.94E-2)	1.392E+1(1.80E+0)	2.731E+0(3.84E-2)	2.741E+0(2.60E-2)	4.193E+0(2.82E-1)	3.031E+0(1.65E-2)	**9.666E-2(1.21E-2)**	1.205E+0(2.27E-2)	2.823E+0(2.02E-2)
	10	4.315E+0(3.17E-2)	1.917E+1(2.86E-3)	4.405E+0(1.97E-2)	4.139E+0(1.79E-2)	6.689E+0(1.16E-1)	4.744E+0(2.85E-2)	**1.108E-1(7.62E-3)**	1.852E+0(1.56E-1)	4.474E+0(3.21E-2)
	15	9.186E+0(9.05E-2)	3.080E+1(1.51E-4)	8.813E+0(8.38E-1)	9.334E+0(1.74E-1)	1.677E+1(3.26E-1)	9.066E+0(6.26E-2)	5.947E+0(6.72E+0)	**1.403E+0(1.07E+0)**	8.575E+0(1.31E-1)
WFG8	3	2.800E-1(3.50E-3)	3.570E-1(1.40E-2)	2.827E-1(1.87E-2)	2.632E-1(3.86E-3)	2.754E-1(1.74E-2)	2.949E-1(3.71E-3)	**1.404E-1(2.88E-2)**	7.018E-1(2.36E-1)	2.649E-1(3.71E-3)
	5	1.051E+0(1.27E-2)	2.592E+0(1.11E-1)	1.012E+0(1.91E-3)	1.159E+0(3.32E-2)	1.079E+0(3.43E-2)	1.080E+0(2.01E-2)	**3.831E-1(7.64E-3)**	1.568E+0(1.50E+0)	1.011E+0(5.93E-3)
	8	3.046E+0(3.60E-2)	1.320E+1(1.43E+0)	2.847E+0(3.07E-2)	2.962E+0(7.88E-2)	4.315E+0(2.30E-1)	3.110E+0(2.79E-2)	1.082E+0(5.07E-1)	**9.951E-1(1.51E-1)**	2.855E+0(1.57E-2)
	10	4.522E+0(4.24E-2)	1.848E+1(7.62E-1)	4.280E+0(1.30E-2)	4.569E+0(8.79E-2)	6.209E+0(7.95E-2)	4.917E+0(5.21E-2)	**1.654E+0(1.04E+0)**	4.328E+0(5.15E+0)	4.635E+0(1.57E-1)
	15	9.650E+0(5.40E-2)	3.079E+1(1.42E-2)	**1.280E+1(8.03E-1)**	9.266E+0(3.00E-1)	1.509E+1(2.96E-1)	9.345E+0(3.80E-1)	2.263E+0(7.72E-1)	2.704E+0(2.74E-2)	9.621E+0(8.73E-2)
Best/All		1/95	0/95	4/95	8/95	4/95	3/95	32/95	5/95	39/95

TABLE A. XII
PERFORMANCE OF FDEA AND ITS FIVE VARIANTS ON 5- AND 15-OBJECTIVE MAF, WFG AND WFG4X PROBLEMS WITH HV

Problems	m	FDEA-I	FDEA-II	FDEA-III	FDEA-IV	FDEA-V	FDEA-VI	FDEA
MaF1	5	1.301E-02(6.15E-05)-	1.293E-02(6.69E-05)-	1.290E-02(9.66E-05)-	**1.312E-02(3.85E-05)~**	1.310E-02(2.15E-05)-	1.286E-02(5.45E-05)-	**1.312E-2(7.97E-5)**
	10	0.000E+00(0.00E+0)-	0.000E+00(0.00E+0)-	2.447E-07(4.89E-07)-	4.832E-07(5.58E-07)-	0.000E+0(0.00E+0)-	2.647E-07(4.29E-07)-	**6.035E-7(1.88E-8)**
MaF2	5	**2.606E-01(7.11E-04)~**	2.381E-01(2.35E-03)-	2.601E-01(7.14E-04)-	2.594E-01(1.11E-03)-	2.528E-01(1.48E-03)-	2.588E-01(7.95E-04)-	2.604E-1(1.66E-3)
	10	2.154E-01(1.02E-03)-	1.759E-01(6.21E-03)-	2.232E-01(1.23E-03)~	**2.302E-01(3.16E-03)+**	2.207E-01(8.87E-03)-	2.181E-01(2.42E-03)-	2.252E-1(4.17E-3)
MaF3	5	9.994E-01(1.25E-04)~	9.995E-01(6.42E-05)~	**9.996E-01(2.79E-05)~**	9.978E-01(1.16E-04)-	9.812E-01(1.49E-02)-	**9.996E-01(4.98E-05)~**	9.995E-1(2.74E-4)
	10	**1.000E+00(1.02E-15)~**	**1.000E+00(7.82E-13)~**	9.974E-01(4.52E-03)-	9.738E-01(2.88E-02)-	8.376E-01(1.99E-01)-	**1.000E+00(1.99E-14)~**	**1.000E+0(2.10E-6)**
MaF4	5	**1.329E-01(1.38E-03)~**	1.308E-01(2.86E-03)~	1.327E-01(1.89E-03)~	1.326E-01(1.48E-03)~	1.317E-01(4.00E-03)-	1.323E-01(1.73E-03)~	1.328E-1(1.56E-3)
	10	4.106E-04(1.06E-05)-	4.196E-04(3.03E-05)-	3.926E-04(1.00E-05)-	4.165E-04(3.11E-05)-	4.183E-04(2.34E-05)-	4.193E-04(1.47E-05)-	4.233E-4(1.97E-5)
MaF5	5	**8.000E-01(9.70E-04)~**	7.823E-01(2.71E-03)-	7.815E-01(3.99E-03)-	7.977E-01(1.45E-03)~	7.989E-01(1.06E-03)~	**8.000E-01(2.68E-03)~**	**8.000E-1(1.85E-3)**
	10	9.651E-01(8.82E-04)~	9.121E-01(1.10E-03)-	9.547E-01(1.02E-03)-	9.653E-01(9.67E-04)~	9.655E-01(2.13E-04)~	9.657E-01(3.38E-04)~	**9.668E-1(7.47E-4)**
MaF6	5	**1.300E-01(2.63E-05)~**	1.299E-01(4.26E-04)~	1.273E-01(3.75E-04)-	1.299E-01(3.22E-05)~	1.298E-01(9.28E-04)~	**1.300E-01(1.14E-04)~**	**1.300E-1(4.82E-4)**
	10	0.000E+00(0.00E+0)-	1.774E-05(3.55E-05)-	1.679E-02(2.20E-02)+	0.000E+0(0.00E+0)-	**1.003E-01(2.44E-04)+**	0.00E+00(0.00E+00)-	1.303E-3(5.90E-3)
MaF7	5	3.153E-01(3.02E-03)-	3.046E-01(3.70E-03)-	3.178E-01(3.24E-03)~	**3.214E-01(2.12E-03)+**	3.123E-01(5.59E-03)-	3.168E-01(2.42E-03)~	3.184E-1(2.17E-3)
	10	1.973E-01(4.76E-03)-	1.752E-01(7.31E-03)-	2.265E-01(1.35E-03)-	2.353E-01(8.10E-03)~	**2.372E-01(5.74E-03)+**	2.352E-01(4.31E-03)~	2.369E-1(5.50E-3)
MaF8	5	1.285E-01(3.14E-04)-	1.286E-01(3.49E-04)~	1.286E-01(2.10E-04)~	1.286E-01(3.09E-04)~	1.288E-01(1.02E-04)~	1.225E-01(1.89E-04)-	**1.288E-1(1.02E-4)**
	10	7.667E-03(7.60E-06)-	7.803E-03(1.01E-05)-	7.347E-03(1.29E-05)-	7.550E-03(1.37E-05)-	7.733E-03(8.57E-06)-	7.761E-04(1.06E-05)-	**9.733E-3(8.57E-6)**
MaF9	5	3.242E-01(5.69E-04)-	1.569E-02(4.11E-02)-	3.104E-01(8.51E-04)-	3.196E-01(6.99E-04)-	3.013E-01(7.17E-04)-	3.088E-01(2.12E-04)-	**3.283E-1(3.91E-4)**
	10	1.571E-02(5.87E-04)-	5.148E-03(1.03E-04)-	1.473E-02(9.77E-04)-	1.546E-02(3.41E-04)-	1.500E-02(4.79E-04)-	1.551E-02(1.06E-04)-	**1.601E-2(1.03E-4)**
MaF10	5	7.022E-01(4.48E-03)-	6.737E-01(2.11E-02)-	7.215E-01(2.49E-02)+	**7.268E-01(1.87E-02)+**	7.166E-01(1.90E-02)~	7.171E-01(2.02E-02)~	7.174E-1(1.66E-2)
	10	8.295E-01(8.42E-03)-	8.431E-01(2.82E-03)-	8.154E-01(2.09E-02)-	8.174E-01(5.00E-03)-	**8.513E-01(1.17E-02)~**	**8.566E-01(6.83E-03)~**	8.515E-1(7.84E-3)
MaF11	5	9.637E-01(1.68E-03)-	8.971E-01(9.91E-02)-	9.831E-01(8.92E-04)~	8.971E-01(1.00E-01)-	9.661E-01(7.19E-03)-	9.557E-01(7.91E-02)~	**9.843E-1(3.24E-2)**
	10	9.740E-01(1.02E-03)-	9.925E-01(4.71E-04)~	9.940E-01(3.06E-04)~	9.476E-01(8.93E-02)-	9.842E-01(6.68E-04)-	9.944E-01(6.39E-04)~	**9.948E-1(7.91E-4)**
MaF12	5	6.856E-01(3.62E-02)-	6.361E-01(2.07E-02)-	6.526E-01(3.11E-03)-	6.870E-01(3.26E-02)-	7.145E-01(3.28E-03)+	**7.178E-01(2.78E-03)+**	7.033E-1(2.46E-2)
	10	7.918E-01(4.32E-02)~	6.651E-01(2.42E-02)-	7.570E-01(4.87E-03)-	7.563E-01(3.95E-03)-	**8.182E-01(6.77E-03)+**	7.962E-01(3.86E-02)-	8.100E-1(3.06E-2)
MaF13	5	2.585E-01(3.96E-03)~	2.492E-01(1.26E-02)-	2.434E-01(5.09E-03)-	2.546E-01(7.67E-03)-	2.287E-01(2.34E-02)-	2.482E-01(8.07E-03)-	**2.625E-1(4.56E-3)**
	10	1.245E-01(4.94E-03)+	**1.268E-01(2.42E-03)+**	1.247E-01(3.37E-03)+	1.226E-01(1.65E-02)-	1.157E-01(1.32E-02)-	1.230E-01(6.33E-03)~	1.236E-1(5.76E-3)
WFG1	5	7.022E-01(4.48E-03)-	6.737E-01(2.11E-02)-	7.215E-01(2.49E-02)+	**7.268E-01(1.87E-02)+**	7.166E-01(1.90E-02)~	7.171E-01(2.02E-02)~	7.174E-1(1.66E-2)
	10	8.295E-01(8.42E-03)-	8.431E-01(2.82E-03)-	8.154E-01(2.09E-02)-	8.174E-01(5.00E-03)-	8.513E-01(1.17E-02)~	8.566E-01(6.83E-03)~	**8.515E-1(7.84E-3)**
WFG2	5	9.637E-01(1.68E-03)-	8.971E-01(9.91E-02)-	9.831E-01(8.92E-04)~	8.971E-01(1.00E-01)-	9.661E-01(7.19E-03)-	9.557E-01(7.91E-02)-	**9.843E-1(3.24E-2)**
	10	9.740E-01(1.02E-03)-	9.925E-01(4.71E-04)-	9.940E-01(3.06E-04)~	9.476E-01(8.93E-02)-	9.842E-01(6.68E-04)-	9.944E-01(6.39E-04)~	**9.948E-1(7.91E-4)**
WFG3	5	6.147E-01(3.51E-03)-	5.870E-01(1.43E-02)-	**6.687E-01(6.04E-03)+**	6.238E-01(1.11E-02)-	5.461E-01(5.63E-02)-	6.270E-01(1.55E-02)~	6.283E-1(1.25E-2)
	10	6.251E-01(8.06E-03)-	5.984E-01(4.19E-02)-	6.784E-01(4.02E-03)+	**6.946E-01(4.07E-03)+**	6.591E-01(9.58E-03)+	6.476E-01(1.38E-02)~	6.472E-1(1.38E-2)
WFG4	5	7.551E-01(1.92E-03)~	6.766E-01(1.87E-02)-	7.357E-01(3.95E-03)-	7.495E-01(3.84E-03)-	**7.652E-01(4.66E-03)+**	7.545E-01(4.85E-03)~	7.545E-1(2.52E-3)
	10	9.133E-01(9.20E-03)~	6.563E-01(1.53E-02)-	9.147E-01(1.30E-02)-	9.156E-01(6.15E-04)-	9.210E-01(3.73E-03)+	**9.220E-01(3.34E-03)~**	9.187E-1(3.53E-3)
WFG5	5	7.330E-01(1.79E-03)~	6.622E-01(7.19E-03)-	7.300E-01(3.76E-03)-	7.310E-01(3.31E-03)~	**7.331E-01(4.73E-03)+**	7.311E-01(2.40E-03)~	7.303E-1(3.46E-3)
	10	8.810E-01(2.79E-03)~	7.099E-01(9.74E-03)-	8.721E-01(2.48E-03)-	8.804E-01(1.23E-03)~	8.817E-01(3.48E-03)~	8.803E-01(2.27E-03)-	**8.831E-1(6.00E-4)**
WFG6	5	7.317E-01(6.86E-03)~	6.679E-01(1.31E-02)-	7.238E-01(4.00E-03)-	7.297E-01(8.22E-03)-	7.318E-01(7.16E-03)-	7.338E-01(8.37E-03)~	**7.361E-1(2.18E-3)**
	10	8.937E-01(5.72E-03)~	7.024E-01(1.76E-02)-	8.939E-01(3.55E-03)-	8.944E-01(7.83E-03)~	**8.960E-01(1.04E-02)+**	8.940E-01(5.75E-03)~	8.948E-1(8.16E-3)
WFG7	5	**7.834E-01(1.44E-03)+**	7.089E-01(6.02E-03)-	7.794E-01(2.33E-03)~	7.811E-01(5.79E-04)~	7.832E-01(2.06E-03)+	7.852E-01(2.48E-03)+	7.822E-1(2.47E-3)
	10	9.520E-01(5.53E-04)+	7.086E-01(2.55E-02)-	9.376E-01(1.40E-03)-	9.471E-01(6.63E-04)~	**9.579E-01(9.65E-04)+**	9.478E-01(3.94E-03)-	9.485E-1(2.99E-3)
WFG8	5	6.474E-01(4.74E-03)~	5.857E-01(1.65E-02)-	6.339E-01(4.52E-03)-	6.420E-01(5.47E-03)-	**6.478E-01(7.00E-03)~**	6.473E-01(3.79E-03)-	**6.478E-1(5.59E-3)**
	10	8.339E-01(6.61E-03)~	5.285E-01(3.84E-02)-	8.473E-01(2.74E-03)+	**8.609E-01(2.00E-03)+**	8.214E-01(4.04E-02)-	8.239E-01(1.96E-02)-	8.398E-1(1.26E-2)
WFG9	5	6.856E-01(3.62E-02)-	6.361E-01(2.07E-02)-	6.526E-01(3.11E-03)-	6.870E-01(3.26E-02)-	**7.145E-01(3.28E-03)+**	7.178E-01(2.78E-03)+	7.033E-1(2.46E-2)
	10	7.918E-01(4.32E-02)-	6.651E-01(2.42E-02)-	7.570E-01(4.87E-03)-	7.563E-01(3.95E-03)-	**8.182E-01(6.77E-03)+**	7.962E-01(3.86E-02)-	8.100E-1(3.06E-2)
WFG41	5	7.561E-01(2.50E-03)+	6.729E-01(1.10E-02)-	7.498E-01(4.39E-03)-	7.475E-01(4.45E-03)-	7.550E-01(3.22E-03)~	**7.567E-01(3.73E-03)+**	7.540E-1(3.89E-3)
	10	9.214E-01(5.55E-03)~	6.562E-01(3.96E-02)-	9.114E-01(8.68E-03)-	9.157E-01(4.05E-03)-	9.212E-01(4.68E-03)-	9.187E-01(2.84E-03)-	**9.239E-1(4.47E-3)**
WFG42	5	9.925E-01(8.71E-04)~	9.892E-01(2.47E-03)-	**9.960E-01(5.30E-04)+**	9.865E-01(2.97E-03)-	9.731E-01(5.88E-03)-	9.925E-01(5.25E-04)~	9.929E-1(1.46E-3)
	10	9.970E-01(6.44E-04)-	9.970E-01(1.39E-03)~	**9.996E-01(1.25E-04)+**	9.958E-01(4.96E-04)-	9.864E-01(9.85E-04)-	9.967E-01(5.86E-04)-	9.979E-1(7.28E-4)
WFG43	5	4.475E-01(6.01E-03)~	4.125E-01(5.51E-03)-	4.473E-01(3.88E-03)-	4.446E-01(2.10E-03)-	4.459E-01(7.34E-03)-	4.467E-01(7.09E-03)~	**4.491E-1(7.57E-3)**
	10	4.782E-01(1.64E-02)-	3.551E-01(1.12E-02)-	4.736E-01(1.88E-02)-	5.008E-01(9.76E-03)-	5.062E-01(4.13E-03)-	4.799E-01(4.71E-02)-	**5.475E-1(3.13E-2)**
WFG44	5	9.969E-01(8.18E-04)-	9.973E-01(3.39E-04)-	9.982E-01(4.63E-04)-	9.956E-01(6.86E-04)-	9.924E-01(1.95E-03)-	9.979E-01(4.16E-04)-	**9.990E-1(6.55E-4)**
	10	9.992E-01(2.47E-04)-	9.987E-01(2.47E-04)-	9.997E-01(1.03E-04)~	9.982E-01(1.23E-04)-	9.953E-01(9.12E-04)-	9.991E-01(1.38E-04)~	**9.999E-1(2.52E-4)**
WFG45	5	8.170E-01(5.06E-03)~	7.439E-01(7.38E-03)-	8.270sE-01(3.14E-03)+	**8.309E-01(2.31E-03)+**	8.152E-01(2.95E-03)~	8.168E-01(2.70E-03)~	8.181E-1(3.81E-3)
	10	9.309E-01(6.70E-03)~	6.865E-01(3.27E-02)-	9.441E-01(1.39E-02)+	**9.482E-01(2.74E-03)+**	9.262E-01(4.85E-03)-	9.293E-01(6.55E-03)~	9.307E-1(5.11E-3)
WFG46	5	9.633E-01(3.67E-03)~	9.174E-01(5.53E-03)-	9.619E-01(4.36E-04)-	9.643E-01(5.63E-03)~	9.379E-01(8.30E-03)-	9.406E-01(2.89E-03)-	**9.648E-1(2.60E-3)**
	10	9.917E-01(1.48E-03)~	9.389E-01(4.92E-03)-	9.768E-01(1.62E-03)-	**9.918E-01(1.33E-03)+**	9.627E-01(4.90E-03)-	9.901E-01(1.91E-03)~	9.907E-1(1.35E-3)
WFG47	5	8.160E-01(4.50E-03)~	7.550E-01(5.75E-03)-	**8.387E-01(2.39E-03)+**	8.313E-01(1.21E-03)~	8.180E-01(4.90E-03)-	7.618E-01(1.22E-01)-	8.293E-1(7.03E-2)
	10	9.151E-01(2.63E-03)-	6.852E-01(2.82E-02)-	**9.488E-01(1.07E-02)+**	9.485E-01(3.76E-03)+	9.252E-01(2.80E-03)~	9.307E-01(6.07E-03)~	9.297E-1(4.95E-3)
WFG48	5	9.765E-01(1.43E-03)-	9.836E-01(8.85E-04)-	**9.947E-01(1.84E-04)+**	9.806E-01(1.99E-03)-	9.649E-01(3.37E-03)-	9.882E-01(1.01E-03)~	9.893E-1(1.20E-3)
	10	9.966E-01(1.17E-03)-	9.952E-01(2.01E-03)-	9.990E-01(4.54E-04)-	9.947E-01(1.80E-03)-	9.832E-01(1.01E-03)-	9.964E-01(7.64E-04)-	**9.996E-1(9.56E-4)**
Best/All		6/60	2/60	7/60	10/60	11/60	9/60	25/60
+/-/~		6/28/26	1/53/6	14/34/12	10/36/14	14/33/13	5/24/31	−−

