

1 Overview Table

In table 1, the computational results of our hybrid genetic algorithm (HGA) and our hybrid scatter search (HSS) are given. We compare the obtained makespan values with the best known solutions (BKS) from literature. These BKS are the optimal values or the best upper bounds achieved for the open problem instances. These upper bounds are based on the bounds published on the websites <http://people.brunel.ac.uk/~mastjjb/jeb/orlib/> and <http://mistic.heig-vd.ch/taillard/default.htm> and are updated with the results obtained in the papers of, amongst others, Zhang et al., 2008, Chandrasekaran et al., 2006 and Pardalos et al., 2010.

Table 1: Results on the benchmark instances

Benchmark	size	UB (LB)	HSS	Dev.BKS	HGA	Dev.BKS
abz5	10 × 10	1234	1234	0.00%	1239	0.41%
abz6	10 × 10	943	943	0.00%	943	0.00 %
abz7	20 × 15	656	679	3.51%	714	8.84%
abz8	20 × 15	665	691	3.91%	743	11.73%
abz9	20 × 15	678	716	5.60%	765	12.83%
ft06	6 × 6	55	55	0.00%	55	0.00 %
ft10	10 × 10	930	930	0.00%	961	3.33 %
ft20	20 × 5	1165	1175	0.86%	1182	1.46 %
la01	10 × 5	666	666	0.00%	666	0.00%
a02	10 × 5	655	655	0.00%	655	0.00%
la03	10 × 5	597	597	0.00%	597	0.00%
la04	10 × 5	590	590	0.00%	590	0.00%
la05	10 × 5	593	593	0.00%	593	0.00%
la06	15 × 5	926	926	0.00%	926	0.00%
la07	15 × 5	890	890	0.00%	890	0.00%
la08	15 × 5	863	863	0.00%	863	0.00%
la09	15 × 5	951	951	0.00%	951	0.00%
la10	15 × 5	958	958	0.00%	958	0.00%
la11	20 × 5	1222	1222	0.00%	1222	0.00%
la12	20 × 5	1039	1039	0.00%	1039	0.00%
la13	20 × 5	1150	1150	0.00%	1150	0.00%
la14	20 × 5	1292	1292	0.00%	1292	0.00%
la15	20 × 5	1207	1207	0.00%	1207	0.00%
la16	10 × 10	945	946	0.11%	946	0.11%
la17	10 × 10	784	784	0.00%	784	0.00%
la18	10 × 10	848	848	0.00%	848	0.00%

Continued on next page...

Benchmark	size	UB (LB)	HSS	Dev.BKS	HGA	Dev.BKS
la19	10 × 10	842	842	0.00%	843	0.12%
la20	10 × 10	902	907	0.55%	907	0.55%
la21	15 × 10	1046	1050	0.38%	1070	2.29%
la22	15 × 10	927	936	0.97%	940	1.40%
la23	15 × 10	1032	1032	0.00%	1032	0.00%
la24	15 × 10	935	944	0.96%	971	3.85%
la25	15 × 10	977	984	0.72%	1015	3.89%
la26	20 × 10	1218	1218	0.00%	1237	1.56%
la27	20 × 10	1235	1241	0.49%	1288	4.29%
la28	20 × 10	1216	1225	0.74%	1242	2.14%
la29	20 × 10	1152	1193	3.56%	1243	7.90%
la30	20 × 10	1355	1355	0.00%	1364	0.66%
la31	30 × 10	1784	1784	0.00%	1784	0.00%
la32	30 × 10	1850	1850	0.00%	1850	0.00%
la33	30 × 10	1719	1719	0.00%	1719	0.00%
la34	30 × 10	1721	1721	0.00%	1721	0.00%
la35	30 × 10	1888	1888	0.00%	1888	0.00%
la36	15 × 15	1268	1292	1.89%	1327	4.65%
la37	15 × 15	1397	1424	1.93%	1464	4.80%
la38	15 × 15	1196	1220	2.01%	1279	6.94%
la39	15 × 15	1233	1250	1.38%	1268	2.84%
la40	15 × 15	1222	1250	2.29%	1254	2.62%
orb01	10 × 10	1059	1060	0.09%	1086	2.55%
orb02	10 × 10	888	889	0.11%	900	1.35%
orb03	10 × 10	1005	1005	0.00%	1026	2.09%
orb04	10 × 10	1005	1011	0.60%	1011	0.60%
orb05	10 × 10	887	889	0.23%	902	1.69%
orb06	10 × 10	1010	1011	0.10%	1033	2.28%
orb07	10 × 10	397	397	0.00%	397	0.00%
orb08	10 × 10	899	899	0.00%	929	3.34%
orb09	10 × 10	934	934	0.00%	948	1.50%
orb10	10 × 10	944	944	0.00%	944	0.00%
swv01	20 × 10	1407	1466	4.19%	1622	15.28%
swv02	20 × 10	1475	1530	3.73%	1678	13.76%
swv03	20 × 10	1398	1469	5.08%	1596	14.16%
swv04	20 × 10	1470	1545	5.10%	1676	14.01%
swv05	20 × 10	1424	1502	5.48%	1602	12.50%
swv06	20 × 15	1678	1776	5.84%	1972	17.52%
swv07	20 × 15	1600	1702	6.38%	1846	15.38%
swv08	20 × 15	1756	1870	6.49%	2068	17.77%

