

Table 1: HV Indicator values of 6 algorithms on test problems MaF1- MaF10 , where the best mean for each problem is highlighted

Function	Obj	KnEA	NSGA-III	MOEA/DD	SPEA/R	RVEA	MSPSO
MaF1	2	3.423E+0(4.5623E-2)	7.685E+0(8.563E-2)	1.341E+0(3.2317E-2)	1.834E+0(4.020E-2)	1.548E+0(2.36E-2)	1.673E+0(2.427E-2)
	4	1.348E+0(3.156E-2)	2.514E-0(6.314E-2)	1.341E+0(3.23E-2)	2.450E+0(3.19E-2)	2.082E+0(3.118E-2)	1.588E+0(2.510E-2)
	6	6.861E+0(6.163E-2)	2.223 E-0(6.34E-2)	6.82E+0(1.271E-2)	1.66E+0(2.132E-2)	2.899E+0(1.331E-2)	2.032E+0(2.181E-2)
	8	4.1983E+1(1.926E-2)	4.56E+0(6.34E-2)	1.932+0(2.164E-2)	1.834E+0(4.020E-2)	1.981E+0(2.132E-2)	2.134E+0(1.717E-2)
	10	8.364E+1(1.586E-2)	2.485E+0(8.469E-2)	2.64E+0(3.52E-1)	1.532E+0(1.583E-1)	2.6387E+0(6.578E-2)	3.579E+0(5.47E-2)
MaF2	2	3.263E+0(2.331E-2)	6.434E+0(5.613E-2)	2.221E-1(3.147E-2)	1.6234E-1(2.02E-2)	2.668E+0(3.16E-2)	1.322E+0(3.517E-2)
	4	2.541E+0(2.556E-2)	1.254E-0(4.004E-2)	3.441E+0(3.201E-2)	2.416E+0(2.089E-2)	2.372E+0(3.48E-2)	2.018E-2(3.65E-3)
	6	2.226E-1(4.013E-2)	2.343 E-0(4.124E-2)	5.452E-1(3.126E-2)	2.506E+0(3.142E-2)	1.921E+0(2.361E-2)	2.345E-2(3.024E-3)
	8	5.221E+1(1.453E-2)	2.156E+0(4.234E-2)	3.914+0(3.764E-2)	1.446E+0(4.369E-2)	2.7181E-2(3.536E-3)	2.884E-20(1.446E-3)
	10	1.641E+1(1.446E-2)	4.325E+0(6.335E-2)	3.614E+0(3.502E-1)	1.882E+0(2.643E-1)	1.864E-2(6.004E-3)	2.667E-2(3.03E-2)
MaF3	2	2.3180E-3 (1.78E-5)	7.5417E-2 (1.721E-1)	2.4914E-2 (2.123E-3)	4.9162E-3 (1.89E-4)	6.321E-2 (1.64E-1)	6.582E-3 (4.728E-4)
	4	3.31427E+0 (3.68E-2)	8.21E-1 (4.289E-1)	1.173E-1 (5.68E-3)	2.8538E-1 (7.96E-3)	5.371E-2 (1.821E-3)	2.412E-1 (3.526E-2)
	6	7.661E+0 (8.127E-2)	5.7183E-1 (2.35E-1)	3.8586E-1 (2.13E-2)	5.426E-1 (2.226E-2)	1.434E-2 (2.42E-3)	4.890E-1 (1.826E-2)
	8	2.184E+0 (1.424E-1)	1.876E+0 (2.932E-1)	1.061E+0 (2.103E-2)	9.791E-1 (5.14E-2)	2.529E-2 (1.631E-1)	8.6947E-1 (6.49E-2)
	10	2.5870E+0 (1.01E-1)	1.7560E+0 (5.18E-1)	1.79E+0 (1.18E-1)	1.284E+0 (8.41E-2)	1.89E-2 (1.561E-1)	1.1988E+0 (5.41E-2)
MaF4	2	5.1750E-3 (1.38E-6)	4.1369E-3 (1.76E-4)	8.2565E-3 (2.69E-4)	3.41E-2 (3.281E-1)	4.1603E-3 (1.39E-5)	6.7929E-3 (1.03E-3)
	4	2.4911E-2 (2.82E-4)	2.8469E-2 (2.26E-3)	1.5966E-2 (1.04E-3)	4.5300E-2 (1.17E-2)	8.103E-3 (1.119E-5)	8.3933E-2 (2.52E-2)
	6	2.537E-2 (2.54E-3)	8.712E-2 (1.144E-2)	1.766E-2 (1.76E-3)	2.3084E-3 (2.54E-4)	3.165E-1 (7.18E-2)	2.106E-1 (4.23E-2)
	8	3.20E-2 (3.378E-3)	6.095E-2 (3.765E-2)	2.241E-1 (3.86E-2)	2.37E-2 (1.43E-3)	2.571E-1 (3.124E-2)	5.295E-2 (3.15E-2)
	10	3.85E-2 (1.67E-3)	6.111E-2 (3.734E-2)	3.838E-1 (5.47E-2)	4.1898E-2 (6.112E-4)	2.1038E+0 (6.47E-1)	2.5135E-1 (4.31E-2)
MaF5	2	6.8710E-3 (2.10E-4)	5.5751E-1 (3.28E-1)	8.8575E-3 (5.04E-4)	3.9883E-3 (2.70E-5)	4.871E-1 (2.128E-1)	5.260E-3 (4.281E-4)
	4	4.64E-1 (4.320E-3)	4.153E-1 (2.12E-1)	1.1443E-1 (6.24E-2)	2.3346E-1 (6.32E-2)	5.161E-1 (2.312E-3)	2.2611E-1 (3.164E-3)
	6	4.35E-1 (1.127E-1)	5.38E-1 (8.29E-2)	2.15E-1 (1.867E-3)	2.1706E-1 (3.87E-3)	2.5392E-1 (1.42E-4)	2.769E-1 (3.299E-3)
	8	3.7719E-1 (2.60E-2)	6.05E-1 (6.185E-2)	3.67E-1 (1.296E-3)	3.936E-1 (3.42E-3)	3.3896E-1 (2.62E-3)	3.129E-1 (3.245E-2)
	10	6.536E-1 (1.49E-2)	7.380E-1 (3.64E-2)	3.4736E-1 (1.38E-3)	4.1024E-1 (2.19E-2)	3.2591E-1 (2.04E-3)	2.355E-1 (1.687E-3)
MaF6	2	4.250E1 (2.7E1)	2.663E1 (6.18E2)	4.976E1 (3.34E1)	1.449E1 (4.49E3)	5.382E1 (2.78E1)	1.913E1 (1.01E1)
	4	6.330E1 (3.41E1)	3.973E1 (7.01E2)	7.018E1 (2.86E1)	3.147E1 (3.92E2)	5.857E1 (3.05E1)	2.154E1 (9.75E2)
	6	6.035E1 (1.67E1)	9.541E1 (1.62E1)	6.672E1 (1.012E1)	3.685E1 (1.61E2)	6.498E1 (1.6E1)	3.007E1 (4.63E3)
	8	6.459E1 (1.18E1)	1.175E+1 (2.24E1)	9.199E1 (6.11E2)	5.400E1 (2.05E2)	7.600E1 (8.64E2)	4.020E1 (3.52E3)
	10	6.267E1 (9.24E2)	8.66E1 (2.74E1)	1.074E+0 (6.19E2)	8.178E1 (4.15E2)	8.311E1 (8.74E2)	4.928E1 (3.29E3)
MaF7	2	6.417E-2 (2.721E-1)	4.2310E-3 (1.64E-5)	5.582E-3 (4.28E-4)	3.8162E-3 (1.749E-4)	5.231E-2 (1.56E-1)	3.484E-2 (2.223E-3)
	4	1.614E+0 (3.81E-2)	7.21E-1 (4.829E-1)	2.465E-1 (3.422E-2)	2.88E-1 (6.96E-3)	5.221E-2 (1.861E-1)	1.152E-1 (4.68E-3)
	6	2.79E+0 (6.27E-2)	5.783E-1 (3.385E-1)	3.490E-1 (1.26E-3)	4.46E-1 (2.65E-2)	2.34E-2 (2.442E-1)	3.586E-1 (2.143E-2)
	8	2.143E+0 (1.424E-1)	1.876E+0 (2.932E-1)	9.791E-1 (5.14E-2)	1.061E+0 (2.103E-2)	2.529E-2 (1.631E-1)	8.6947E-1 (6.49E-2)
	10	2.870E+0 (1.31E-1)	2.560E+0 (4.18E-1)	2.228E+0 (6.241E-2)	1.179E+0 (1.118E-1)	1.59E-2 (1.601E-1)	1.1988E+0 (5.41E-2)
MaF8	2	3.492E1 (1.81E1)	2.151E1 (8.26E3)	4.846E1 (1.99E1)	1.57E+0 (4.19E1)	5.152E1 (7.42E2)	1.897E1 (6.8E3)
	4	6.310E1 (2.112E1)	4.127E1 (1.46E2)	8.972E1 (2.51E1)	7.581E+0 (1.3E+0)	6.444E1 (8.17E2)	3.238E1 (1.0E2)
	6	5.856E1 (1.49E1)	6.608E1 (3.06E2)	9.894E1 (1.95E1)	1.085E+1 (2.54E+0)	7.551E1 (6.18E2)	4.888E1 (1.67E2)
	8	8.971E1 (5.14E3)	2.293E+0 (4.31E1)	1.065E+0 (4.12E2)	1.945E+1 (2.06E+0)	1.064E+0 (1.34E1)	7.643E1 (3.15E2)
	10	1.180E-2 (3.26E3)	4.211E+0 (7.52E1)	1.224E+0 (8.41E2)	2.670E+1 (3.4E+0)	1.546E+0 (2.04E1)	1.057E+0 (3.82E2)
MaF9	2	3.126E-10(2.246E-2)	6.715E+0(5.332E-2)	2.341E+0(4.127E-2)	3.834E-2(4.332E-3)	2.458E+0(3.136E-2)	4.513E+0(1.217E-2)
	4	4.248E+0(2.551E-2)	3.614E-0(2.134E-2)	1.431E+0(4.123E-2)	2.445E-2(3.339E-3)	2.82E+0(3.18E-2)	1.588E+0(2.51E-2)
	6	16243E+0(3.223E-2)	3.113 E-0(7.34E-2)	4.182E+0(2.371E-2)	3.33E+0(2.452E-2)	2.842E+0(2.644E-2)	1.032E-2(2.181E-3)
	8	5.783E+1(1.736E-2)	5.456E+0(3.134E-2)	2.562+0(3.452E-2)	1.431E+0(3.22E-2)	2.014E+0(1.67E-2)	1.771E-2(3.002E-3)
	10	2.364E+0(1.226E-2)	1.861E+0(4.119E-2)	3.164E+0(2.52E-1)	1.432E+0(1.223E-1)	1.3187E+0(4.168E-2)	1.512E-2(3.217E-3)
MaF10	2	1.322E+0(1.123E-2)	5.615E+0(4.563E-2)	1.221E+0(1.217E-2)	1.634E-1(4.321E-2)	1.448E+0(2.326E-2)	2.173E+0(2.142E-2)
	4	1.618E+0(3.106E-2)	1.124E-0(4.324E-2)	1.221E+0(1.213E-2)	2.231E-2(3.709E-3)	2.82E+0(3.18E-2)	1.668E+0(2.512E-2)
	6	2.86E-2(6.163E-3)	2.213 E-0(4.314E-2)	7.812E+0(1.327E-2)	1.686E+0(2.142E-2)	2.569E+0(1.221E-2)	2.432E+0(2.001E-2)
	8	4.413E-2(2.723E-3)	2.516E+0(4.340E-2)	1.763+0(3.164E-2)	1.642E+0(4.111E-2)	3.981E+0(2.167E-2)	3.134E+0(1.537E-2)
	10	3.064E-2(2.62E-3)	2.351E+0(4.119E-2)	1.624E+0(3.532E-1)	2.534E+0(1.682E-1)	3.722E+0(5.538E-2)	2.549E+0(4.247E-2)