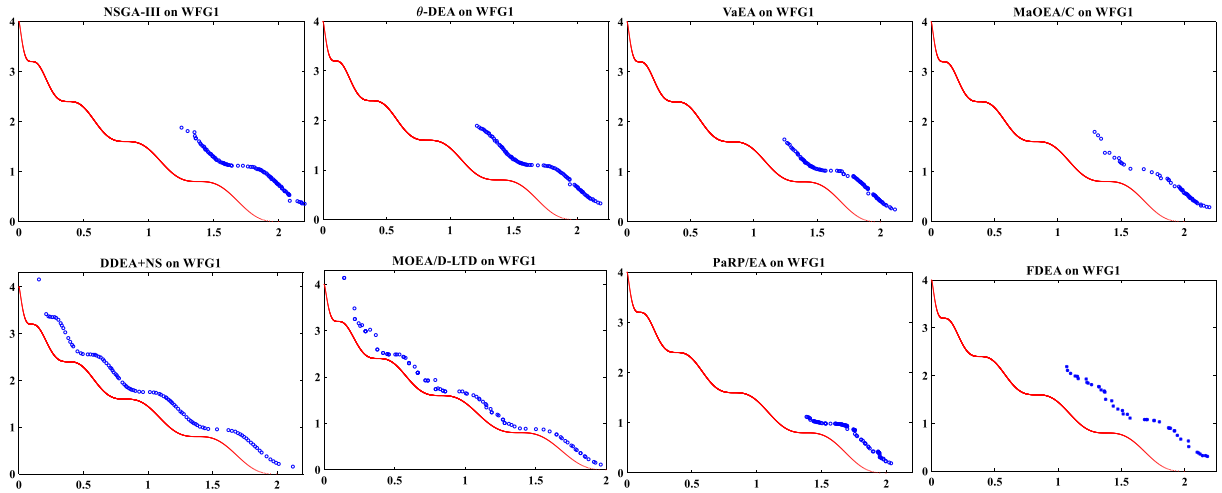


Fig. A1 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG1 problem and the true PF indicated by the red line.

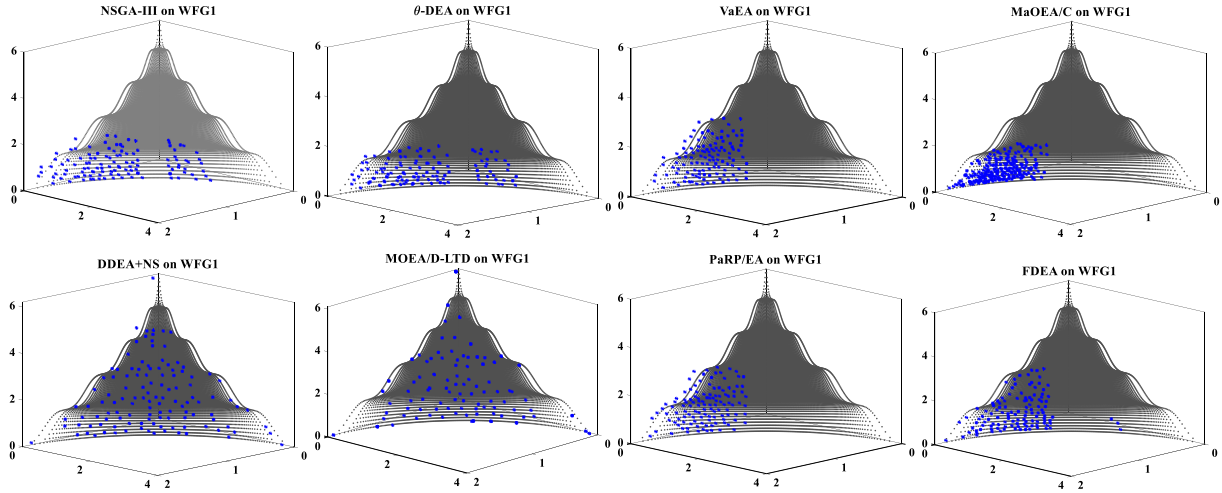


Fig. A2 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG1 problem and the true PF indicated by the dash area.

