

Supplementary Files

Table S-I Statistical results of all metrics of all variant algorithms in all instances.

Instance	HV									
	BRCE-C		BRCE		BRCE+E		BRCE+EV		BRCE+EVH	
n_m_f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.6429	0.0084	0.6435	0.0110	0.6468	0.0076	0.6486	0.0066	0.7267	0.0067
20_10_2	0.5970	0.0118	0.5987	0.0074	0.5963	0.0082	0.5983	0.0084	0.6912	0.0050
20_20_2	0.5497	0.0094	0.5551	0.0064	0.5500	0.0077	0.5518	0.0068	0.6670	0.0020
50_5_2	0.5862	0.0079	0.5845	0.0057	0.6115	0.0070	0.6118	0.0123	0.7112	0.0030
50_10_2	0.5111	0.0057	0.5108	0.0077	0.5373	0.0076	0.5365	0.0082	0.6546	0.0051
50_20_2	0.4826	0.0061	0.4822	0.0077	0.4923	0.0077	0.4992	0.0058	0.6349	0.0029
100_5_2	0.5620	0.0059	0.5613	0.0080	0.5685	0.0076	0.5682	0.0059	0.6864	0.0055
100_10_2	0.5144	0.0044	0.5129	0.0038	0.5191	0.0086	0.5203	0.0082	0.6553	0.0039
100_20_2	0.4554	0.0059	0.4593	0.0112	0.4622	0.0065	0.4612	0.0058	0.6129	0.0050
200_10_2	0.4797	0.0072	0.4807	0.0079	0.4906	0.0060	0.4892	0.0049	0.6388	0.0022
200_20_2	0.4458	0.0042	0.4487	0.0065	0.4514	0.0056	0.4480	0.0064	0.6170	0.0032
20_5_3	0.6505	0.0104	0.6479	0.0095	0.6509	0.0119	0.6579	0.0105	0.7217	0.0062
20_10_3	0.6145	0.0134	0.6194	0.0111	0.6046	0.0119	0.6064	0.0125	0.6969	0.0059
20_20_3	0.5493	0.0079	0.5517	0.0136	0.5601	0.0063	0.5564	0.0086	0.6664	0.0049
50_5_3	0.6335	0.0096	0.6337	0.0064	0.6512	0.0095	0.6594	0.0095	0.7386	0.0042
50_10_3	0.5403	0.0088	0.5431	0.0067	0.5546	0.0077	0.5560	0.0067	0.6711	0.0038
50_20_3	0.4939	0.0048	0.4950	0.0072	0.5018	0.0083	0.5021	0.0113	0.6238	0.0028
100_5_3	0.5777	0.0099	0.5821	0.0111	0.5952	0.0070	0.5974	0.0096	0.6984	0.0074
100_10_3	0.5185	0.0099	0.5151	0.0081	0.5307	0.0100	0.5386	0.0095	0.6554	0.0043
100_20_3	0.4607	0.0092	0.4586	0.0080	0.4669	0.0080	0.4692	0.0064	0.6142	0.0040
200_10_3	0.4843	0.0077	0.4850	0.0090	0.5014	0.0081	0.5035	0.0035	0.6421	0.0060
200_20_3	0.4435	0.0062	0.4414	0.0091	0.4480	0.0071	0.4511	0.0077	0.6111	0.0022
Instance	GD									
	BRCE-C		BRCE		BRCE+E		BRCE+EV		BRCE+EVH	
n_m_f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.0027	0.0008	0.0026	0.0008	0.0022	0.0007	0.0016	0.0003	0.0039	0.0005
20_10_2	0.0032	0.0019	0.0029	0.0008	0.0029	0.0011	0.0025	0.0008	0.0047	0.0006
20_20_2	0.0029	0.0016	0.0025	0.0014	0.0034	0.0018	0.0028	0.0009	0.0051	0.0005
