The Flexible Job-Shop Scheduling Problem with Resource Constraints

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Abstract

This work presents an Iterative Tabu Search (ITS) algorithm for solving a flexible job-shop scheduling problem (FJSSP) with parallel unrelated machines and resource constraints. The examined problem can be described as follows: There is a set of jobs with different due and release dates, and each job consists of a number of operations that should be executed in a particular sequence (precedence constraints). Each operation can be executed on one or more machines with varying processing times. Furthermore, we consider a set of resources and resource constraints. These resources are renewable (e.g. electricity, water and gas utilities) and are consumed by the machines with specific limitations on consumption. Additionally, we consider that machines are not available at all times (machine availability restrictions). Multiple objectives are incorporated including makespan, total flow time, total idle time, total tardiness and total resource consumption in a hierarchical order assuming different objective combinations. An efficient multi-restart iterative tabu search meta-heuristic algorithm has been developed for solving the problem. The local search mechanism includes a set of simple moves (relocation, exchange) but also some compound moves to explore solution neighborhoods. The proposed algorithmic scheme incorporates a perturbation mechanism for escaping local optima, by removing and re-scheduling jobs based on specific criteria. Another important algorithmic component is the feasibility check module for resource consumptions. For this purpose, efficient data structures are employed. Computational experiments are performed on various FJSSP datasets taken from the literature, which demonstrate that the algorithm can provide high quality solutions (including new best solutions) within reasonable computational times. The existing datasets are modified to consider due and release dates as well as resource consumptions. Finally, the proposed algorithm is tested on the modified datasets and the results are discussed for various different scenarios.

Keywords: flexible job-shop scheduling problem, parallel unrelated machines, resource constraints, iterative tabu search