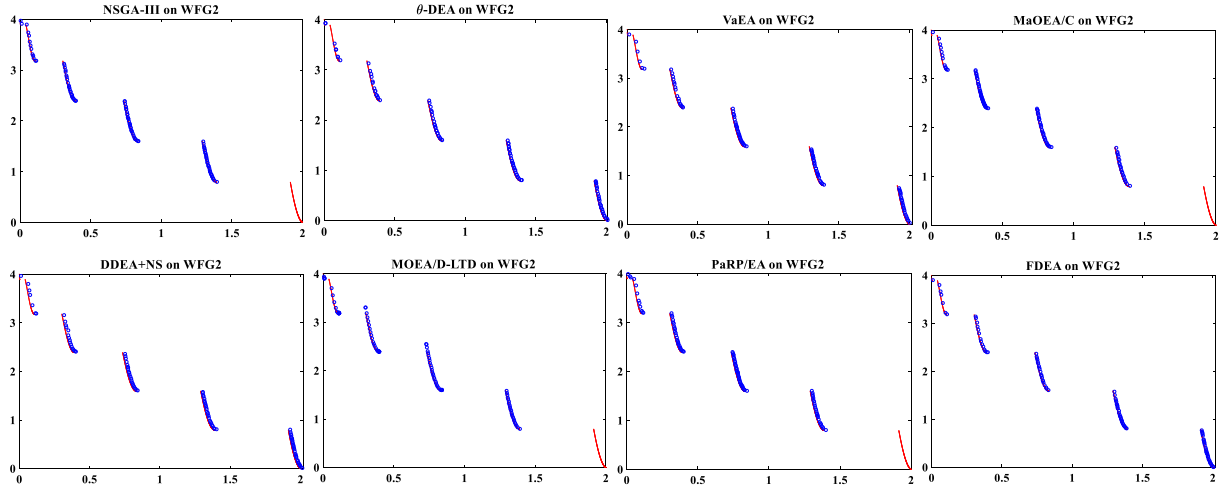
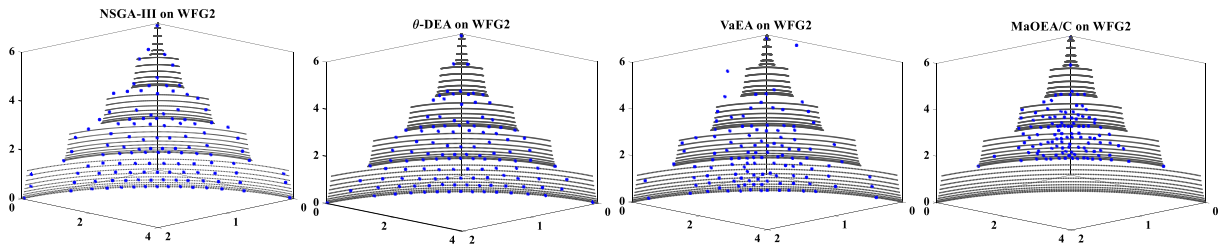


Fig. A3 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG2 problem and the true PF indicated by the red line.



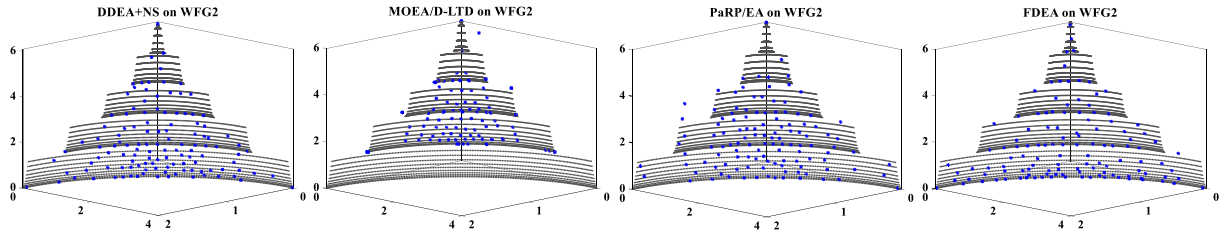


Fig. A4 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG2 problem and the true PF indicated by the dash area.

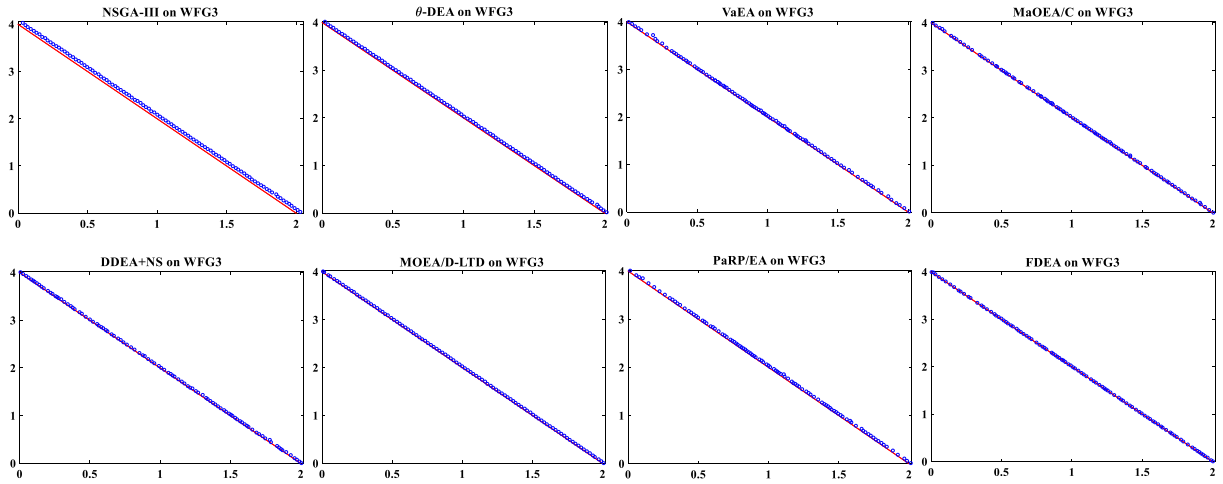


Fig. A5 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG3 problem and the true PF indicated by the red line.

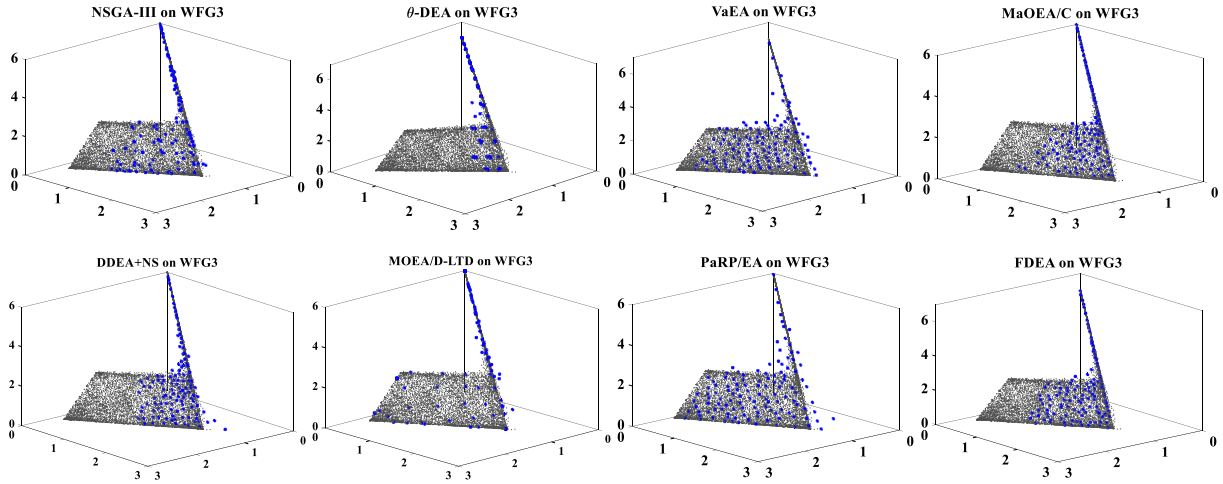


Fig. A6 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG3 problem and the true PF indicated by the dash area.

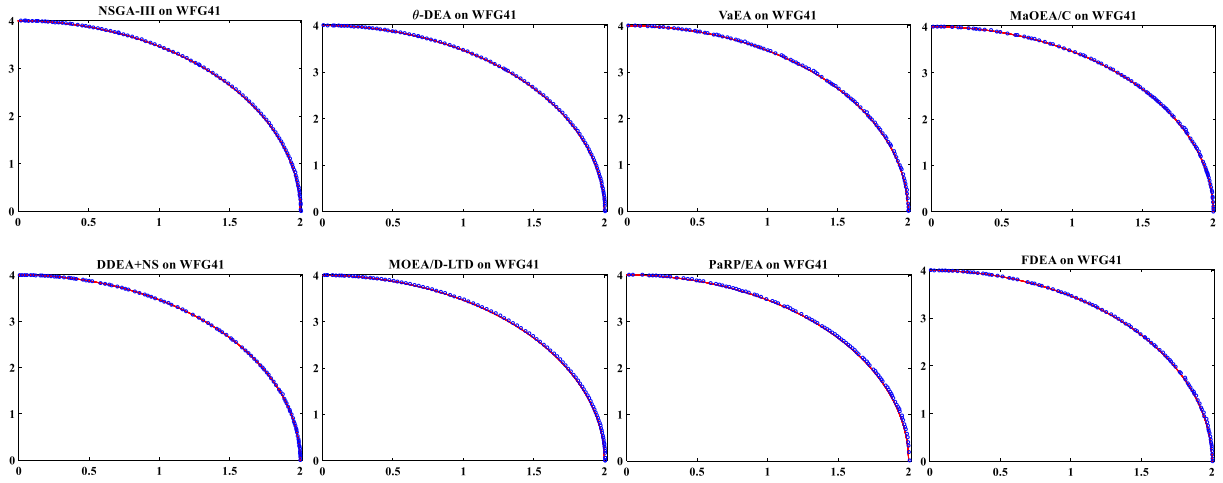


Fig. A7 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG41 problem and the true PF indicated by the red line.

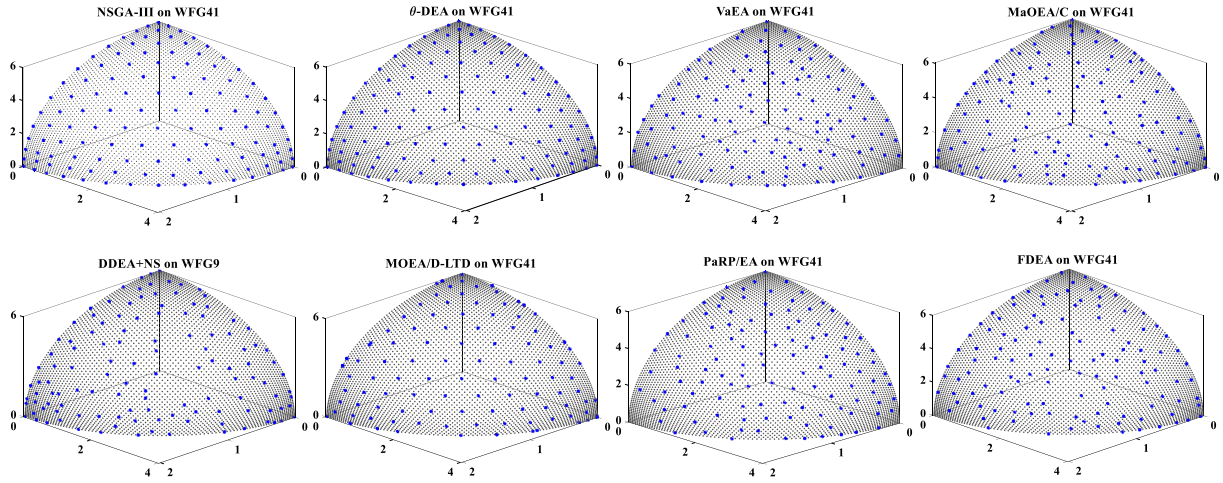


Fig. A8 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG41 problem and the true PF indicated by the dash area.