Table 2: HV Indicator values of 6 algorithms on test problems MaF11- MaF15 , where the best mean for each problem is highlighted

Function	Obj	KnEA	NSGA-III	MOEA/DD	SPEA/R	RVEA	MSPSO
MaF11	2	3.205E-3 (1.618E-5)	5.327E-2 (1.401E-1)	2.434E-2 (3.123E-3)	3.8162E-3 (1.869E-4)	4.231E-2 (1.654E-1)	2.422E-3 (3.668E-4)
	4	2.314E+0 (2.628E-2)	6.241E-1 (3.219E-1)	2.773E-1 (4.268E-3)	2.828E-1 (4.926E-3)	3.241E-2 (1.541E-1)	2.426E-2 (3.52E-3)
	6	1.668E+0 (2.127E-2)	4.383E-1 (2.365E-1)	3.186E-1 (2.133E-2)	5.646E-2 (2.162E-3)	1.444E-2 (2.412E-1)	4.872E-1 (1.624E-3)
	8	2.148E+0 (1.455E-1)	1.436E+0 (2.332E-1)	1.261E+0 (2.153E-2)	4.661E-2 (2.514E-3)	2.429E-2 (2.631E-1)	8.227E-1 (3.419E-2)
	10	2.566E+0 (1.342E-1)	1.763E+0 (3.418E-1)	2.719E+0 (1.128E-1)	1.223E-2 (6.41E-3)	1.849E-2 (1.5161E-1)	1.148E+0 (3.451E-2)
MaF12	2	5.162E-3 (2.38E-3)	4.189E-3 (1.46E-5)	5.465E-3 (2.169E-4)	2.421E-2 (3.641E-1)	4.183E-3 (1.349E-4)	4.239E-2 (1.203E-3)
	4	2.311E-2 (4.282E-3)	2.628E-3 (3.246E-5)	1.556E-2 (1.204E-3)	4.653E-2 (1.117E-2)	8.166E-3 (1.129E-3)	5.313E-2 (3.152E-2)
	6	3.447E-2 (2.524E-3)	5.712E-2 (1.341E-2)	1.216E-2 (1.46E-3)	2.384E-1 (2.536E-2)	3.165E-2 (4.318E-4)	3.196E-1 (4.223E-2)
	8	2.246E-2 (3.356E-3)	4.185E-2 (3.465E-2)	1.241E-1 (3.721E-2)	3.567E-1 (6.143E-2)	2.543E-2 (2.124E-4)	3.521E-2 (3.615E-2)
	10	2.815E-2 (2.637E-3)	4.101E-2 (3.531E-2)	3.442E-1 (5.417E-2)	4.126E-1 (3.122E-2)	2.638E-2 (4.147E-4)	2.415E-1 (3.321E-2)
MaF13	2	1.261E-3 (2.122E-4)	3.5751E-1 (3.218E-1)	8.215E-3 (5.004E-4)	3.183E-3 (3.710E-5)	4.871E-1 (2.128E-1)	5.260E-2 (4.281E-3)
	4	2.21E-1 (4.320E-3)	4.153E-1 (2.12E-1)	1.1423E-1 (6.240E-2)	2.346E-1 (6.322E-2)	5.161E-2 (2.312E-3)	2.261E-1 (3.164E-3)
	6	2.35E-1 (1.127E-1)	3.38E-1 (8.219E-2)	2.150E-1 (1.867E-3)	2.176E-1 (3.871E-3)	2.572E-2 (1.420E-4)	2.769E-1 (3.295E-3)
	8	4.719E-1 (2.601E-2)	6.825E-1 (6.185E-2)	3.617E-1 (1.296E-3)	3.122E-1 (3.412E-3)	3.312E-2 (2.622E-4)	3.129E-2 (3.245E-3)
	10	7.536E-1 (1.49E-2)	3.380E-1 (3.624E-2)	3.4736E-1 (1.338E-3)	4.124E-1 (2.119E-2)	3.291E-1 (2.024E-3)	2.355E-2 (1.627E-3)
MaF14	2	1.330E1 (2.217E1)	2.663E1 (4.118E2)	4.436E1 (3.314E1)	1.449E2 (2.419E3)	5.382E1 (2.742E1)	1.913E1 (1.021E1)
	4	2.243E1 (3.541E1)	3.323E1 (2.421E2)	5.418E1 (2.860E1)	3.2147E1 (3.972E2)	26657E1 (3.105E1)	2.154E2 (9.750E3)
	6	6.445E1 (2.67E1)	7.541E1 (1.6221)	4.672E1 (1.512E1)	3.395E1 (1.621E2)	6.378E1 (1.436E1)	3.224E2 (2.063E3)
	8	4.759E1 (3.128E1)	1.765E+1 (2.424E1)	5.579E1 (4.141E2)	5.400E1 (2.45E2)	6.420E-1 (5.634E2)	3.122E2 (4.152E3)
	10	3.267E1 (9.241E2)	8.636E1 (2.724E1)	1.174E+0 (6.232E2)	4.168E1 (4.15E2)	4.21E1 (8.74E2)	3.248E2 (2.229E3)
MaF15	2	3.722E-2 (3.521E-1)	4.205E-3 (1.842E-5)	6.592E-3 (4.280E-3)	3.422E-3 (1.419E-4)	3.231E-2 (1.560E-1)	2.442E-2 (2.263E-3)
	4	3.614E+0 (3.821E-2)	6.242E-1 (4.818E-1)	2.665E-1 (2.422E-2)	2.421E-1 (5.946E-3)	2.221E-2 (1.861E-1)	1.152E-1 (4.68E-3)
	6	2.524E+0 (4.227E-2)	5663E-1 (2.385E-1)	3.490E-2 (1.26E-3)	3.426E-1 (2.651E-2)	2.534E-2 (2.442E-1)	3.486E-2 (2.343E-2)
	8	2.243E+0 (1.424E-1)	1.876E+0 (2.932E-1)	6.781E-1 (5.14E-2)	1.061E+0 (2.103E-2)	2.529E-2 (1.631E-1)	3.646E-2 (3.490E-3)
	10	2.361E+0 (1.31E-1)	2.560E+0 (4.18E-1)	2.228E+0 (6.241E-2)	1.179E+0 (1.118E-1)	1.580E-2 (1.637E-1)	1.668E-2 (3.341E-3)