Continued on next page...

Benchmark	size	UB (LB)	HSS	Dev.BKS	HGA	Dev.BKS
swv09	20 × 15	1661	1758	5.84%	1882	13.31%
swv10	20 × 15	1754	1878	7.07%	1959	11.69%
swv11	50 × 10	2983	3353	12.40%	3637	21.92%
swv12	50 × 10	2979	3485	16.99%	3631	21.89%
swv13	50 × 10	3104	3527	13.63%	3813	22.84%
swv14	50 × 10	2968	3327	12.10%	3497	17.82%
swv15	50 × 10	2886	3367	16.67%	3594	24.53%
swv16	50 × 10	2924	2924	0.00%	2924	0.00%
swv17	50 × 10	2794	2794	0.00%	2794	0.00%
swv18	50 × 10	2852	2852	0.00%	2852	0.00%
swv19	50 × 10	2843	2843	0.00%	2843	0.00%
swv20	50 × 10	2823	2823	0.00%	2823	0.00%
yn1	20 × 20	884	912	3.17%	973	10.07%
yn2	20 × 20	907	952	4.96%	1009	11.25%
yn3	20 × 20	892	924	3.59%	991	11.10%
yn4	20 × 20	968	1028	6.20%	1080	11.57%
Ta01	15 × 15	1231	1263	2.60%	1317	6.99%
Ta02	15 × 15	1244	1272	2.25%	1298	4.34%
Ta03	15 × 15	1205	1241	2.99%	1308	8.55%
Ta04	15 × 15	1170	1199	2.48%	1276	9.06%
Ta05	15 × 15	1215	1250	2.88%	1302	7.16%
Ta06	15 × 15	1210	1271	5.04%	1299	7.36%
Ta07	15 × 15	1223	1256	2.70%	1296	5.97%
Ta08	15 × 15	1187	1253	5.56%	1294	9.01%
Ta09	15 × 15	1274	1315	3.22%	1344	5.49%
Ta10	15 × 15	1241	1302	4.92%	1315	5.96%
Ta11	20 × 15	1357 (1323)	1448	6.71%	1508	11.13%
Ta12	20 × 15	1367 (1351)	1437	5.12%	1510	10.46%
Ta13	20 × 15	1342 (1282)	1449	7.97%	1503	12.00%
Ta14	20 × 15	1345	1388	3.20%	1447	7.58%
Ta15	20 × 15	1339 (1304)	1422	6.20%	1500	12.02%
Ta16	20 × 15	1351 (1302)	1435	6.22%	1505	11.40%
Ta17	20 × 15	1458	1518	4.12%	1552	6.45%
Ta18	20 × 15	1396 (1369)	1488	6.59%	1562	11.89%
Ta19	20 × 15	1332 (1297)	1445	8.48%	1503	12.84%
Ta20	20 × 15	1347 (1318)	1437	6.68%	1502	11.51%
Ta21	20 × 20	1642 (1539)	1736	5.72%	1832	11.57%
Ta22	20 × 20	1600 (1511)	1706	6.63%	1792	12.00%
Ta23	20 × 20	1556 (1472)	1632	4.88%	1717	10.35%
Ta24	20 × 20	1624 (1602)	1737	6.96%	1816	11.82%

Continued on next page...

