Genetic Algorithm with Optimal Recombination for Makespan Minimization on Single Machine

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The strongly NP-hard Makespan Minimization Problem on a Single Machine ($1|l_{ij}|C_{\max}$) [2] is considered. We propose a new genetic algorithm (GA) with steady state scheme for $1|l_{ij}|C_{\max}$, which solves an *Optimal Recombination Problem* (ORP) within crossover operator. Given two parent solutions, the ORP consists in finding the best possible offspring as a result of a crossover operator, obeying the conditions of gene transmitting recombination [3].

The computational complexity and solving method of the ORP for $1|l_{ij}|C_{\max}$ has been analyzed in [1]. Moreover, we have investigated in [1] two simple crossover-based GAs using ORPs but no local search procedures or fine-tuning of parameters were employed. In comparison to the GAs from [1], the GA proposed in this paper uses problem-specific local search heuristics and greedy constructive heuristics to generate the initial population. In addition, this GA applies mutation operators and a restart rule to avoid localization of the search and restore the population diversity.

The experimental evaluation shows that the proposed GA with ORP yields competitive results. In particular, the GA demonstrates at least 98% frequency of finding an optimum in the same time as in [1] on all instances generated from ATSP instances of TSPLIB library by assigning setup times for $1|l_{ij}|C_{\max}$ equal to weights of arcs in ATSP. We estimate that the average frequency of obtaining an optimum by the best GA from [1] is by factor 2.6 smaller than such frequency for the GA presented here. The experimental comparison indicates an advantage of the optimized crossover based on solving the ORP over its randomized prototype. We also analyze effectiveness to use local search not only at the initialization stage, but on iterations of our GA with ORP.

References

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