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Flow shop scheduling based on a novel cooling temperature driven simulated annealing algorithm

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Abstract. The Permutation Flow Shop Problem (PFSP) has been applied to many types of problems. The PFSP is an NP-hard permutation sequencing scheduling problem. A local search with simulated annealing scheme involving two phases is proposed in this investigation for solving PFSP. First, for lowering computation complexity, a simple insertion local search is applied to generate the solution of the PFSP. Second, two non-decreasing cooling temperature driven Simulated Annealing (SA), namely, steady SA and reheating SA are employed to maintain successive exploration or exploitation in the solution space. The steady SA maintains the same temperature and keeps the same search behavior and thereby allows the neighbors of the worse solutions to be explored, consequently increasing the chances of finding better solutions, while the reheating SA increases the temperature and exploration ability. The most important feature of the proposed method is its simple implementation and low computation time complexity. Experimental results are compared with other state-of-the-art algorithms and reveal that the proposed simple insertion with steady SA (SI-SSA) method is able to efficiently yield the best permutation schedules.

1. Introduction

There are many classes of real-world scheduling problems, such as job-shop scheduling, open-shop scheduling, Flow Shop Problem (FSP), task assignment scheduling, real-time scheduling, etc. Generally, scheduling problems involve the allocation of resources (such as machines or processors) to execute a set of activities (such as processes or tasks) satisfying given constraints and optimizing given criteria. Processes or tasks usually have time constraints, such as ready time, execution time, precedence, and deadline. Scheduling algorithms must determine a schedule for a set of processes that satisfies the prerequisite constraints; FSP is one of these and is currently the focus of much research since it can be used for finding near optimal solutions to many real-world optimization problems. FSP can be defined as the problem of assigning a set of independent jobs to run on a set of machines. Each job requires a given fixed, non-negative processing time on every machine. In this study, we focus on the Permutation Flow Shop Problem (PFSP), a special case of FSP, where the processing order of jobs always is the same on every machine, that is, all jobs follow the same machine order in the shop starting from the first machine and finishing on the last machine. PFSP applications can be found in a large number of real world environments, including manufacturing, maintenance, and warehous-

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