A Combined Method for the Resource Constrained Project Scheduling Problems

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We consider the resource constrained project scheduling problem with precedence and resource constraints (RCPSP). We are given a set of activities $N = \{1, ..., n\}$. The partial order on the set of activities is given by directed acyclic graph $G = (N, A)$. Each activity $j \in N$ is characterized by its deterministic processing time $p_j \in Z^+$ and the resource requirement r_{jk} in resource type k in each unit of time. For each constrained resource type k are known its capacity R^k during the each unit time slot of the planning horizon $\hat{T}$. All resources are renewable. Activities preemptions are not allowed. The objective is to compute the schedule $S = \{s_j\}$ that meets all resource and precedence constraints and minimizes the makespan $C_{\max}(S)$.

The considered problem is NP-hard. We propose to use a combined method to solve the problem. It is based on algorithms of branch and bound and metaheuristics. For the successful use of the branch and bound method the lower bound is very important. We have considered two variants for calculating the lower bound. We propose as the lower bound to use the solution of the relaxed problem where all constrained resources being accumulative. To solve this problem we use a polynomial exact algorithm [1]. As another lower bound, we consider the problem $P|prec, p_j = 1|C_{max}$. In this problem all activities have the unit processing time. V.V. Servah [2] developed a method for solving this problem, based on the dynamic programming idea, the algorithm has an exponential time complexity. At each step of the branch and bound algorithm we apply metaheuristics. We present results of numerical experiments illustrating quality of proposed algorithm. The test instances were used from the library of test problems PSPLIB.

References

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