A Selection Scheme in Genetic Algorithms for a Complex Scheduling Problem

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Extended Abstract

Studies have shown that the job shop scheduling problem landscape, without being a rough one, has its local optima widely spread through the whole solution space (Mattfeld, 1995). Thus, we need a method that incorporates a local search type procedure keeping at the same time an adequate degree of population diversity. We choose to modify the selection procedure of the standard Genetic Algorithm to achieve this goal.

The selection method we propose here consists of a partial enumeration of neighbors of a set of sampled individuals to control the algorithm selection pressure and to keep, at the same time, an adequate degree of population diversity. The method is applied to a set of still open benchmark problems.

The neighborhood generation method (Critical Block Method (**CBM**)) uses problem specific knowledge to improve accuracy. This is achieved by building neighborhoods based on the swap of operations belonging to the critical path, and that are to be processed on the same machine. This procedure works as one step hill climbing for each neighborhood but elements of better neigborhoods have higher probability to survive. The idea of applying the method to still open benchmark problems is to take the challenge of generating the best upper bounds for these problems, most of which come from the operations research area.

Since all possible swaps are performed, the neighborhood size becomes big and the computation cost is higher than in standard genetic algorithms. However, the neighborhood size can still be reduced by avoiding the use of internal elements as it is done in (Nowicki, 1996). By doing this we could increase the diversity and reduce the computational load. The decrease of computational load will allow us to go deeper over good neighbors, i.e. instead of going only one step in the CB neighborhood we can go a greater number of steps. This will probably lead us to still better accuracy results. Future work is aimed to verify these hypotheses.

Table 1 shows the results for the famous FT10 (10 jobs and 10 machines), and other 15X15 problems. Here, TD03 to TD09 are still open problems while FT10, and LA36 to LA40 are solved ones (the optima are bold faced). The accuracy results are within 1.7% to 5.8% over the Best Upper Bound (**BUB**) available to date. These results are motivating since they can still be improved.

Table 1: Makespan averages and best values. TD03-09 open, FT10 and LA36-40 solved.

Problem	**CB Method** Average	Best	**BUB**
TD03	1272.8	1252	1218
TD04	1222.5	1207	1175
TD05	1262.8	1248	1228
TD06	1280.3	1258	1240
TD07	1260.5	1249	1228
TD08	1270.5	1261	1217
TD09	1347.4	1318	1274
FT10	943.9	930	**930**
LA36	1311.7	1292	**1268**
LA37	1454.9	1437	**1397**
LA38	1256.0	1242	**1196**
LA39	1254.1	1250	**1233**
LA40	1254.4	1246	**1222**

References

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E. Nowicki and C. Smutnicki (1996). A Fast Taboo Search Algorithm for the Job Shop Problem. Management Science **42**(6):797-813.