Table 3: ZDT Test Suite used for evaluation of MSPSO

No	Function Name	Objective Functions	Search Domain
1	ZDT1	$f_1(x) = x_1, f_2 = g \cdot (1.0 - \sqrt{f_1/g}),$ $g = 1.0 + \frac{9}{n-1} \sum_{i=2}^n x_i, 0 \leq x_i \leq 1, i = 1, 2, \dots, n$	$0 \leq x_i \leq 1,$ $1 \leq i \leq 30$
2	ZDT2	$f_1(x) = x_1, f_2 = g(x) \cdot \left(1.0 - \left(\frac{x_1}{g(x)}\right)^2\right)$ $g(x) = 1.0 + \frac{9}{n-1} \sum_{i=2}^n x_i, 0 \leq x_i \leq 1, i = 1, 2, \dots, n$	$0 \leq x_i \leq 1,$ $1 \leq i \leq 30$
3	ZDT3	$f_1(x) = x_1, f_2 = g(x) \cdot \left(1.0 - \sqrt{\frac{x_1}{g(x)}} - \frac{x_1}{g(x)} \sin(10\pi x_1)\right),$ $g(x) = 1.0 + \frac{9}{n-1} \sum_{i=2}^n x_i,$	$0 \leq x_i \leq 1,$ $1 \leq i \leq 30$
4	ZDT4	$f_1(x) = x_1, f_2 = g(x) \cdot \left(1.0 - \sqrt{\frac{x_1}{g(x)}}\right),$ $g(x) = 1.0 + 10(n-1) + \sum_{i=2}^n (x_i^2 - 10 \cos(4\pi x_i)),$	$0 \leq x_i \leq 1,$ $1 \leq i \leq 30$
6	ZDT6	$f_1(x) = 1 - e^{-4x_1} \sin^6(6\pi x_1),$ $f_2(x) = g(x) \cdot \left(1 - \left(\frac{f_1(x)}{g(x)}\right)^2\right),$ $g(x) = 1 + 9 \left(\frac{\sum_{i=2}^n x_i}{n-1}\right)^{\frac{1}{4}}$	$0 \leq x_i \leq 1,$ $1 \leq i \leq 30$

Table 4: DTZ Test Suite used for evaluation of MSPSO

No	Function Name	Objective Functions	Search Domain
1	DTLZ1	$f_1(x) = \frac{1}{2}x_1x_2(1 + g(x)),$ $g(x) = 100 \left(10 + \sum_{i=3}^n (x_i - 0.5)^2 - \cos(20\pi(x_i - 0.5)) \right),$ $f_2(x) = \frac{1}{2}x_1(1 - x_2)(1 + g(x))$	$n = 12,$ $0 \leq x_i \leq 1,$ $1 = 1, 2, \dots, 12$
2	DTLZ2	$f_1(x) = (1 + g(x)\prod_{i=1}^2 \cos(y_i \frac{\pi}{2})),$ $f_2(x) = (1 + g(x)(\prod_{i=1}^2 \cos(y_i \frac{\pi}{2}) \sin(y_2 \frac{\pi}{2})))$ $f_3(x) = (1 + g(x)) \sin(y_1 \frac{\pi}{2}), g(x) = \sum_{i=1}^n (x_i - 0.5)^2$	$n = 12,$ $0 \leq x_i \leq 1,$ $1 = 1, 2, \dots, 12$
3	DTLZ3	$f_1(x) = (1 + g(x)\prod_{i=1}^2 \cos(y_i \frac{\pi}{2})),$ $f_2(x) = (1 + g(x)(\prod_{i=1}^2 \cos(y_i \frac{\pi}{2}) \sin(y_2 \frac{\pi}{2}))),$ $f_3(x) = (1 + g(x)) \sin(y_1 \frac{\pi}{2}),$ $g(x) = 100 \left(10 + \sum_{i=3}^n (x_i - 0.5)^2 - \cos(20\pi(x_i - 0.5)) \right)$	$n = 12,$ $0 \leq x_i \leq 1,$ $1 = 1, 2, \dots, 12$
4	DTLZ7	$f_1(x) = x_1, f_2(x) = x_2, f_3(x) = (1 + g(x)) \cdot h(f_1(x),$ $f_2(x), g(x)), g(x) = 1 + \frac{9}{22} \sum_{i=3}^n x_i$ $h(f_1(x), f_2(x), g(x)) = 3 - \sum_{i=1}^2 \left(\frac{f_i(x)}{1 + g(x)} (1 + \sin(3\pi f_i(x))) \right)$	$n = 12,$ $0 \leq x_i \leq 1,$ $1 = 1, 2, \dots, 12$

Table 5: Parameter Specifications of the proposed algorithm for ZDT test suite

Test Function	Population	Parameter Specification
ZDT1	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = +.2, V_{min} = -.2, Neighborhood = 21, P = 40$
ZDT2	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = +.2, V_{min} = -.2, Neighborhood = 21, P = 40$
ZDT3	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = +.2, V_{min} = -.2, Neighborhood = 21, P = 40$
ZDT4	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = +.2, V_{min} = -.2, Neighborhood = 21, P = 40$
ZDT6	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = +.2, V_{min} = -.2, Neighborhood = 21, P = 40$

Table 6: Parameter Specifications of the proposed algorithm for DTLZ test suite

Test Function	Population	Parameter Specification
DTLZ1	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = -+.2, V_{min} = -.4, Neighborhood = 22, P = 60$
DTLZ2	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = -+.2, V_{min} = -.4, Neighborhood = 22, P = 60$
DTLZ3	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = -+.2, V_{min} = -.4, Neighborhood = 22, P = 60$
DTLZ7	20 particles per objective function	$N = 2, M = 20$ per objective function, $Max = 10000, C3 = 2, V_{max} = -+.2, V_{min} = -.4, Neighborhood = 22, P = 60$

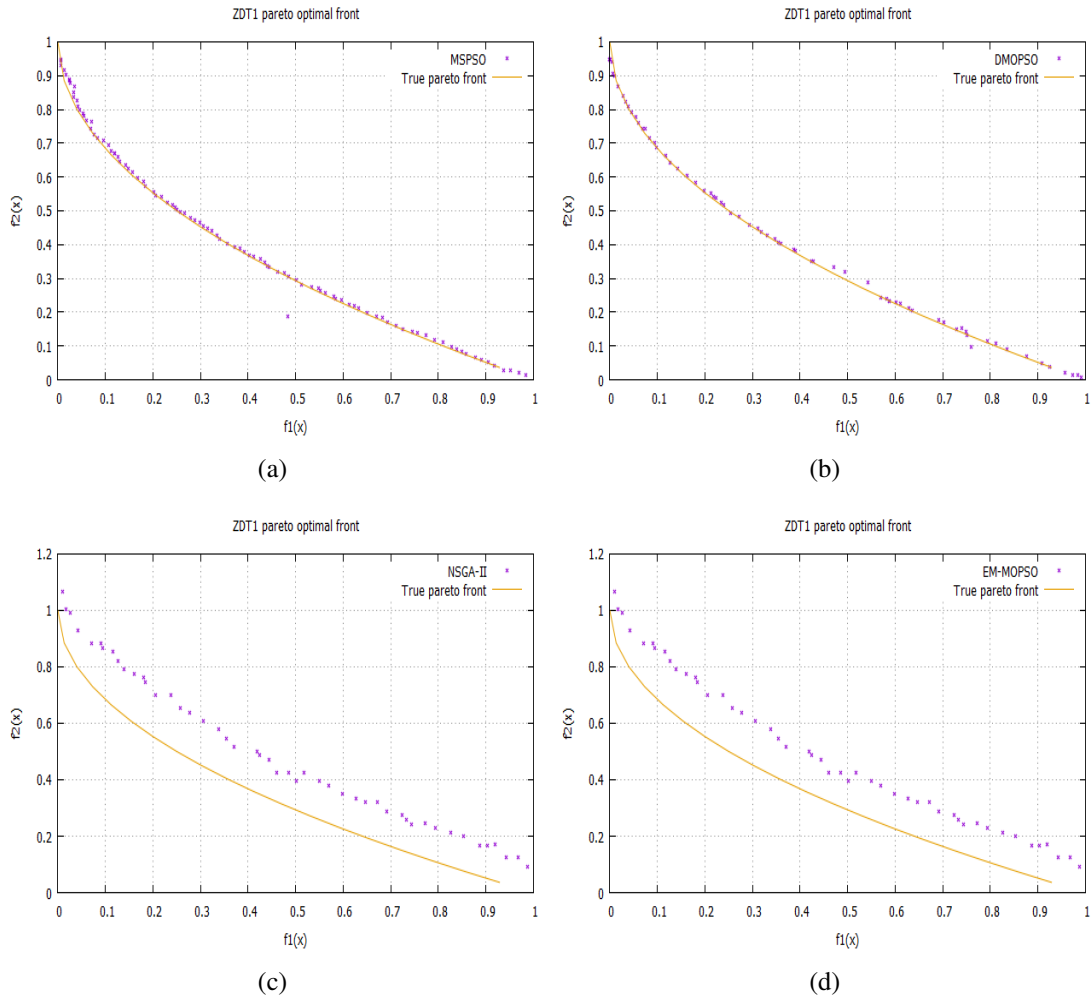


Figure 1: (a)-(d) Pareto front produced by different algorithms on ZDT1 Test function