50_5_2	0.0069	0.0015	0.0069	0.0009	0.0025	0.0008	0.0017	0.0007	0.0045	0.0005
50_10_2	0.0071	0.0021	0.0069	0.0018	0.0023	0.0011	0.0019	0.0012	0.0039	0.0004
50_20_2	0.0050	0.0014	0.0055	0.0015	0.0037	0.0018	0.0020	0.0009	0.0033	0.0004
100_5_2	0.0019	0.0008	0.0018	0.0009	0.0010	0.0005	0.0009	0.0003	0.0028	0.0004
100_10_2	0.0038	0.0016	0.0033	0.0011	0.0023	0.0012	0.0019	0.0008	0.0034	0.0005
100_20_2	0.0031	0.0011	0.0034	0.0027	0.0020	0.0014	0.0018	0.0017	0.0027	0.0003
200_10_2	0.0028	0.0012	0.0020	0.0008	0.0013	0.0010	0.0008	0.0004	0.0020	0.0002
200_20_2	0.0018	0.0013	0.0014	0.0013	0.0008	0.0006	0.0017	0.0014	0.0015	0.0001
20_5_3	0.0029	0.0012	0.0033	0.0012	0.0027	0.0017	0.0025	0.0009	0.0048	0.0006
20_10_3	0.0032	0.0019	0.0024	0.0017	0.0057	0.0011	0.0053	0.0011	0.0067	0.0007
20_20_3	0.0034	0.0011	0.0036	0.0014	0.0020	0.0008	0.0024	0.0011	0.0049	0.0007
50_5_3	0.0061	0.0016	0.0051	0.0012	0.0029	0.0018	0.0026	0.0011	0.0060	0.0008
50_10_3	0.0061	0.0027	0.0049	0.0019	0.0028	0.0017	0.0028	0.0015	0.0043	0.0007
50_20_3	0.0060	0.0009	0.0063	0.0018	0.0044	0.0014	0.0044	0.0019	0.0048	0.0005
100_5_3	0.0037	0.0007	0.0032	0.0012	0.0013	0.0005	0.0014	0.0010	0.0039	0.0003
100_10_3	0.0046	0.0015	0.0051	0.0014	0.0025	0.0015	0.0021	0.0012	0.0035	0.0003
100_20_3	0.0046	0.0027	0.0049	0.0014	0.0029	0.0023	0.0023	0.0009	0.0029	0.0003
200_10_3	0.0044	0.0010	0.0045	0.0014	0.0018	0.0015	0.0015	0.0009	0.0026	0.0003
200_20_3	0.0031	0.0020	0.0033	0.0017	0.0024	0.0016	0.0015	0.0015	0.0021	0.0003
Instance	Spread									
	BRCE-C		BRCE		BRCE+E		BRCE+EV		BRCE+EVH	
n_m_f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.8890	0.0371	0.9026	0.0350	0.8934	0.0279	0.9111	0.0166	0.7522	0.0742
20_10_2	0.9437	0.0232	0.9314	0.0145	0.9352	0.0220	0.9453	0.0177	0.8149	0.0560
20_20_2	0.9616	0.0183	0.9511	0.0168	0.9610	0.0204	0.9627	0.0143	0.8352	0.0695
50_5_2	0.9602	0.0335	0.9287	0.0103	0.9473	0.0203	0.9768	0.0282	0.8805	0.0329
50_10_2	0.9636	0.0140	0.9511	0.0133	0.9537	0.0141	0.9836	0.0084	0.8802	0.0497
50_20_2	0.9705	0.0110	0.9723	0.0139	0.9750	0.0170	0.9868	0.0062	0.9338	0.0835
100_5_2	0.9611	0.0096	0.9601	0.0114	0.9585	0.0111	0.9781	0.0057	0.8882	0.0449
100_10_2	0.9759	0.0145	0.9786	0.0083	0.9730	0.0130	0.9890	0.0038	0.9051	0.0667
100_20_2	0.9890	0.0047	0.9869	0.0075	0.9899	0.0078	0.9937	0.0013	0.9155	0.0541