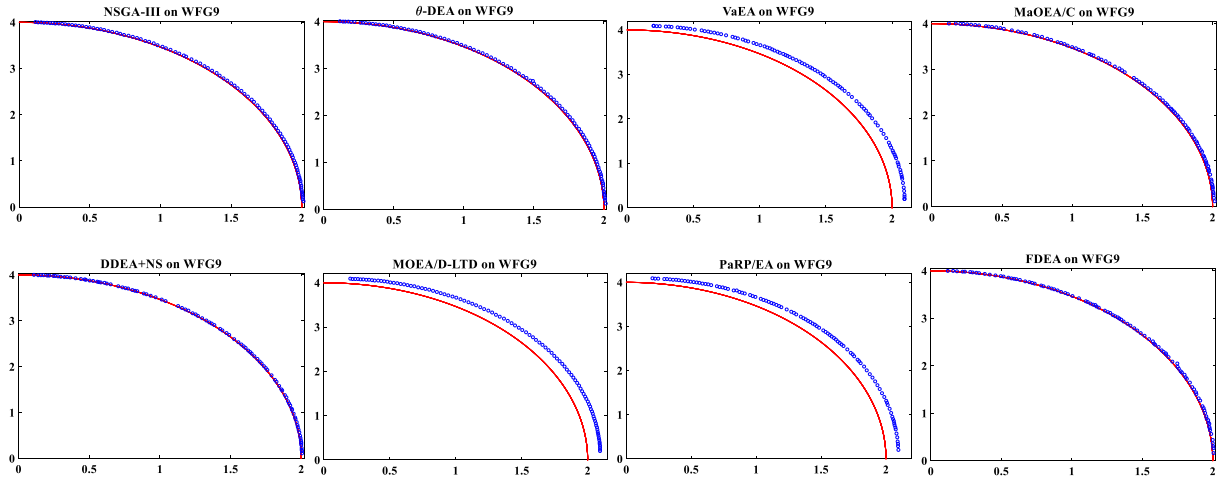


Fig. A9 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG9 problem and the true PF indicated by the red line.

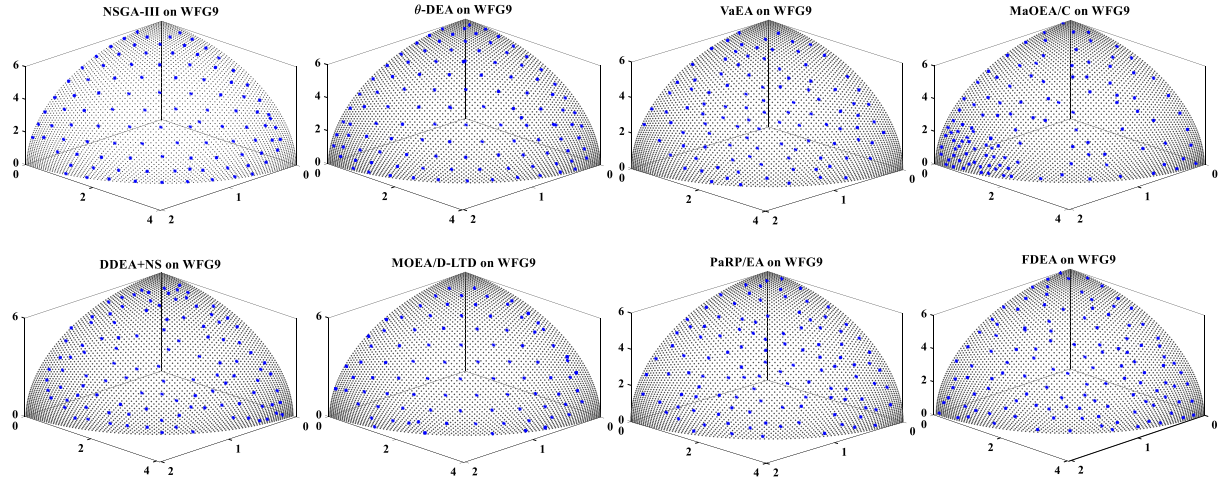
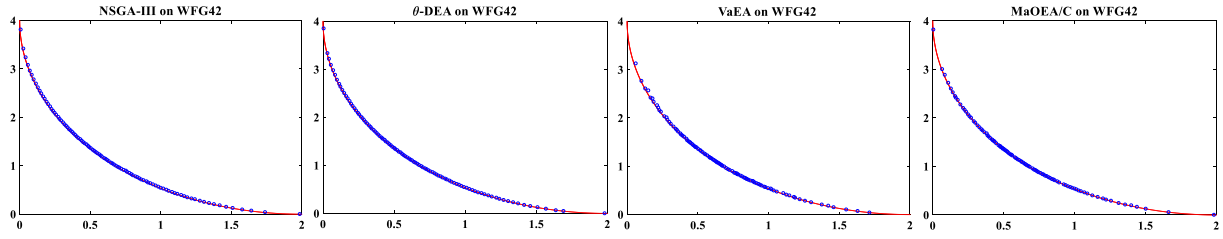


Fig. A10 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG9 problem and the true PF indicated by the dash area.



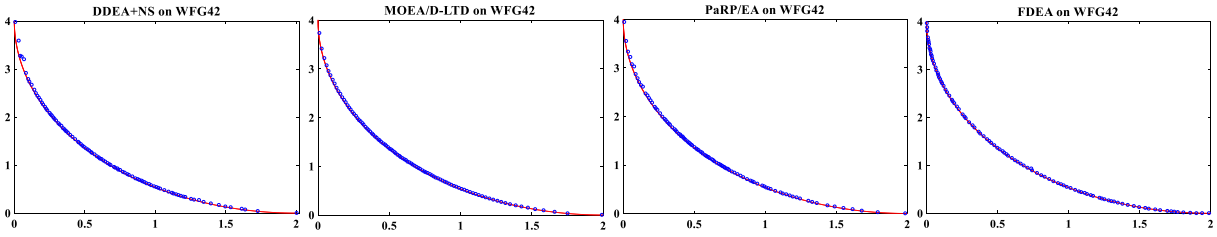


Fig. A11 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG42 problem and the true PF indicated by the red line.

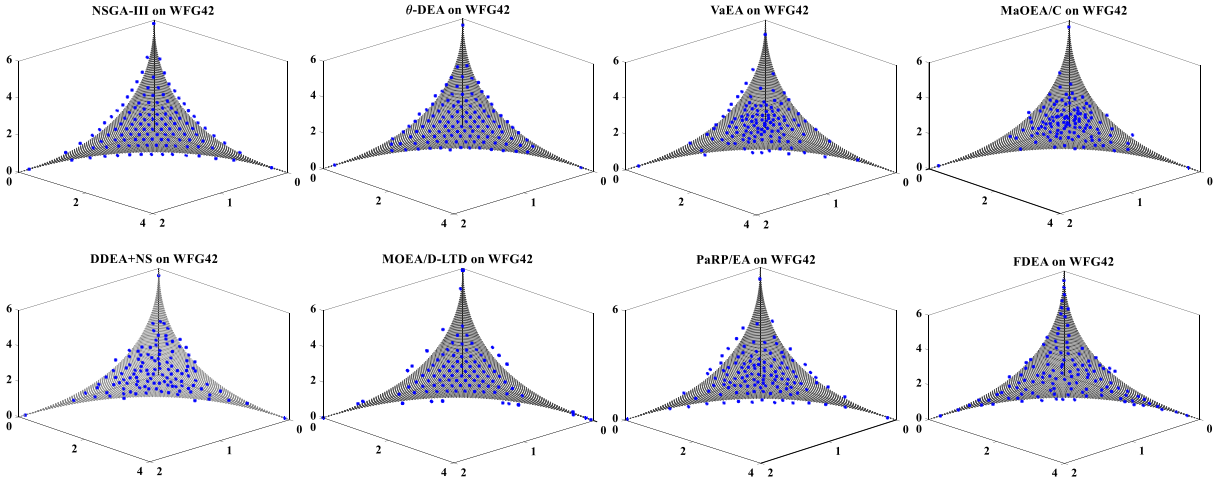


Fig. A12 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG42 problem and the true PF indicated by the dash area.

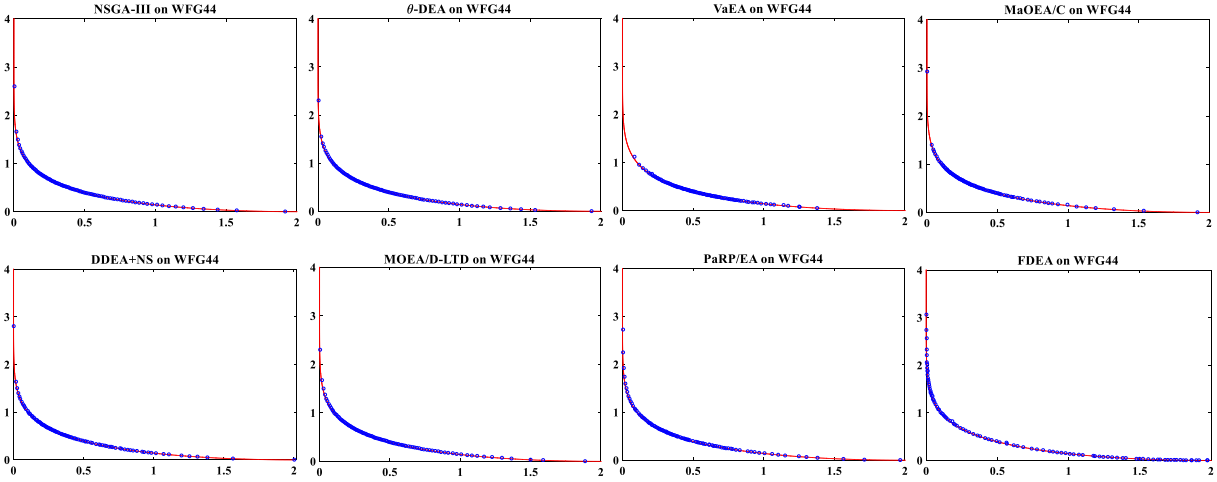


Fig. A13 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG44 problem and the true PF indicated by the red line.

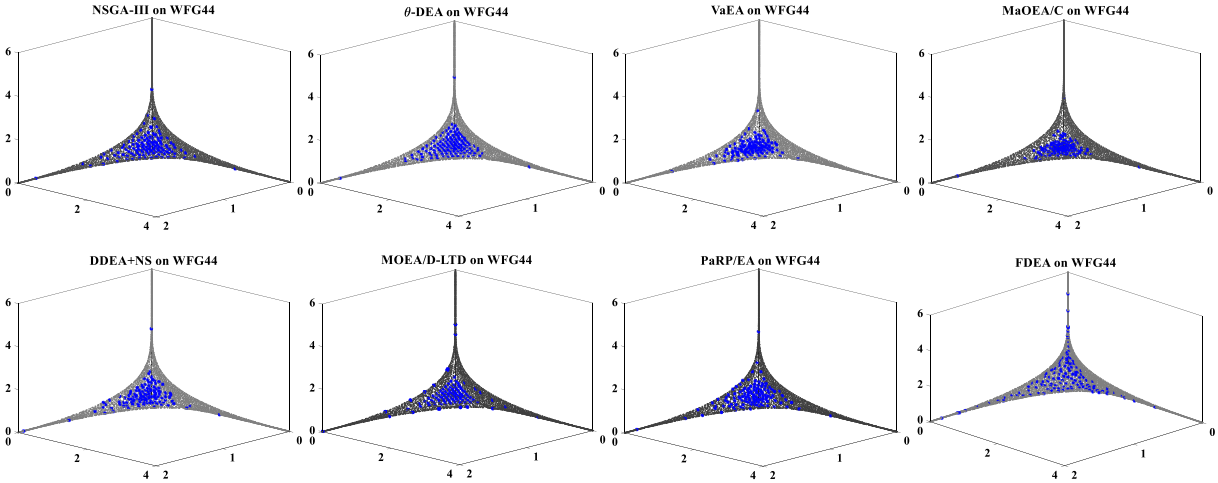


Fig. A14 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG44 problem and the true PF indicated by the dash area