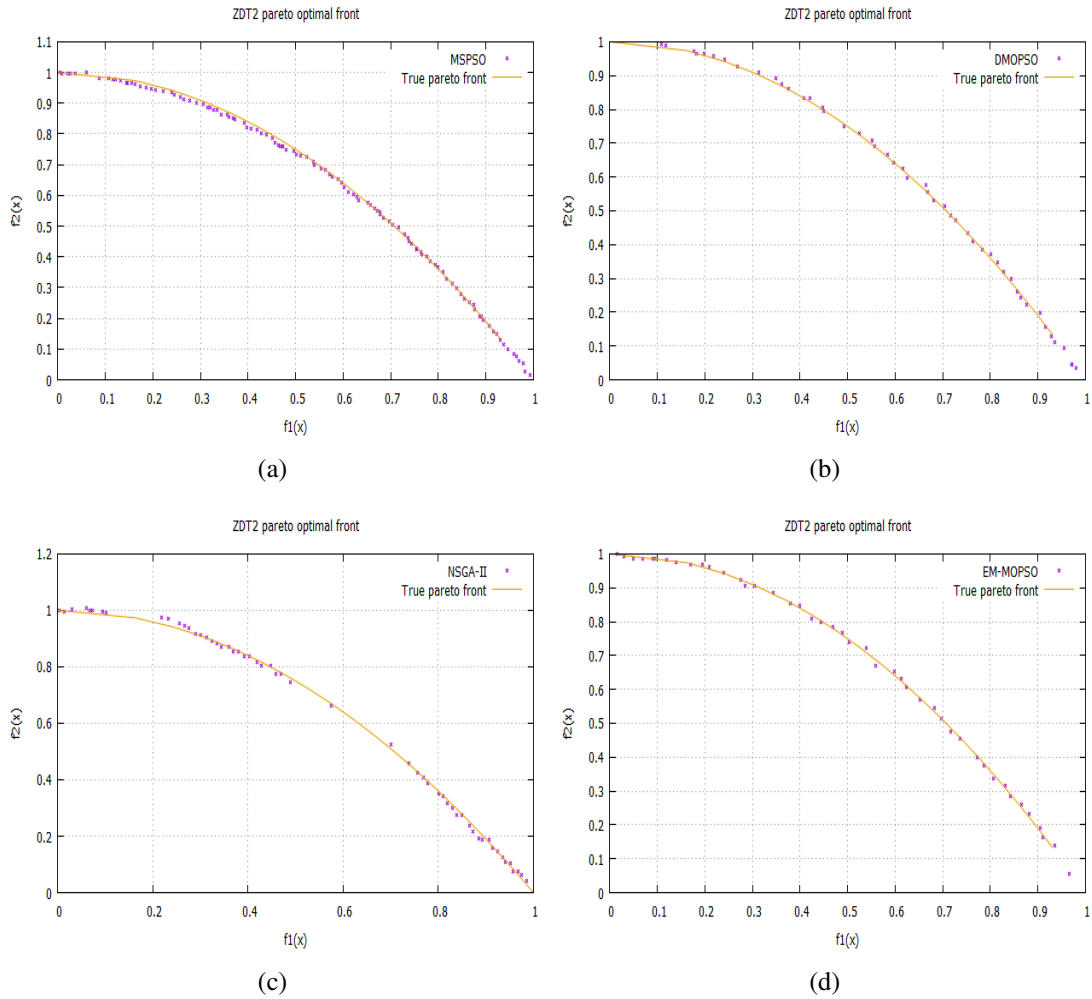


Figure 2: (a)-(d) Pareto front produced by different algorithms on ZDT2 Test function

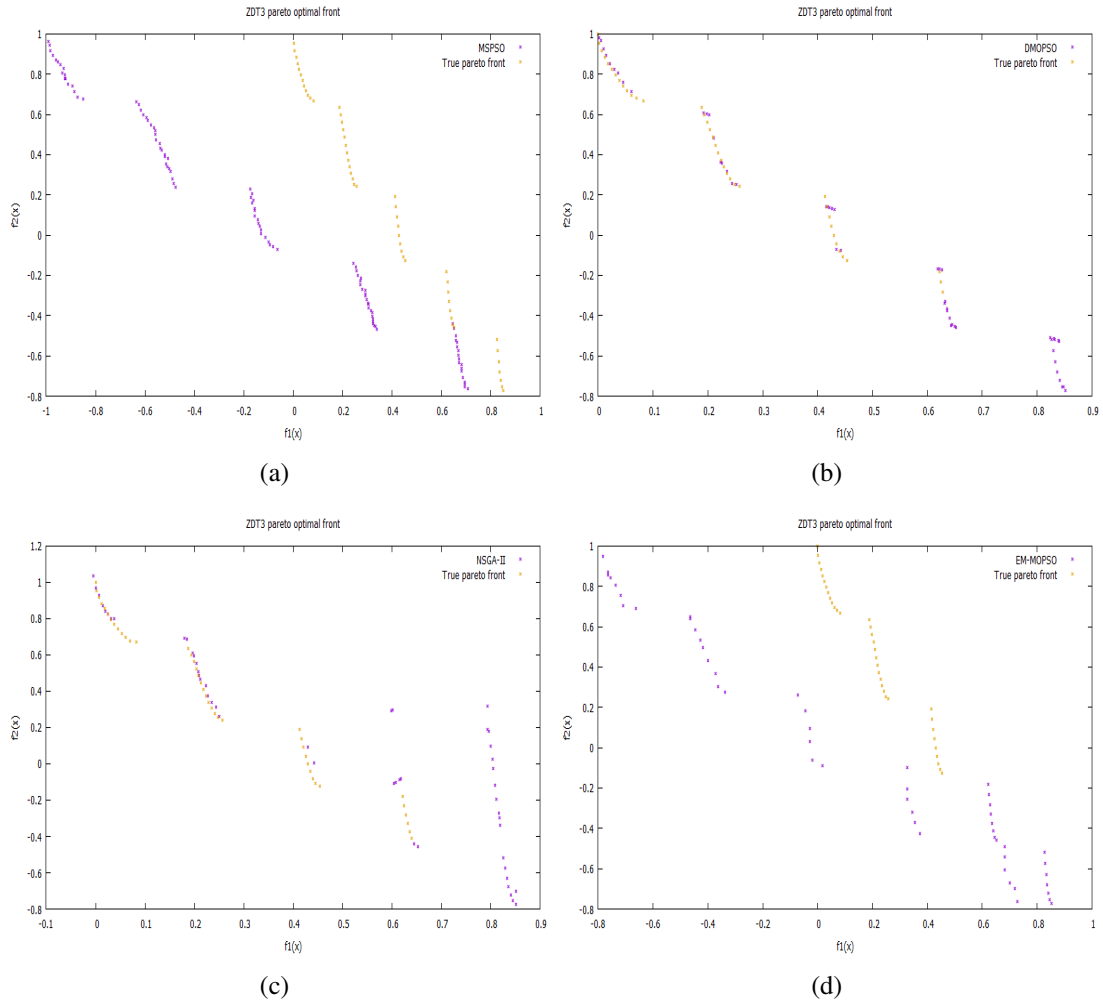


Figure 3: (a)-(d) Pareto front produced by different algorithms on ZDT3 Test function