200_10_2	0.9905	0.0093	0.9916	0.0048	0.9874	0.0029	0.9928	0.0038	0.8934	0.0333
200_20_2	0.9950	0.0034	0.9966	0.0037	0.9950	0.0028	0.9975	0.0026	0.9201	0.0597
20_5_3	0.9225	0.0292	0.9350	0.0380	0.9208	0.0223	0.9388	0.0281	0.7998	0.0492
20_10_3	0.9397	0.0175	0.9515	0.0138	0.9328	0.0308	0.9551	0.0191	0.8474	0.0730
20_20_3	0.9588	0.0116	0.9583	0.0221	0.9587	0.0143	0.9690	0.0132	0.8418	0.0469
50_5_3	0.9367	0.0309	0.9545	0.0371	0.9514	0.0216	0.9747	0.0193	0.9034	0.0448
50_10_3	0.9679	0.0295	0.9573	0.0216	0.9624	0.0183	0.9869	0.0116	0.9007	0.0571
50_20_3	0.9840	0.0156	0.9765	0.0117	0.9842	0.0145	0.9791	0.0079	0.8896	0.0279
100_5_3	0.9771	0.0448	0.9706	0.0213	0.9676	0.0126	0.9841	0.0158	0.8712	0.0291
100_10_3	0.9864	0.0180	0.9912	0.0171	0.9814	0.0108	0.9891	0.0075	0.9266	0.0522
100_20_3	0.9952	0.0171	0.9957	0.0281	0.9915	0.0072	0.9995	0.0141	0.9060	0.0529
200_10_3	0.9959	0.0115	0.9898	0.0077	0.9921	0.0103	0.9994	0.0087	0.9495	0.0613
200_20_3	1.0021	0.0086	0.9984	0.0049	0.9968	0.0037	0.9984	0.0032	0.9208	0.0491

Table S-II Statistical results of all metrics of all comparison algorithms in all instances.

Instance	HV									
	NSGA-II		MOEA/D		PMMA		KCA		BRCE	
n.m.f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.6619-	0.0086	0.5656-	0.0127	0.5214-	0.0108	0.5965-	0.0146	0.7480	0.0063
20_10_2	0.6203-	0.0110	0.5372-	0.0135	0.4827-	0.0150	0.5796-	0.0150	0.7201	0.0046
20_20_2	0.553-	0.0094	0.4581-	0.0097	0.4427-	0.0094	0.5214-	0.0145	0.6710	0.0021
50_5_2	0.5862-	0.0079	0.5437-	0.0113	0.5118-	0.0126	0.5193-	0.0137	0.7112	0.0030
50_10_2	0.5274-	0.0057	0.4837-	0.0068	0.4699-	0.0053	0.5292-	0.0097	0.6744	0.0049
50_20_2	0.4836-	0.0061	0.4193-	0.0048	0.4317-	0.0050	0.5173-	0.0068	0.6362	0.0029
100_5_2	0.5748-	0.0058	0.5379-	0.0071	0.4912-	0.0039	0.5024-	0.0075	0.7016	0.0053
100_10_2	0.5347-	0.0040	0.4942-	0.0067	0.468-	0.0047	0.5119-	0.0050	0.6806	0.0036
100_20_2	0.4775-	0.0057	0.4305-	0.0058	0.4283-	0.0045	0.5026-	0.0049	0.6416	0.0048
200_10_2	0.4894-	0.0070	0.4798-	0.0038	0.4415-	0.0034	0.4806-	0.0036	0.6514	0.0021
200_20_2	0.4629-	0.0042	0.4339-	0.0043	0.4242-	0.0030	0.4932-	0.0053	0.6397	0.0030
20_5_3	0.7083-	0.0098	0.6222-	0.0221	0.5638-	0.0150	0.5957-	0.0307	0.7874	0.0060
20_10_3	0.6354-	0.0120	0.5431-	0.0154	0.5075-	0.0102	0.5138-	0.0140	0.7202	0.0058
20_20_3	0.5759-	0.0077	0.4923-	0.0094	0.4734-	0.0116	0.5478-	0.0183	0.6997	0.0045