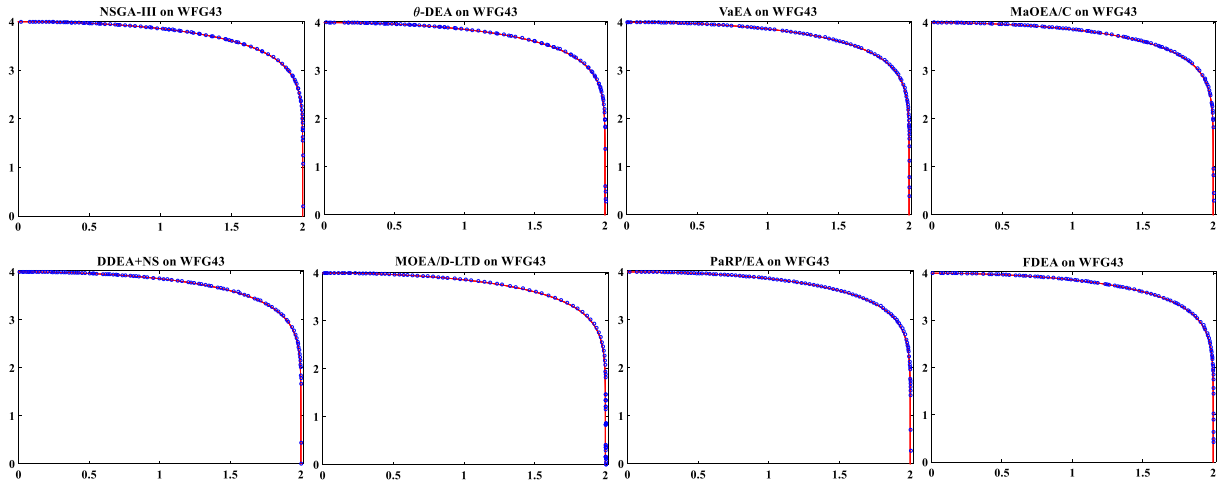


Fig. A15 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG43 problem and the true PF indicated by the red line

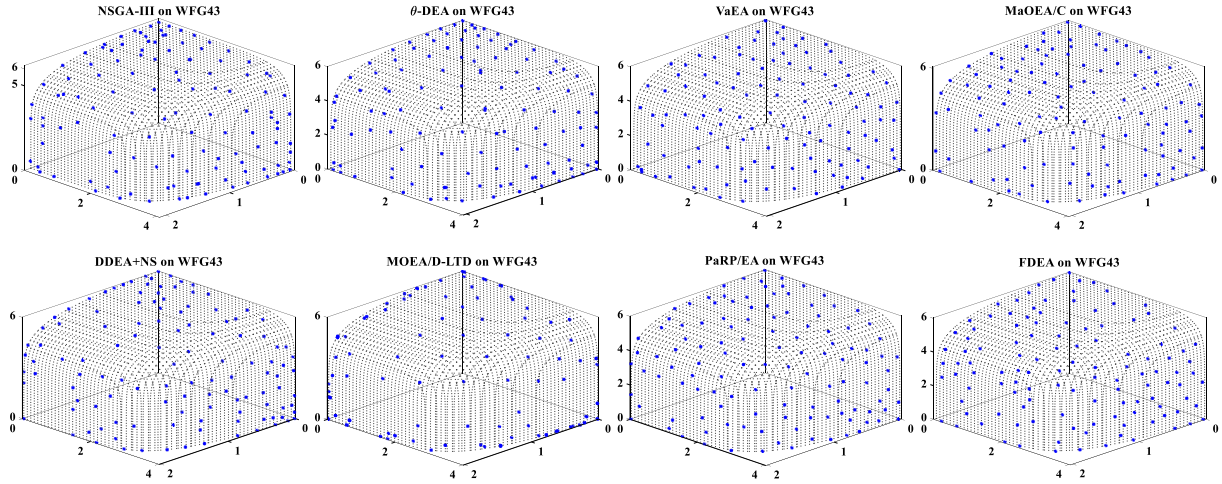


Fig. A16 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG43 problem and the true PF indicated by the dash area.

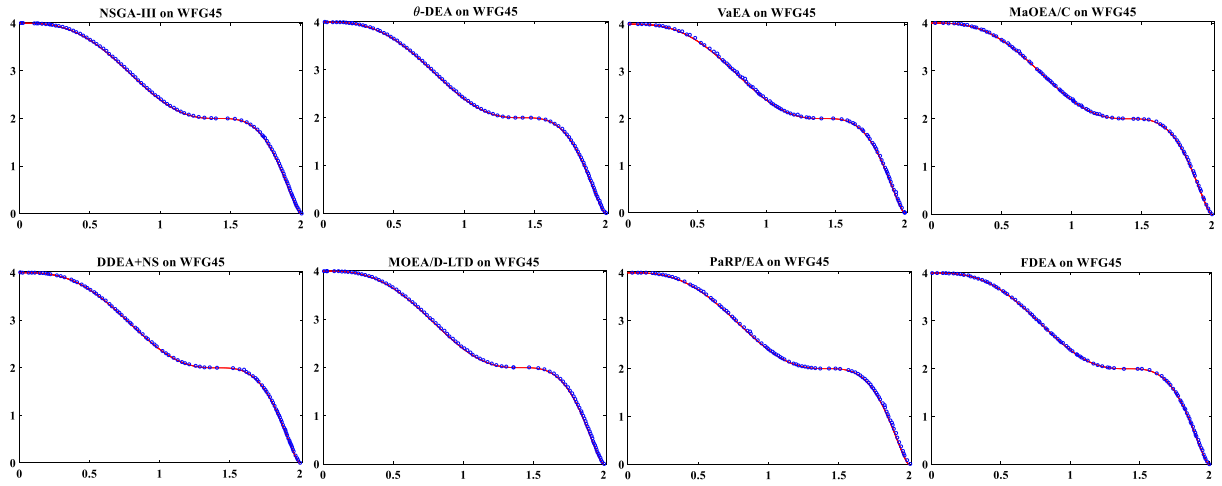
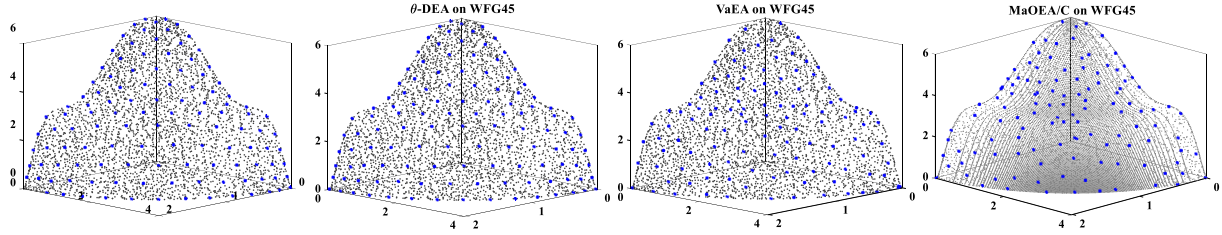


Fig. A17 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG45 problem and the true PF indicated by the red line.



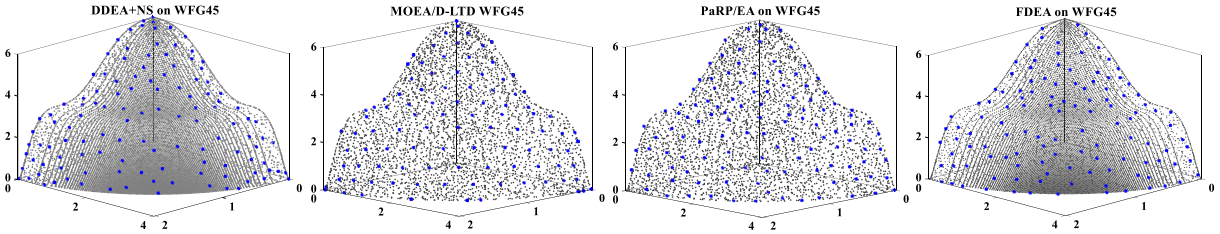


Fig. A18 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG45 problem and the true PF indicated by the dash area.

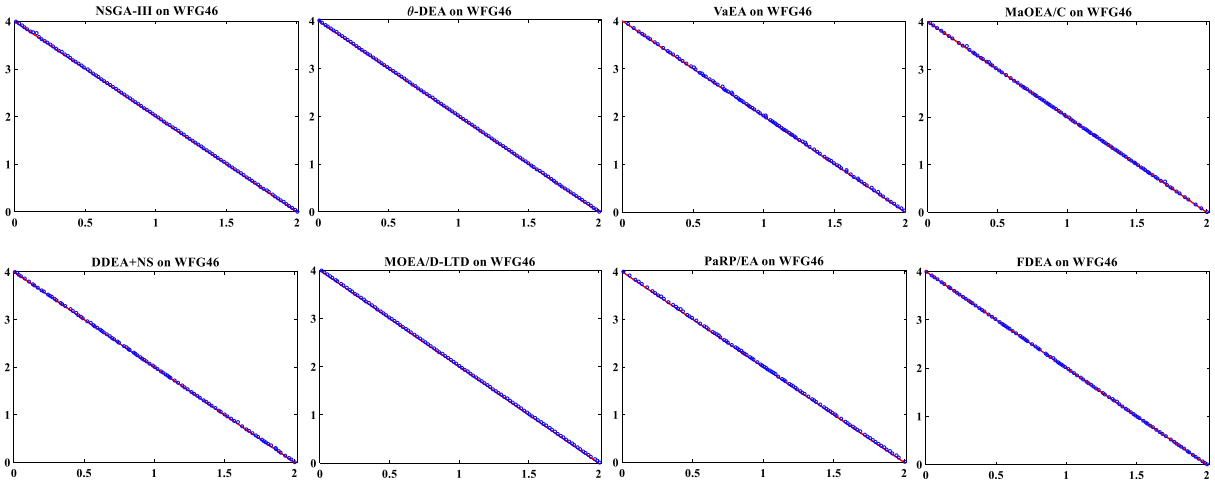


Fig. A19 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG46 problem and the true PF indicated by the red line.

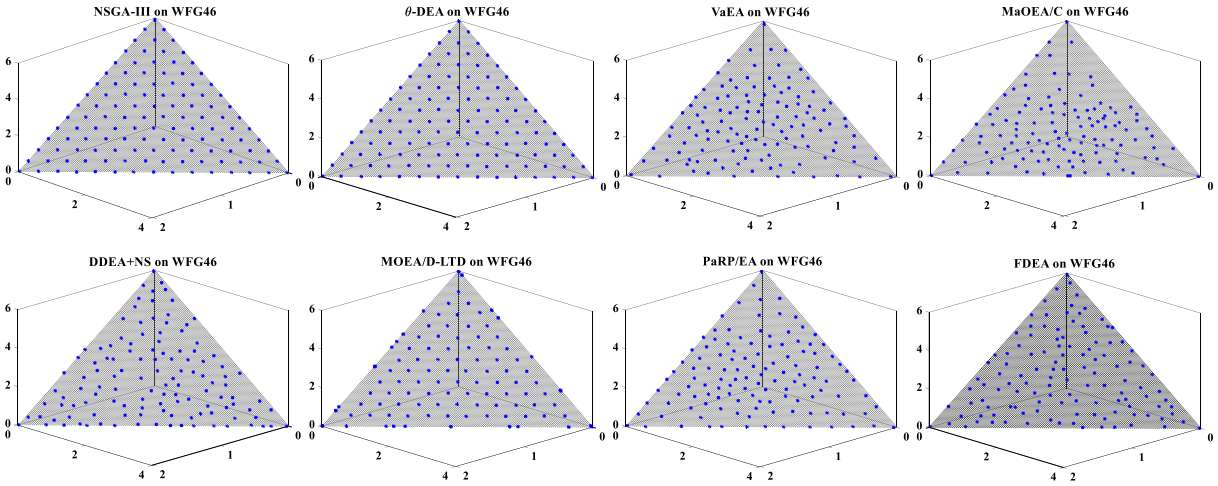


Fig. A20 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG46 problem and the true PF indicated by the dash area.