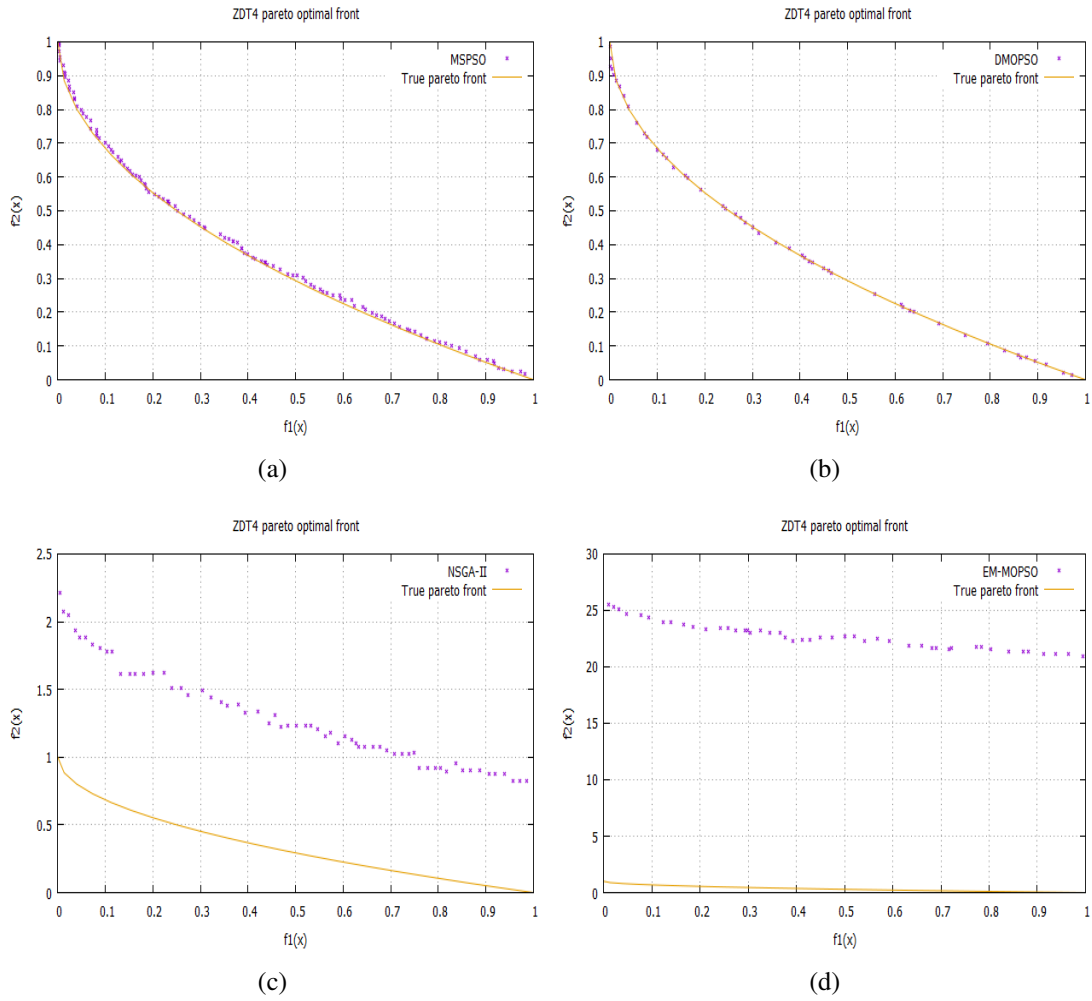


Figure 4: (a)-(d) Pareto front produced by different algorithms on ZDT4 Test function

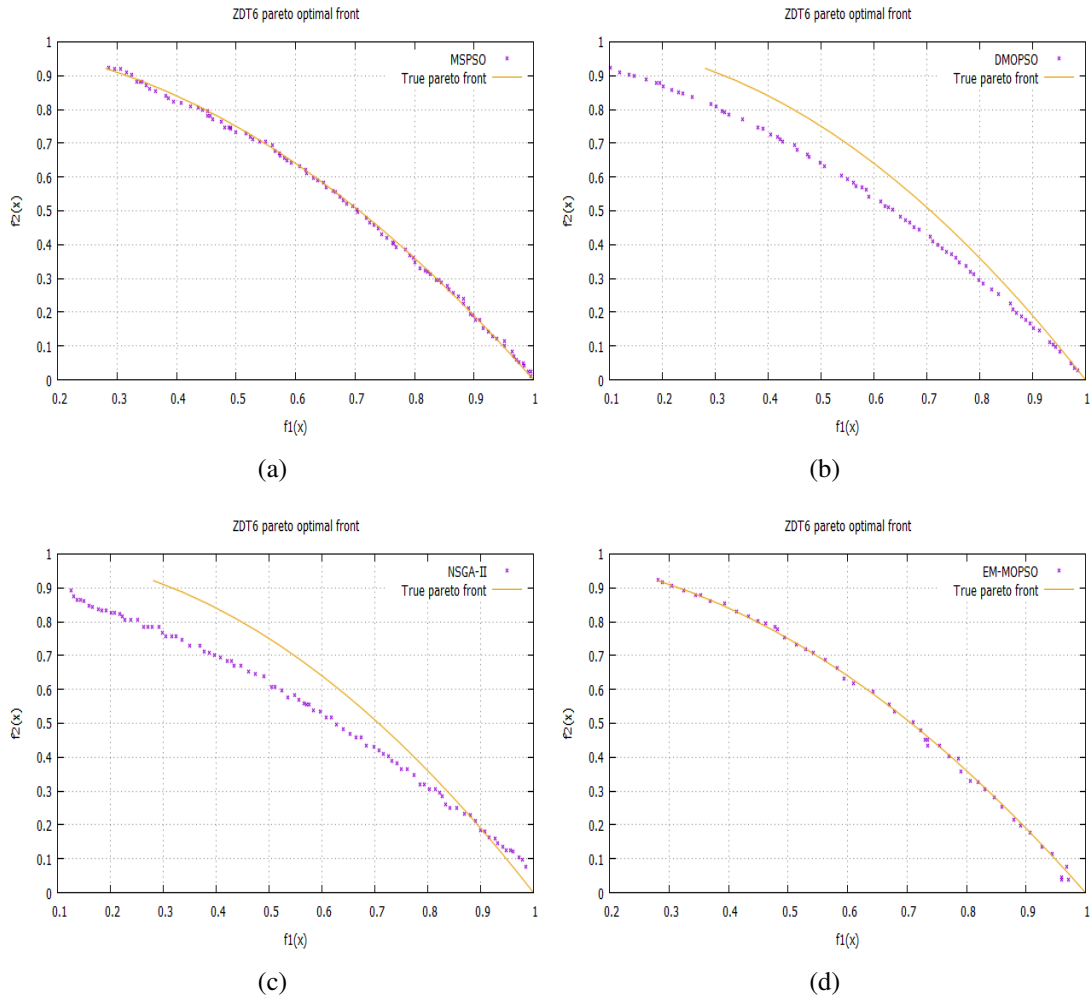
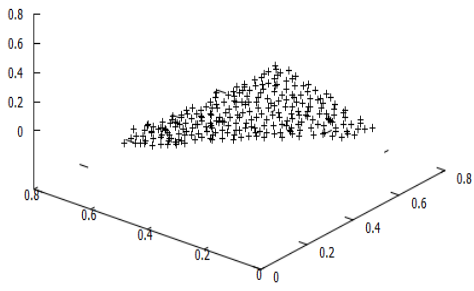
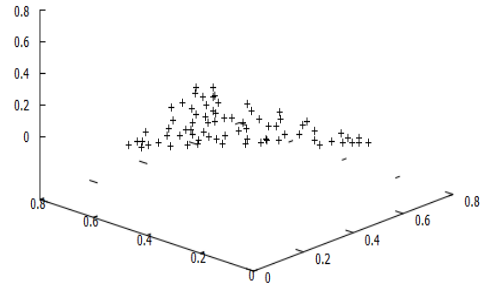


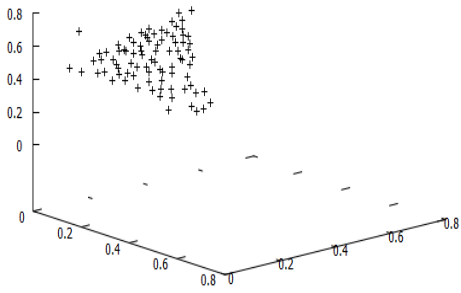
Figure 5: (a)-(d) Pareto front produced by different algorithms on ZDT6 Test function



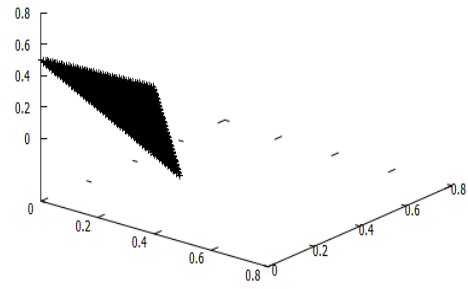
(a) MSPSO



(b) NSGA-II

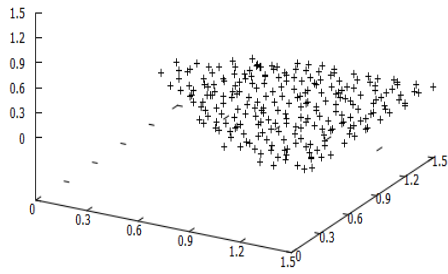


(c) DMOPSO

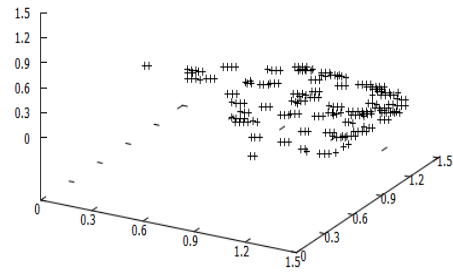


(d) True Front

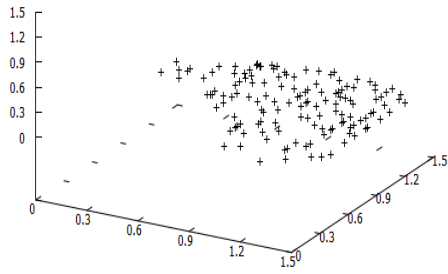
Figure 6: Pareto front on DTLZ1 Test function