50_5_3	0.6335-	0.0096	0.5658-	0.0145	0.552-	0.0127	0.5405-	0.0129	0.7386	0.0042
50_10_3	0.5589-	0.0082	0.5082-	0.0087	0.4979-	0.0083	0.5324-	0.0114	0.6931	0.0035
50_20_3	0.514-	0.0045	0.442-	0.0101	0.4531-	0.0081	0.4593-	0.0084	0.6494	0.0027
100_5_3	0.585-	0.0102	0.5536-	0.0115	0.5233-	0.0089	0.4993-	0.0097	0.7082	0.0072
100_10_3	0.5269-	0.0096	0.4903-	0.0085	0.4791-	0.0052	0.505-	0.0055	0.6653	0.0041
100_20_3	0.4837-	0.0091	0.4352-	0.0078	0.4376-	0.0032	0.5155-	0.0057	0.6442	0.0037
200_10_3	0.5028-	0.0075	0.5039-	0.0055	0.4641-	0.0061	0.4962-	0.0053	0.6655	0.0056
200_20_3	0.4585-	0.0061	0.4354-	0.0062	0.4192-	0.0034	0.4945-	0.0039	0.6305	0.0021
-/=/+	22/0/0		22/0/0		22/0/0		22/0/0			
Instance	GD									
	NSGA-II		MOEA/D		PMMA		KCA		BRCE	
n.m.f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.0025+	0.0008	0.0101-	0.0035	0.0227-	0.0045	0.0066-	0.0009	0.0037	0.0005
20_10_2	0.003+	0.0018	0.0137-	0.0015	0.0252-	0.0063	0.0066-	0.0013	0.0047	0.0006
20_20_2	0.0027+	0.0014	0.0227-	0.0033	0.0258-	0.0039	0.008-	0.0018	0.0051	0.0005
50_5_2	0.0069-	0.0015	0.0111-	0.0025	0.0152-	0.0026	0.0108-	0.0027	0.0047	0.0005
50_10_2	0.007-	0.0022	0.0135-	0.0028	0.0109-	0.0022	0.0054-	0.0011	0.0040	0.0003
50_20_2	0.005-	0.0014	0.0193-	0.0027	0.0103-	0.0020	0.004=-	0.0009	0.0033	0.0004
100_5_2	0.0019+	0.0008	0.0065-	0.0010	0.0093-	0.0016	0.0059-	0.0011	0.0029	0.0004
100_10_2	0.0035=-	0.0014	0.008-	0.0017	0.0089-	0.0022	0.0057-	0.0012	0.0031	0.0005
100_20_2	0.0029=-	0.0010	0.0189-	0.0022	0.0054-	0.0015	0.0034-	0.0009	0.0025	0.0003
200_10_2	0.0027=-	0.0011	0.0046-	0.0012	0.0037-	0.0013	0.003-	0.0006	0.0020	0.0002
200_20_2	0.0018=-	0.0011	0.0092-	0.0015	0.0029-	0.0013	0.0027-	0.0009	0.0015	0.0001
20_5_3	0.0025+	0.0011	0.0136-	0.0021	0.0239-	0.0031	0.0099-	0.0019	0.0042	0.0005
20_10_3	0.0022+	0.0019	0.0152-	0.0027	0.0262-	0.0052	0.0131-	0.0026	0.0064	0.0007
20_20_3	0.0032+	0.0011	0.0196-	0.0032	0.0219-	0.0038	0.0086-	0.0018	0.0046	0.0007
50_5_3	0.0061=-	0.0016	0.0128-	0.0053	0.0159-	0.0058	0.0101-	0.0024	0.0058	0.0006
50_10_3	0.0059=-	0.0026	0.0142-	0.0025	0.007-	0.0019	0.0059-	0.0021	0.0043	0.0006
50_20_3	0.0061=-	0.0010	0.0277-	0.0057	0.0094-	0.0036	0.0123-	0.0035	0.0049	0.0006
100_5_3	0.0037+	0.0007	0.0093-	0.0024	0.0071-	0.0022	0.0084-	0.0011	0.0041	0.0003