Benchmark	size	UB (LB)	HSS	Dev.BKS	HGA	Dev.BKS
Ta25	20 × 20	1580 (1504)	1713	8.42%	1790	13.29%
Ta26	20 × 20	1643 (1539)	1736	5.66%	1831	11.44%
Ta27	20 × 20	1680 (1616)	1772	5.48%	1895	12.80%
Ta28	20 × 20	1602 (1591)	1711	6.80%	1801	12.42%
Ta29	20 × 20	1583 (1514)	1698	7.26%	1782	12.57%
Ta30	20 × 20	1573 (1473)	1702	8.20%	1760	11.89%
Ta31	30 × 15	1764	1883	6.75%	2008	13.83%
Ta32	30 × 15	1790 (1774)	1937	8.21%	2083	16.37%
Ta33	30 × 15	1791 (1778)	1980	10.55%	2105	17.53%
Ta34	30 × 15	1829 (1828)	1972	7.82%	2085	14.00%
Ta35	30 × 15	2007	2072	3.24%	2158	7.52%
Ta36	30 × 15	1819	1957	7.59%	2058	13.14%
Ta37	30 × 15	1771	1915	8.13%	2036	14.96%
Ta38	30 × 15	1673	1832	9.50%	1920	14.76%
Ta39	30 × 15	1795	1930	7.52%	2043	13.82%
Ta40	30 × 15	1673 (1631)	1864	11.42%	1924	15.00%
Ta41	30 × 20	2006 (1859)	2251	12.21%	2414	20.34%
Ta42	30 × 20	1945 (1867)	2205	13.37%	2355	21.08%
Ta43	30 × 20	1848 (1809)	2106	13.96%	2242	21.32%
Ta44	30 × 20	1983 (1927)	2235	12.71%	2373	19.67%
Ta45	30 × 20	2000 (1997)	2195	9.75%	2310	15.50%
Ta46	30 × 20	1997 (1940)	2267	13.52%	2382	19.28%
Ta47	30 × 20	1897 (1789)	2151	13.39%	2282	20.30%
Ta48	30 × 20	1945 (1912)	2199	13.06%	2285	17.48%
Ta49	30 × 20	1966 (1915)	2150	9.36%	2324	18.21%
Ta50	30 × 20	1924 (1807)	2213	15.02%	2334	21.31%
Ta51	50 × 15	2760	2859	3.59%	3151	14.17%
Ta52	50 × 15	2756	2850	3.41%	3124	13.35%
Ta53	50 × 15	2717	2812	3.50%	2955	8.76%
Ta54	50 × 15	2839	2877	1.34%	3006	5.88%
Ta55	50 × 15	2679	2854	6.53%	3061	14.26%
Ta56	50 × 15	2781	2908	4.57%	3054	9.82%
Ta57	50 × 15	2943	3023	2.72%	3241	10.13%
Ta58	50 × 15	2885	3002	4.06%	3223	11.72%
Ta59	50 × 15	2655	2859	7.68%	2994	12.77%
Ta60	50 × 15	2723	2843	4.41%	2959	8.67%
Ta61	50 × 20	2868	3175	10.70%	3309	15.38%
Ta62	50 × 20	2869	3235	12.76%	3416	19.07%
Ta63	50 × 20	2755	3035	10.16%	3177	15.32%
Ta64	50 × 20	2702	2935	8.62%	3139	16.17%

Continued on next page...

Benchmark	size	UB (LB)	HSS	Dev.BKS	HGA	Dev.BKS
Ta65	50 × 20	2725	3016	10.68%	3204	17.58%
Ta66	50 × 20	2845	3130	10.02%	3293	15.75%
Ta67	50 × 20	2825	3084	9.17%	3347	18.48%
Ta68	50 × 20	2784	3024	8.62%	3206	15.16%
Ta69	50 × 20	3071	3282	6.87%	3482	13.38%
Ta70	50 × 20	2995	3337	11.42%	3502	16.93%
Ta71	100 × 20	5464	5923	8.40%	6103	11.69%
Ta72	100 × 20	5181	5590	7.89%	5706	10.13%
Ta73	100 × 20	5568	5983	7.45%	6243	12.12%
Ta74	100 × 20	5339	5629	5.43%	5778	8.22%
Ta75	100 × 20	5392	5815	7.84%	6060	12.39%
Ta76	100 × 20	5342	5788	8.35%	5921	10.84%
Ta77	100 × 20	5436	5770	6.14%	5927	9.03%
Ta78	100 × 20	5394	5766	6.90%	5874	8.90%
Ta79	100 × 20	5358	5695	6.29%	5732	6.98%
Ta80	100 × 20	5183	5703	10.03%	5737	10.69%