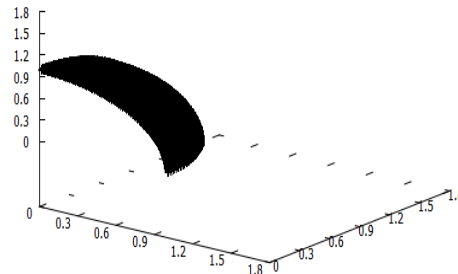
(a) MSPSO



(b) NSGA-II

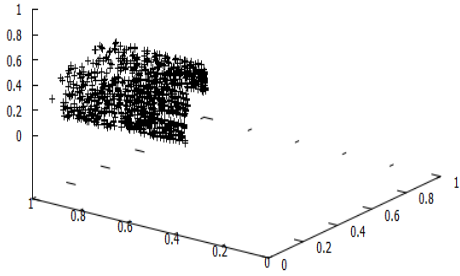


(c) DMOPSO

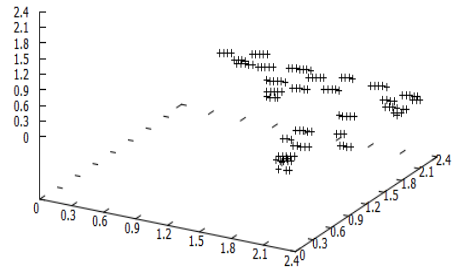


(d) True Front

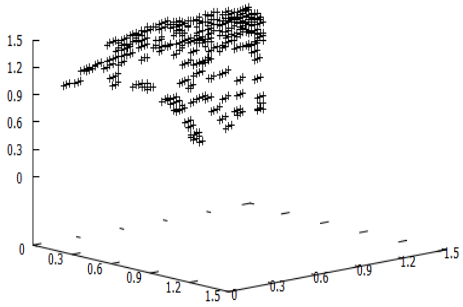
Figure 7: Pareto front on DTLZ2 Test function



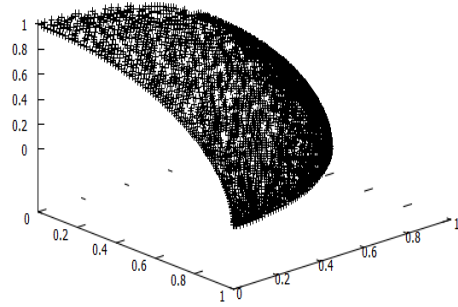
(a) MSPSO



(b) NSGA-II

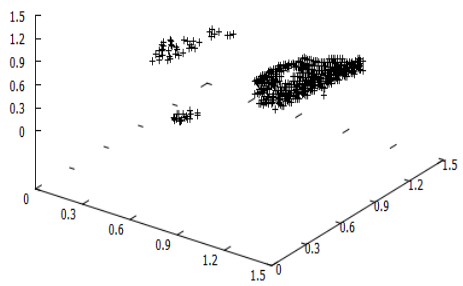


(c) DMOPSO

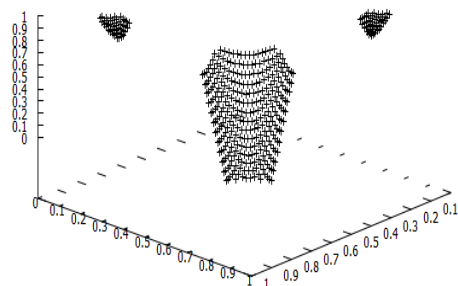


(d) True Front

Figure 8: Pareto front on DTLZ3 Test function



(a) MSPSO



(b) True Front

Figure 9: Pareto front on DTLZ7 Test function

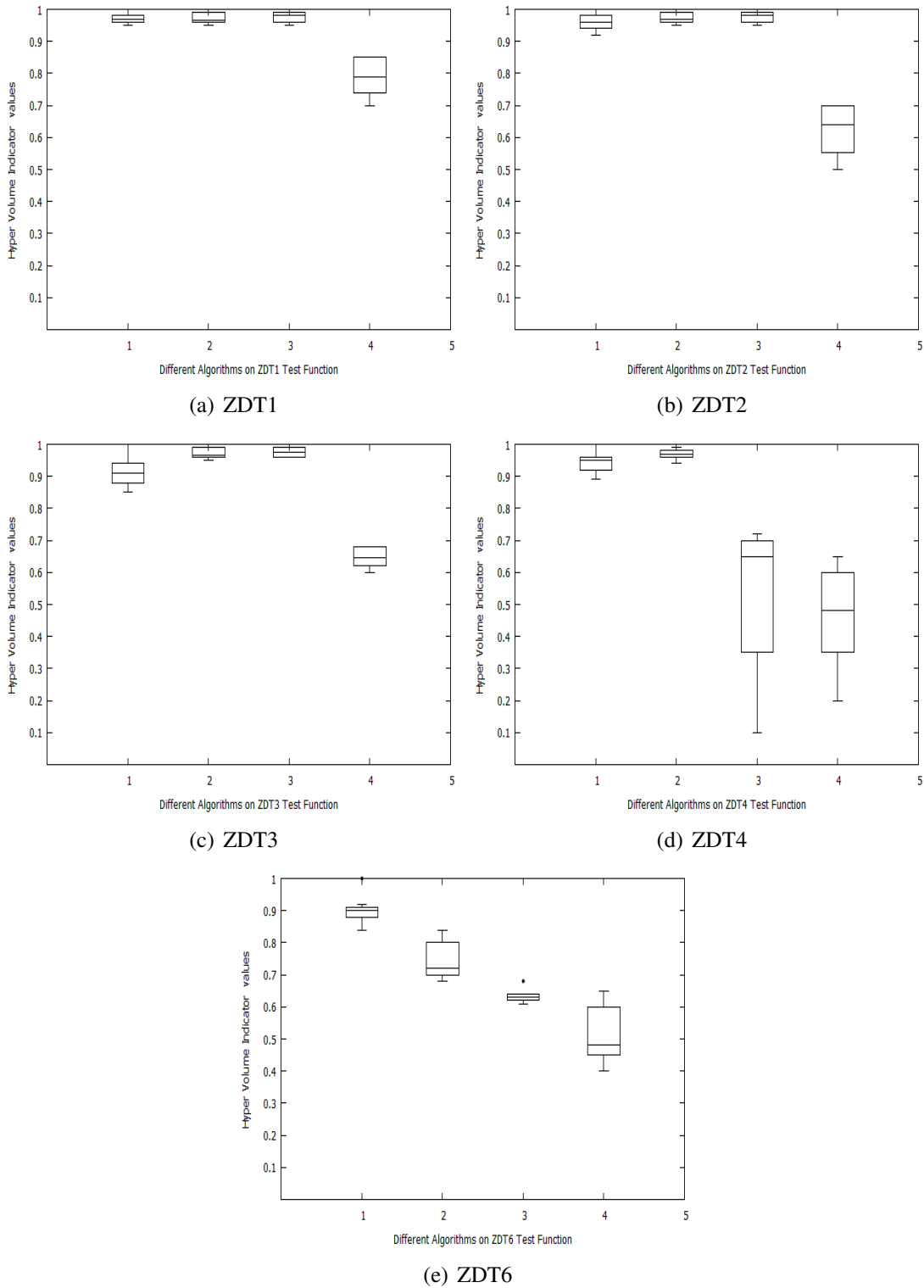


Figure 10: Box Plot of Hyper Volume Indicator (I_H) values of different algorithms on ZDT Test Functions. Values 1 to 4 on the plot represent algorithms, MSPSO, DMOPSO, NSGA-II, EM-MOPSO respectively