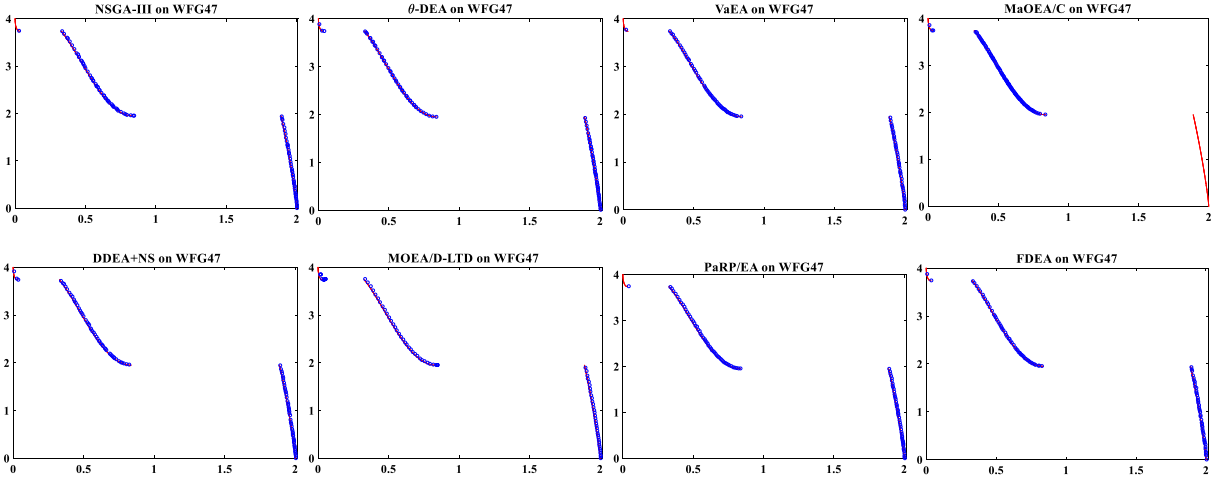


Fig. A21 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG47 problem and the true PF indicated by the red line

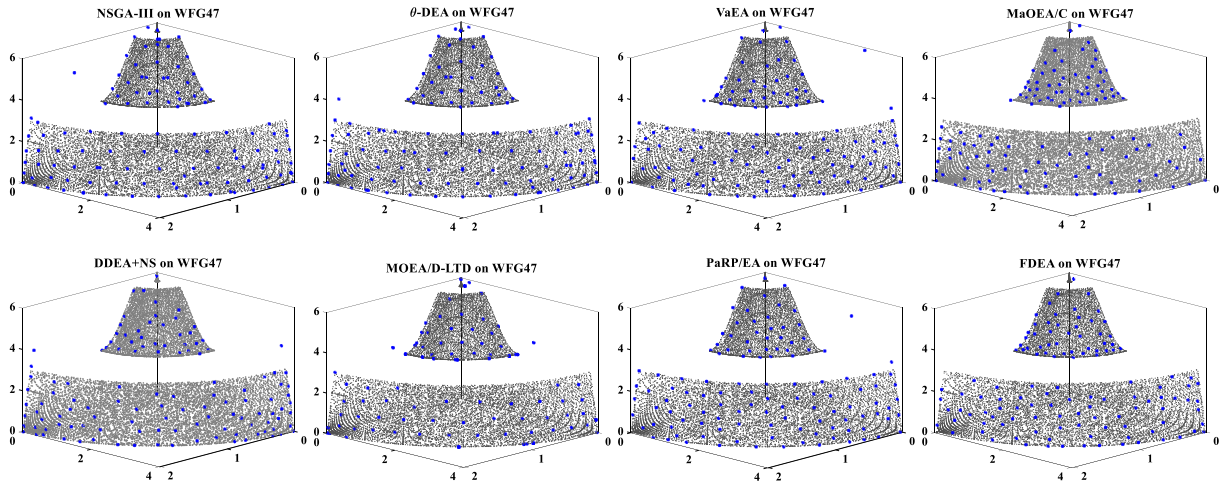


Fig. A22 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG47 problem and the true PF indicated by the dash area.

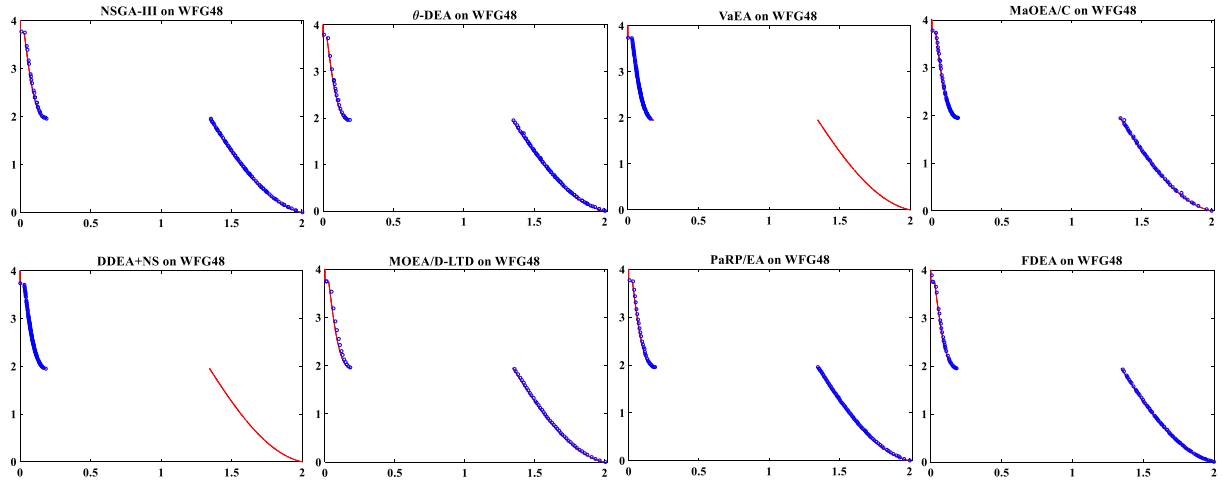


Fig. A23 The final solution sets achieved by FDEA and its seven competitors on 2-objective WFG48 problem and the true PF indicated by the red line

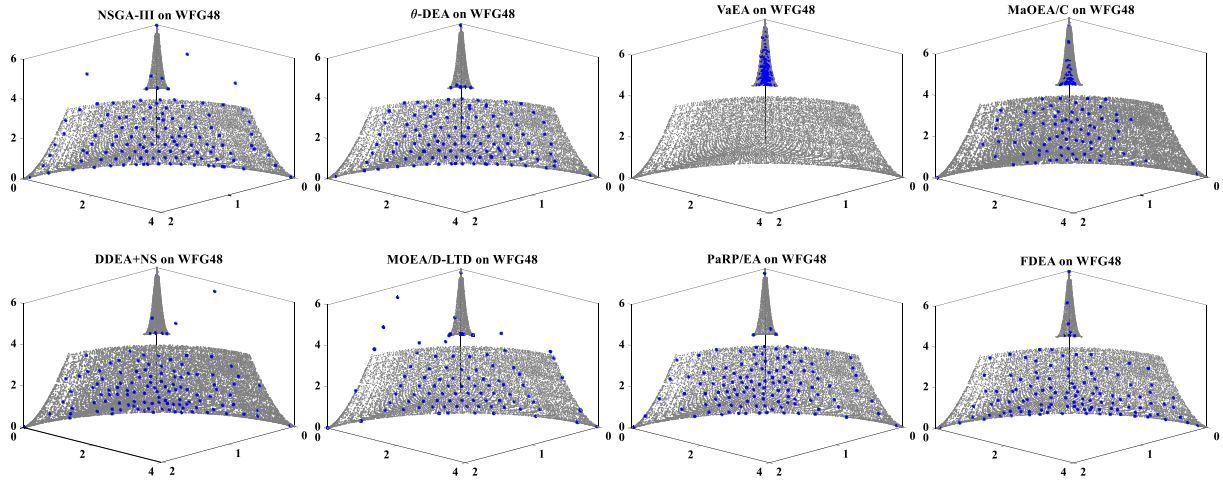
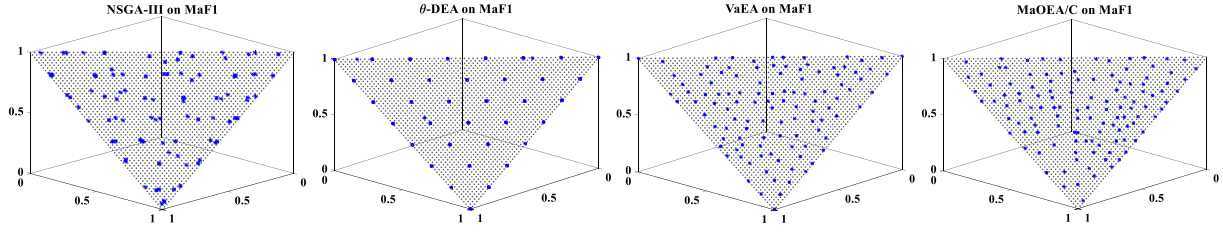


Fig. A24 The final solution sets achieved by FDEA and its seven competitors on 3-objective WFG48 problem and the true PF indicated by the dash area.



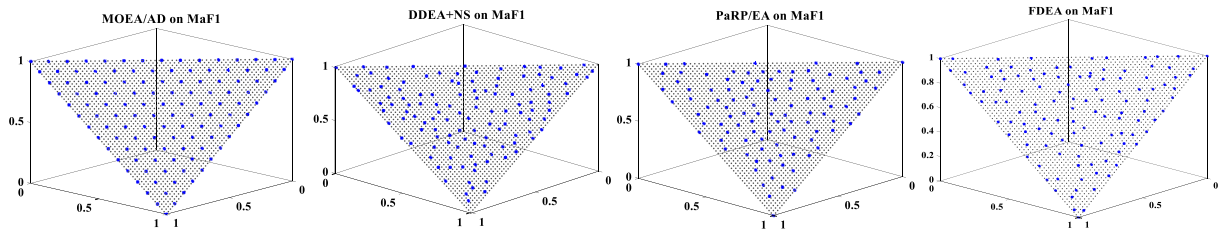


Fig. A25 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF1 problem and the true PF indicated by the dash area

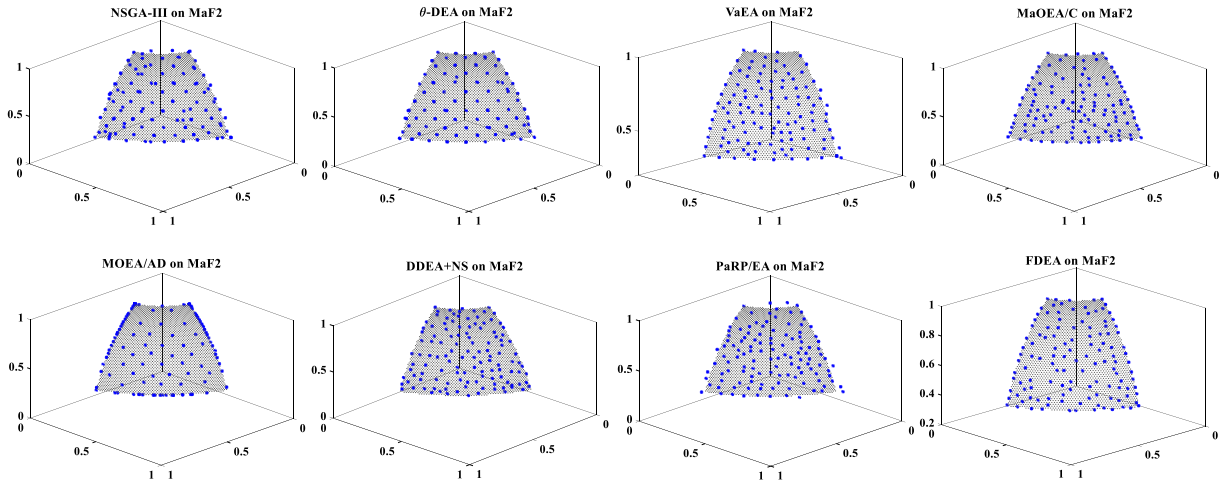


Fig. A26 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF2 problem and the true PF indicated by the dash area.

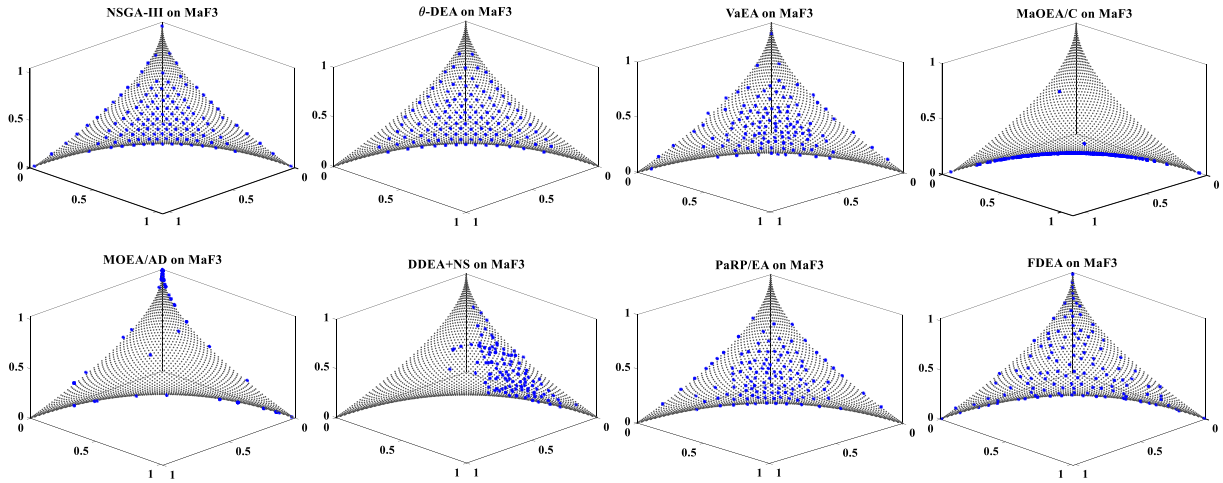


Fig. A27 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF3 problem and the true PF indicated by the dash area.