100_10_3	0.0045=-	0.0015	0.01-	0.0029	0.0058-	0.0025	0.0058-	0.0015	0.0035	0.0003
100_20_3	0.0044=-	0.0026	0.0204-	0.0029	0.0058-	0.0018	0.004-	0.0010	0.0029	0.0003
200_10_3	0.0042-	0.0009	0.0053-	0.0013	0.0049-	0.0012	0.0035-	0.0008	0.0027	0.0003
200_20_3	0.0031=-	0.0020	0.0108-	0.0022	0.0041-	0.0013	0.0022=-	0.0008	0.0020	0.0002
-/=/+	5/9/8		22/0/0		22/0/0		20/2/0			
Instance	Spread									
	NSGA-II		MOEA/D		PMMA		KCA		BRCE	
n.m.f	mean	std	mean	std	mean	std	mean	std	mean	std
20_5_2	0.8889-	0.0371	0.9561-	0.0840	0.9838-	0.0241	0.9297-	0.0217	0.7489	0.0740
20_10_2	0.9448-	0.0237	0.9443-	0.0469	0.9976-	0.0323	0.9742-	0.0443	0.8137	0.0567
20_20_2	0.961-	0.0185	0.9635-	0.0122	0.9865-	0.0128	1.0069-	0.0122	0.8364	0.0677
50_5_2	0.9597-	0.0339	0.9723-	0.0332	0.9927-	0.0044	0.984-	0.0174	0.8800	0.0331
50_10_2	0.9633-	0.0144	0.978-	0.0201	0.9934-	0.0076	0.9909-	0.0193	0.8813	0.0498
50_20_2	0.9705=-	0.0109	0.989=-	0.0153	0.9951=-	0.0102	1.0036-	0.0152	0.9338	0.0834
100_5_2	0.9585-	0.0103	0.9732-	0.0268	0.9853-	0.0130	0.9871-	0.0058	0.8791	0.0476
100_10_2	0.9754-	0.0151	0.9831-	0.0292	0.9896-	0.0099	0.9925-	0.0104	0.9071	0.0660
100_20_2	0.989-	0.0047	0.9942-	0.0079	0.9926-	0.0087	1.0117-	0.0140	0.9166	0.0540
200_10_2	0.9906-	0.0093	0.9771-	0.0091	0.9954-	0.0054	0.9961-	0.0039	0.8927	0.0335
200_20_2	0.995-	0.0034	0.9921-	0.0046	0.9935-	0.0043	1-	0.0038	0.9201	0.0597
20_5_3	0.9223-	0.0299	0.9546-	0.0688	0.9767-	0.0235	0.9215-	0.0365	0.7946	0.0488
20_10_3	0.9475-	0.0152	0.9589-	0.0565	0.9956-	0.0245	0.9894-	0.0253	0.8689	0.0647
20_20_3	0.9579-	0.0117	0.9764-	0.0274	0.9934-	0.0091	1.0286-	0.0190	0.8427	0.0484
50_5_3	0.9437=-	0.0272	0.9761-	0.0495	1.0019-	0.0278	0.9802-	0.0257	0.9054	0.0439
50_10_3	0.9662-	0.0318	0.9765-	0.0197	0.9912-	0.0155	0.9945-	0.0275	0.9016	0.0580
50_20_3	0.9849-	0.0153	0.9966-	0.0157	0.9914-	0.0071	1.0021-	0.0130	0.9049	0.0254
100_5_3	0.976-	0.0456	0.9635-	0.0321	0.9927-	0.0117	0.9872-	0.0096	0.8698	0.0287
100_10_3	0.9865-	0.0181	0.9598-	0.0179	0.9933-	0.0063	0.9977-	0.0140	0.9276	0.0530
100_20_3	0.9953-	0.0174	0.9933-	0.0069	0.992-	0.0058	1.0081-	0.0220	0.9064	0.0536
200_10_3	0.996-	0.0116	0.9808=-	0.0138	0.9939=-	0.0053	0.9965=-	0.0034	0.9495	0.0616
200_20_3	1.002-	0.0084	0.9973-	0.0109	0.9891-	0.0080	1.0002-	0.0047	0.9205	0.0495
-/=/+	20/2/0		20/2/0		20/2/0		21/1/0			