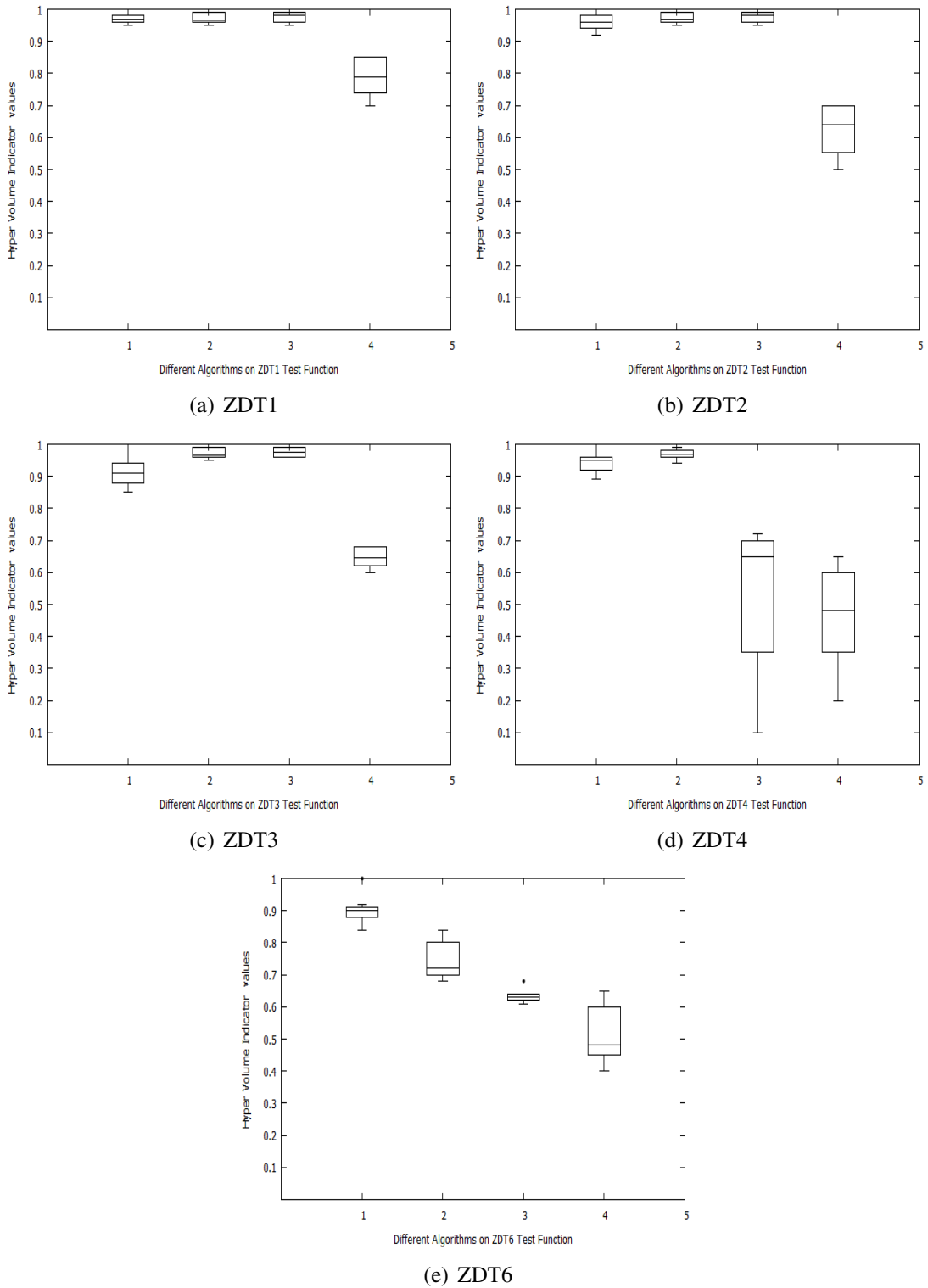


Figure 11: Box Plot of Hyper Volume Indicator (I_H) values of different algorithms on ZDT Test Functions. Values 1 to 4 on the plot represent algorithms, MSPSO, DMOPSO, NSGA-II, EM-MOPSO respectively

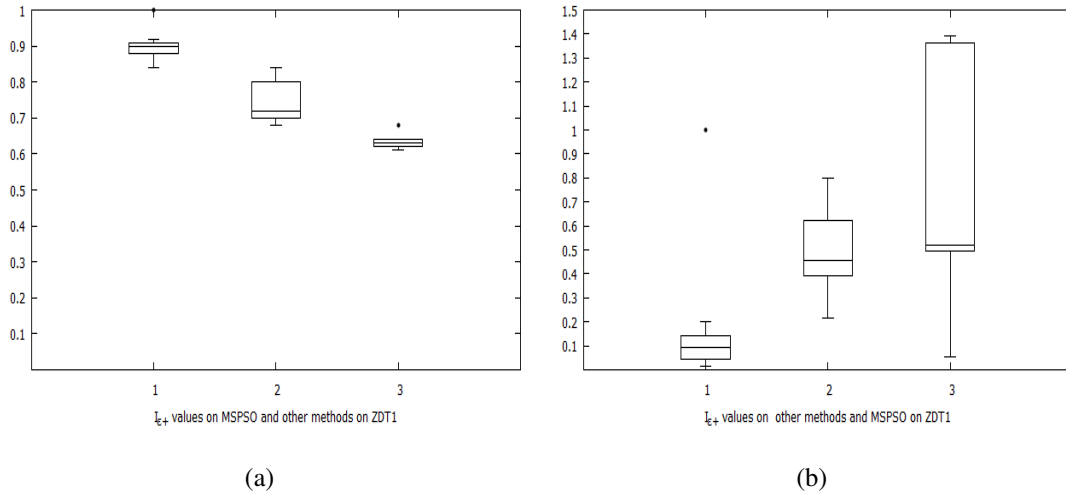


Figure 12: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function ZDT1. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II and EM-MOPSO respectively.

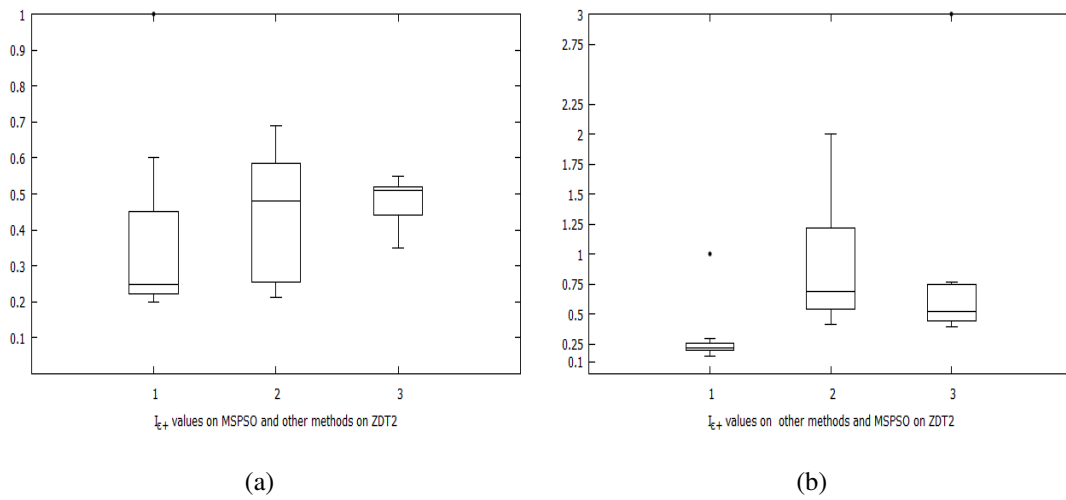


Figure 13: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function ZDT2. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II and EM-MOPSO respectively.

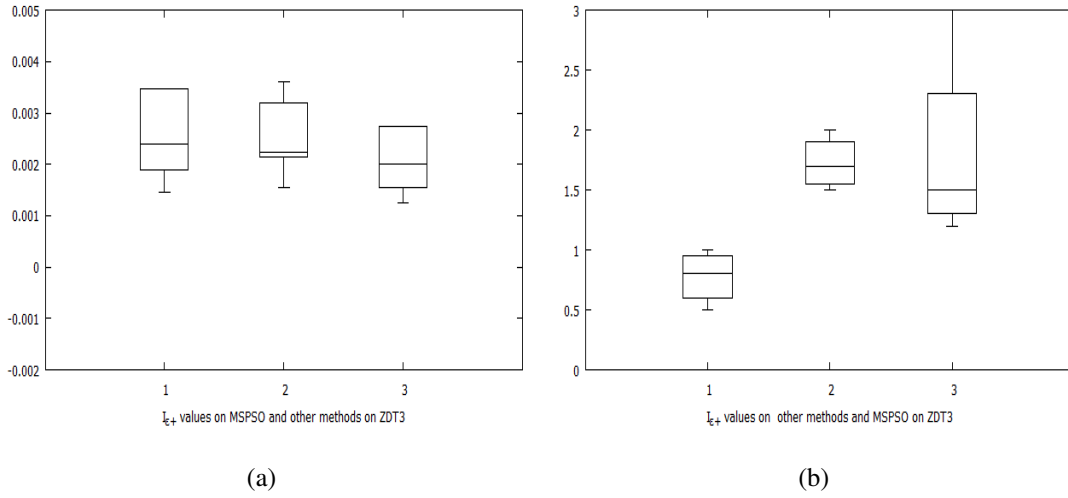


Figure 14: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function ZDT3. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II and EM-MOPSO respectively.