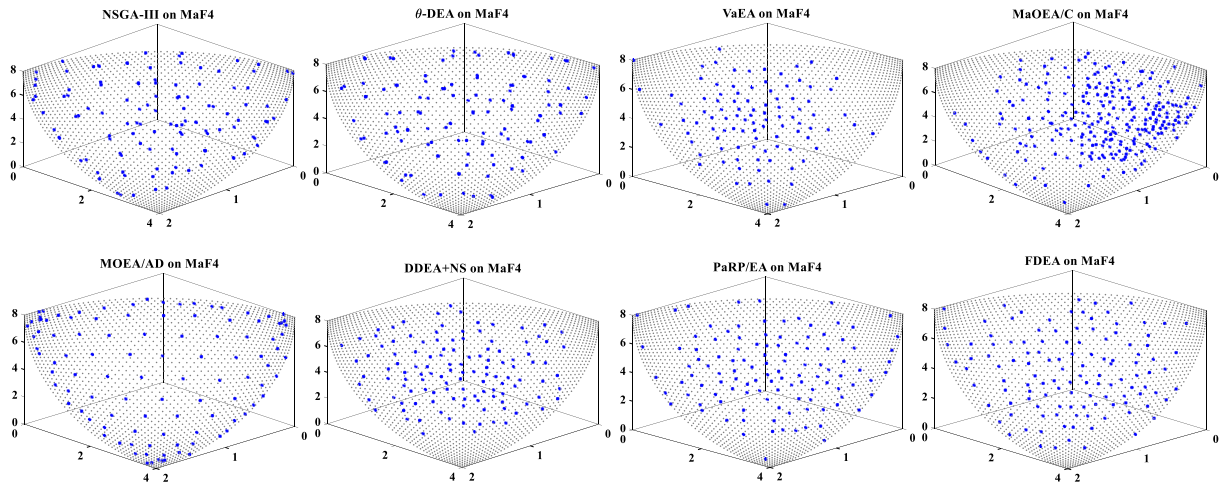


Fig. A28 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF4 problem and the true PF indicated by the dash area.

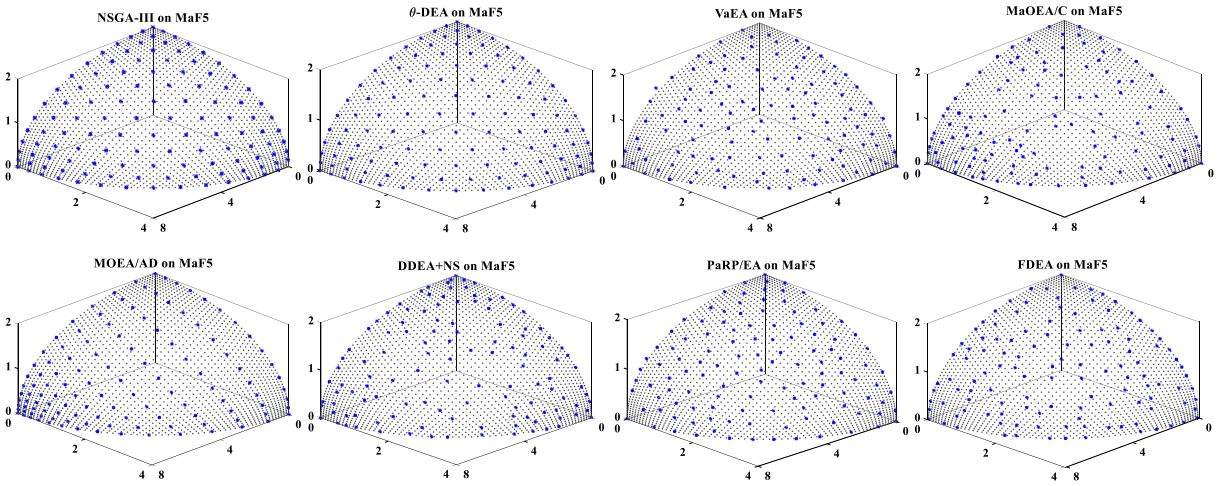


Fig. A29 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF5 problem and the true PF indicated by the dash area.

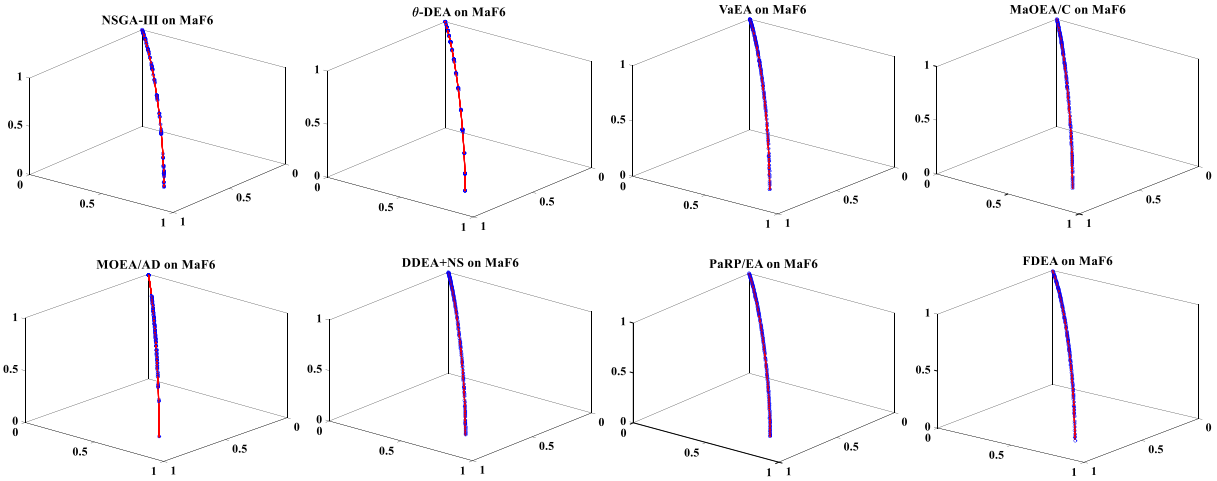


Fig. A30 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF6 problem and the true PF indicated by the dash area

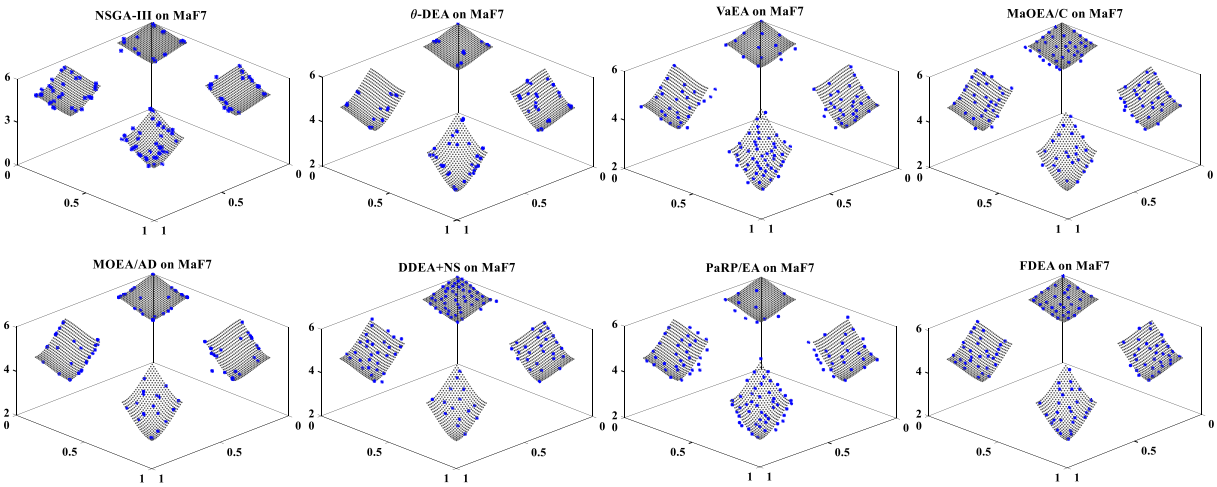


Fig. A31 The final solution sets achieved by FDEA and its seven competitors on 3-objective MaF7 problem and the true PF indicated by the dash area

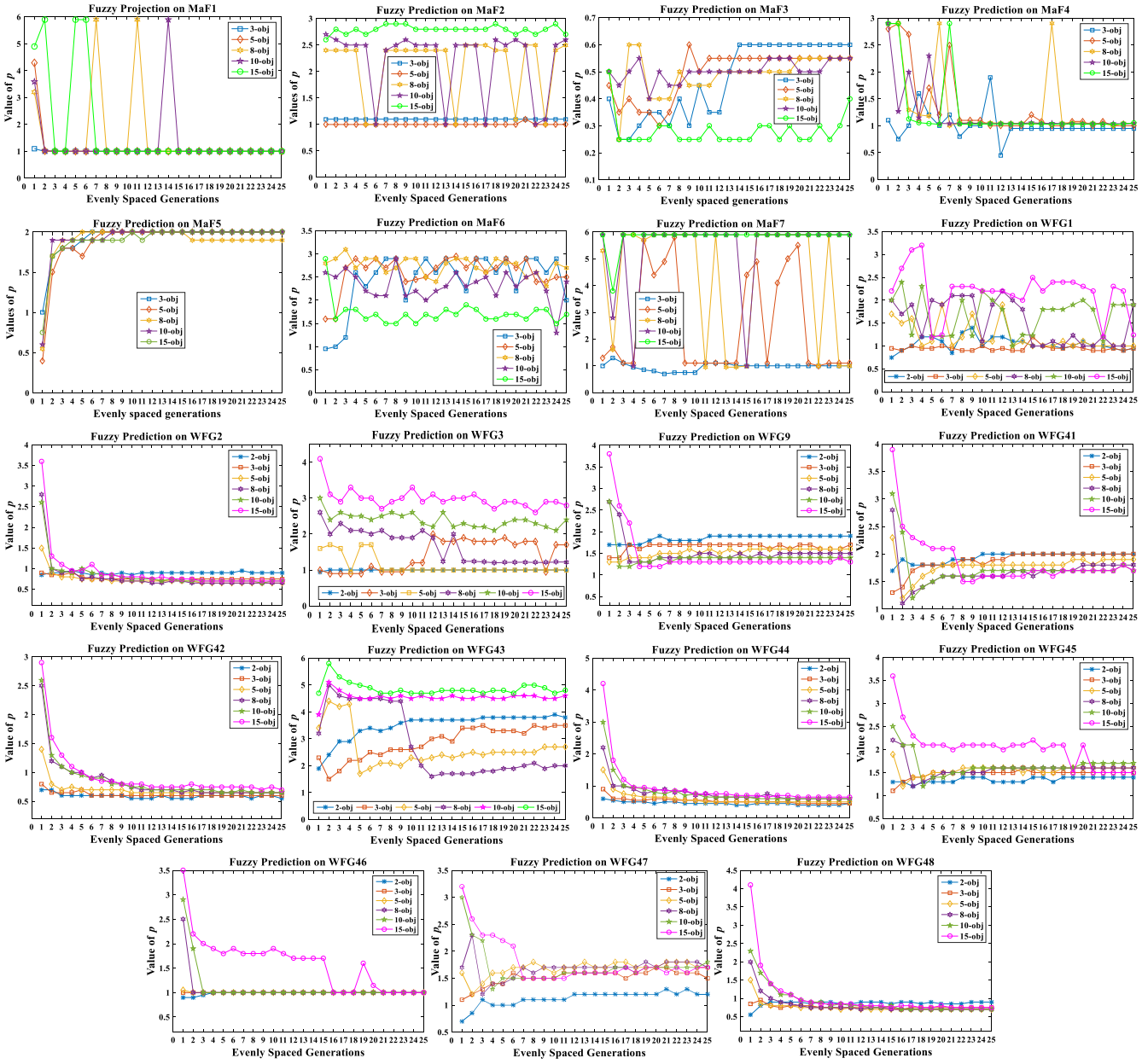


Fig. A32 The values of p obtained by our fuzzy prediction on each test problem over evenly spaced generations.