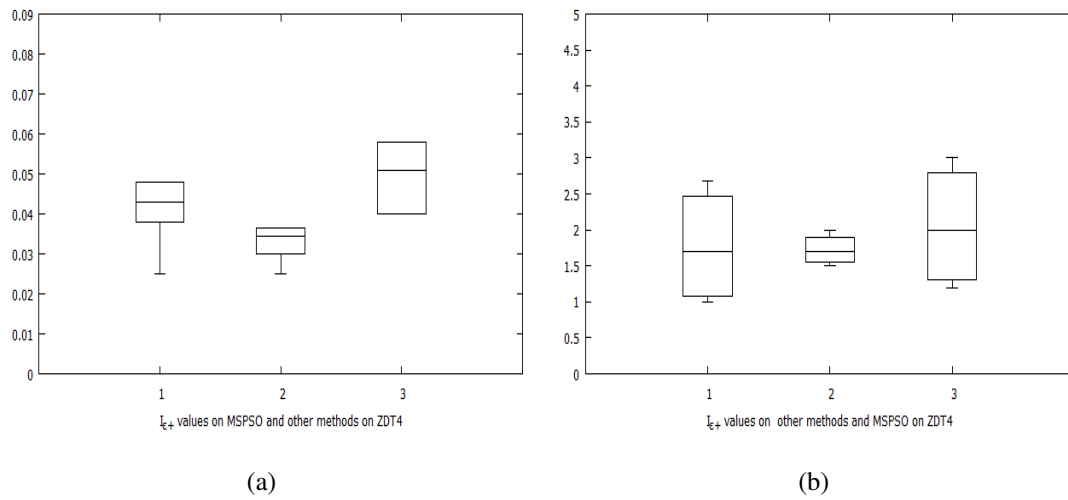


Figure 15: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function ZDT4. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II and EM-MOPSO respectively.

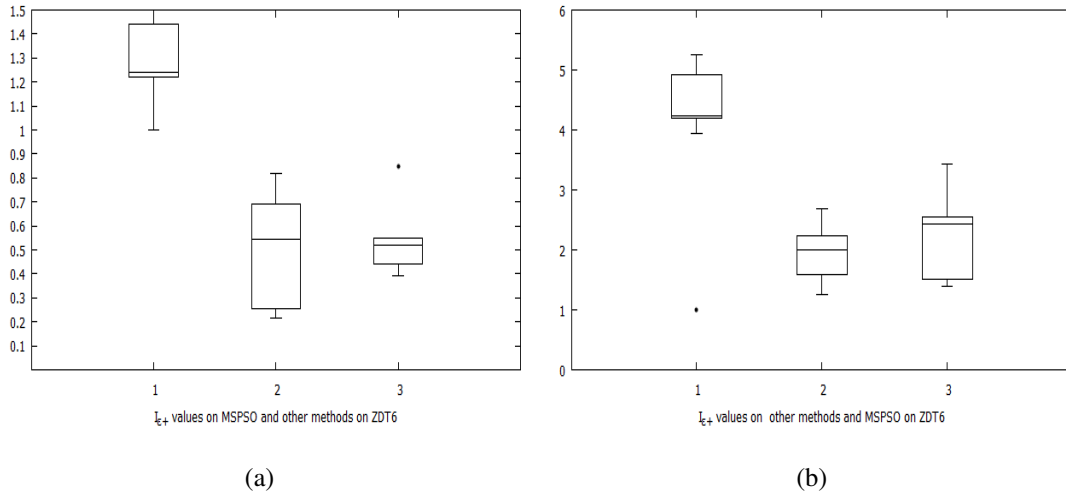


Figure 16: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function ZDT6. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II and EM-MOPSO respectively.

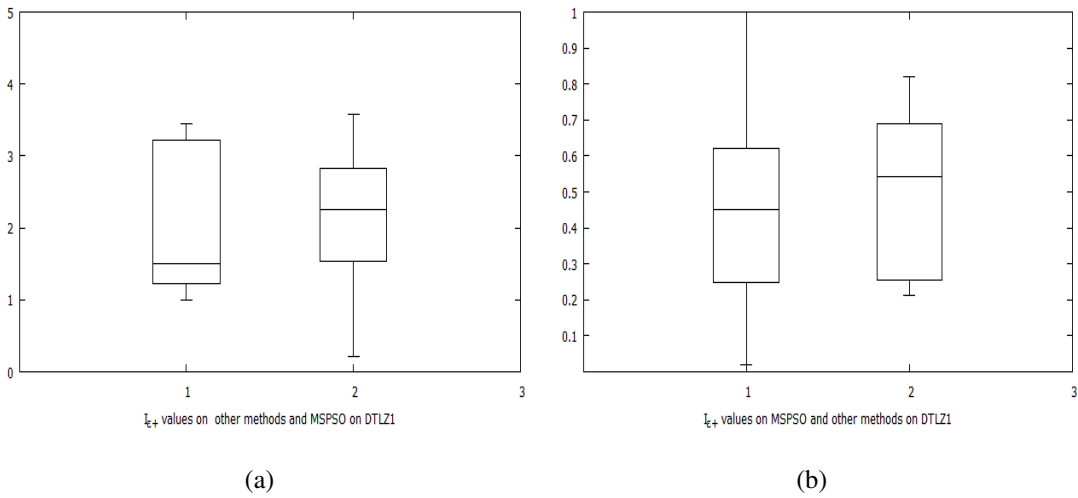


Figure 17: Box Plot based on I_{ϵ}^{+} values of different algorithms on test function DTLZ1. 1,2,3 values on x-axis represents I_{ϵ}^{+} values of MSPSO with DMOPSO, NSGA-II respectively.

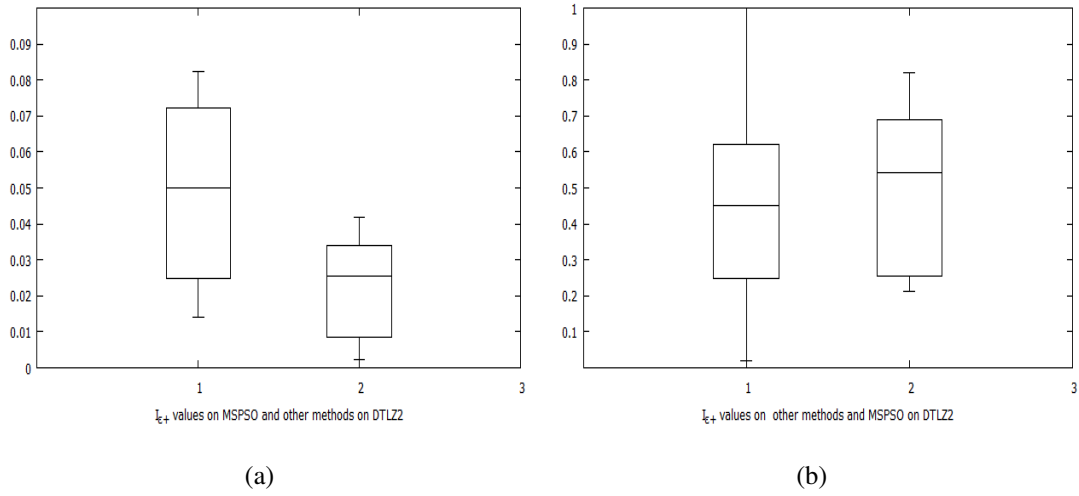


Figure 18: Box Plot based on I_{ϵ}^+ values of different algorithms on test function DTLZ2. 1,2,3 values on x-axis represents I_{ϵ}^+ values of MSPSO with DMOPSO, NSGA-II respectively.

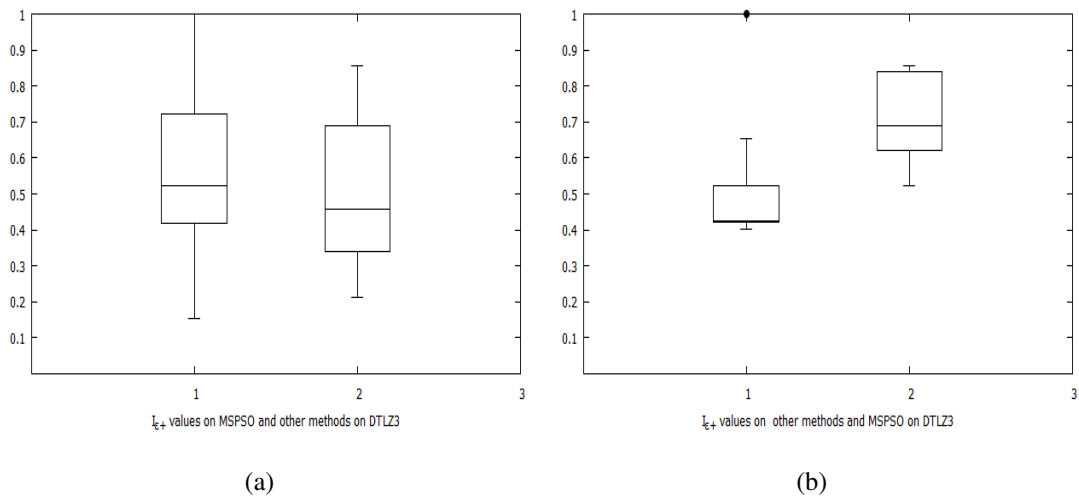


Figure 19: Box Plot based on I_{ϵ}^+ values of different algorithms on test function DTLZ3. 1,2,3 values on x-axis represents I_{ϵ}^+ values of MSPSO with DMOPSO, NSGA-II respectively.