2. More Discussions about the Shared Weight Vector of w and the Predicted Values for p

1) Influence of the Shared Weight Vector w

As introduced in **Section III. C**, in order to provide a stable search direction for each subproblem, a shared subproblem (SSP) is formulated by a shared weight vector w with WS aggregated function, where w is obtained based on N extracted weight vectors by (15). As discussed in **Section III. D**, each subproblem can be regarded as a fuzzy subproblem (FSP) and all FSPs share the same goal of optimizing the SSP for achieving the collaborative optimization. Thus, the decomposition-based optimization of a MOP in FDEA can be figuratively described in Fig. A33, where a MOP is first decomposed into N FSPs to maintain the diversity, followed by a collaborative search via optimizing the SSP to preserve the convergence. Here, two variants of FDEA, respectively termed FDEA-I and FDEA-II, are proposed to validate the efficiency of the collaborative search based on optimizing the SSP. Regarding FDEA-I, the shared w is fixed as (1, 1, …, 1) during the optimization process. Considering FDEA-II, with the same way in traditional decomposition-based optimizers, the i-th FSP is optimized only based on the corresponding extracted weight vector w^i, i.e., no shared w is applied in FDEA-II. Note that, the WS aggregated function is also used for each FSP in FDEA-II.

The HV results of FDEA-I and FDEA-II on MaF1-MaF13, WFG1-WFG9, and WFG41-WFG48 problems with 5 and 10 objectives are provided in Table A. XII. According to Wilcoxon rank sum test, when compared to FDEA-I and FDEA-II, FDEA is respectively worse in 6 and 1 out of 60 cases, while it is respectively better in 28 and 53 cases, which validate that FDEA outperforms its two variants for tackling these 5- and 10-objective MaF, WFG and WFG4x problems. Particularly, FDEA-I is similar with FDEA in 26 out of 60 cases, and most of these similar cases happen when handling the regular problems, e.g., MaF5, WFG4-WFG8, and WFG46, while FDEA-II is almost worse than FDEA on all involved test problems.

For FDEA-I, the shared w is a fixed vector (1, 1, …, 1), which indicates that the SSP is fixed during the optimization process. In FDEA, the w is adaptively obtained by following the distribution of N extracted weight vectors, where N is the population size. On regular problems (with symmetric PFs), the adaptively generated w in FDEA is almost the same with vector (1, 1, …, 1). Hence, the performance of FDEA and FDEA-I is similar on most of regular problems. However, when handling irregular problems (with imbalanced PFs), e.g., WFG1-WFG3 and MaF7 problems, the adaptively formulated SSP with a suitable w can be more effective to guide the evolutionary search, as validated by the HV results in Table A. XII. Moreover, during the early and median stages of the evolution, the distribution of the obtained population is always imbalanced, even for regular problems. Therefore, it is reasonable to formulate the SSP with an adaptively obtained weight vector in FDEA.

For FDEA-II, its performance is extremely worse than FDEA. As shown in Fig. A34, the MOP in FDEA-II is firstly decomposed into N FSPs, and then each of them is optimized independently. Here, each FSP obtains a definite expression, which is formulated by WS function with the corresponding extracted weight vector. However, the N extracted weight vectors are almost changed at each generation, which may deteriorate the convergence speed, as the dynamically changed search directions in each generation may be confusing. Therefore, without defining the SSP for all FSPs to achieve the collaborative optimization, FDEA-II is not good at maintaining the convergence of the population, which inversely validates the efficiency of the collaborative optimization way in FDEA.

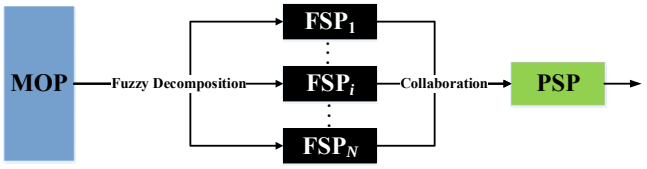


Fig. A33 The Fuzzy Decomposition-based optimization of a MOP in FDEA

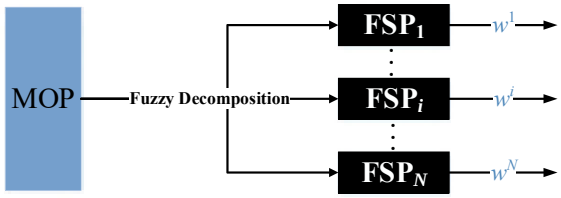


Fig. A34 The Decomposition-based optimization of a MOP in FDEA-II

2) Influence of the Value for p

From the experimental studies in **Section IV**, the effectiveness of our proposed FDEA has been validated. As introduced in **Section III. B**, a fuzzy prediction (FP) is firstly proposed in FDEA to estimate an UH^p for fitting the shape of the population. To verify the effectiveness of the predicted p, another four variants of FDEA are proposed here, which are termed as FDEA-III, FDEA-IV, FDEA-V, and FDEA-VI, respectively. Without adopting FP to predict the value of p in the above former three variants, the p is correspondingly set as $p = 0.5$, $p = 1.0$, and $p = 2.0$. In FDEA-VI, the p is predicted by (9) instead of (10).

The HV results of FDEA-III, FDEA-IV, FDEA-V, and FDEA-VI on MaF1-MaF13, WFG1-WFG9, and WFG41-WFG48 problems with 5 and 10 objectives are provided in Table A. XII. According to Wilcoxon rank sum test, when compared to FDEA-III, FDEA-IV, FDEA-V and FDEA-VI, FDEA is respectively worse in 14, 10, 14, and 5 out of 60 cases, while it is respectively better in 34, 36, 33 and 24 cases, which validate that FDEA outperforms its above four variants for tackling these 5- and 10-objective MaF, WFG and WFG4x problems. Specifically, FDEA-III with $p = 0.5$ performs well on convex problems, e.g., MaF3 and WFG42, but performs poorly on concave problems, e.g., WFG4-WFG8, whereas FDEA-V with $p = 2.0$ has the opposite performance. Considering FDEA-IV with $p = 1.0$, it is good at tackling linear or mixed problems, e.g., MaF1, WFG45-WFG46, but facing some challenges on dealing with convex problems (when compared with FDEA-III) or concave problems (when compared with FDEA-V). For FDEA with an adaptive value of p from the fuzzy prediction, no matter facing the problems with convex, concave or linear PFs, it can handle most of them well, which validates the effectiveness of our proposed fuzzy prediction. Without further adjusting the predicted value of p by (10), FDEA-VI obtains a lot of similar results with FDEA, i.e., in 31 out of 60 cases, but the overall performance of FDEA-VI on these test problems is worse than that of FDEA, especially in linear problems like WFG46 and MaF9, in inverted problems like MaF1 and MaF8, and mixed problems like WFG2, WFG47-WFG48, which validates the effectiveness of the fuzzily adjustment of p by (10). Here, the fuzzy adjustment of p is mainly used to fit the MOPs with linear PF shapes that may be far away from the UH^1, e.g., MaF1. Moreover, for the target MOPs with inconspicuously concave or convex PFs, e.g., linear or mixed PFs, we would predict them to be linear-like PFs, rather than confuse the concave or convex PFs wrongfully, so the predicted values of p by (10) on some

MOPs with linear and mixed PFs are going to fluctuate more around 1.0 compared to the values obtained by (9), which can improve the performance of FDEA on these problems. Furthermore, the condition that the coefficient of variation $cv < 0.1$ in (10) is very difficult to meet, if the MOP's PF has relatively conspicuous concavity and convexity. Thus, for most test problems involved in this paper, the predicted values of p by (10) are basically the same with that obtained by (9).

Moreover, from the results in Table A. XII, the finite three values of p for FDEA, i.e., 0.5 in FDEA-III, 1.0 in FDEA-IV, and 2.0 FDEA-V, are basically enough to cover all involved test problems. Hence, it is reasonable for the proposed FP by fuzzily fitting the shape of the current non-dominated solutions to the model of UH^p with finite sample values of p, and it is also easily implementable and efficient in terms of computational cost.

3) Observation of Predicted Values for p

The effectiveness of the predicted p has been validated above. Here, the values of p obtained by our fuzzy prediction (**Algorithm 3**) on each test problem are examined at each generation. In principle, p can be predicted to be any value within $(0, \infty)$. However, considering the computational efficiency, only a limited number of samples (68 samples in (7)) are used as the predicted values here, as the algorithm's performance is not severely degraded. Thus, Fig. A32 in the supplementary file illustrates the predicted values of p for all test problems over evenly spaced generations, where only 25 values of p are extracted during the evolutionary process for each problem on all considered numbers of objectives. As the values of $G_{\max}$ are set to 300, 500, 600, 800, 1000 and 1500, respectively for 2-, 3-, 5-, 8-, 10- and 15-objective test problems, the interval generations are correspondingly set to 12, 20, 24, 32, 40 and 60 to extract the 25 values of p. For the fuzzy prediction on most problems of Fig. A32, it is observed that the predicted p of UH^p can basically match the characteristics of the target problem's PF, i.e., $p>1$ for concave problems (e.g., MaF5, WFG9, WFG41 and WFG43), $p<1$ for convex problems (e.g., MaF3, WFG42 and WFG44), $p=1$ for linear problems (e.g., MaF1 and WFG46), and p is fluctuated slightly around 1 for mixed problems (e.g., WFG2 and WFG45). Moreover, the predicted p is fluctuated significantly due to the unclear distribution of the population at the early stage of evolution, but it gradually becomes stable at a later stage when the population's distribution tends to be stable for solving MaF4-MaF5, WFG2 and WFG41-WFG48.

Generally, the true PF of a MOP with different objectives can be modeled as UH^p with the same p value. However, from the observation of Fig. A32, we can find that the predicted p is varied for different numbers of objectives on most MOPs. Moreover, when compared to the corresponding true PF, the predicted value of p is inaccurate on some problems, e.g., MaF4, MaF6 and WFG43. In fact, it is hard to guarantee that the estimated p is the same for a MOP on different numbers of objectives. Also, it is hard to assure the high accuracy of the predicted value of p during the optimization process. There are several main factors in influencing the prediction of p, which are explained below:

First, without involving the information of the true PF of the MOP, the prediction of p value in FDEA is based on the current non-dominated solution set. Therefore, it is hard to guarantee that the population keeps the same curvature during the optimization process, and it is more difficult for the case with different numbers of objectives, especially for irregular problems, e.g., inverted and badly-scaled MaF4, and degenerated MaF6. As discussed in **Section III. B. 1**, the performance on the prediction of p is strongly dependent on the quality of the population. Therefore, the convergence degree and the diversity status of the population are the important factors to influence the predicted p. However, only an appropriate value of p can enhance the optimization process.

Second, the normalization procedure is included in FDEA. Thus, before the prediction of p, solutions are firstly normalized to mitigate the impact of different scaled objectives in MOPs (**described in Section III. A**). As we all know, the nadir point needs to be firstly estimated for the normalization, which is also relatively hard to get the accurate nadir point without the true PF information, especially in the high dimensional objective space. Therefore, the prediction of p is also strongly dependent on the estimation of the nadir point, especially for the problems with many objectives.

Third, with the increase in the number of objectives, the proportion of non-dominated solutions increases exponentially, thereby the predicted p is fluctuated slightly under different objective numbers in a MOP. For instance, the predicted values of p on WFG43 are about 3.8, 3.5, 2.7, 2.0, 4.6 and 4.7, respectively for the cases of 2, 3, 5, 8, 10 and 15 objectives, which are plotted in Fig. A32.

Finally, as discussed and validated above, it is reasonable that the p value in FDEA is fuzzily predicted from a finite set of values. Thus, the proposed fuzzy prediction only requires to roughly predict a UH^p that can basically judge the concavity or the convexity on the shape of population, which is enough to enhance the optimization performance during the evolutionary process. For example, the predicted value of p for MaF6 is not so accurate when compared to the true PF, but we still can get a basic judge for the concavity or the convexity on the shape of population during the optimization process in solving MaF6, i.e., its PF shape is concave with the curvature ranging from 1.5 to 3.0.