

Multiobjective parallel machine scheduling in the sawmill industry using memetic algorithms

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Abstract This study presents a multiobjective optimization algorithm that is termed memetic algorithm with compromise search (MACS). This algorithm, proposed by the authors, combines genetic evolution with local search, in the same way as traditional memetic algorithms, but with the use of independent populations for each objective, as well as a mechanism for finding compromise solutions (tradeoffs) via a local search operator. The algorithm was applied to a parallel machine scheduling problem involving a molding production process in the wood industry. The algorithm was compared against four multiobjective techniques available in the literature: the multiobjective genetic algorithm (MOGA), the strength Pareto evolutionary algorithm (SPEA), the non-sorting genetic algorithm II (NSGA II), and multiobjective genetic local search (MOGLS). The proposed approach outperformed the benchmark techniques in most of the test problems based on two objectives of industrial interest: minimization of the maximum completion time (C_{max}) and minimization of total tardiness. These objectives are directly related to the productivity of the product and the ability to deliver goods on time.

Keywords Multiobjective · Memetic · Tradeoff · Scheduling · Parallel machine · Wood industry

1 Introduction

Real-life problems are multiobjective in nature, because decisions are typically made based on more than one criterion. It is

multiobjective nature of real-life problems that has stimulated interest in developing tools that address industrial needs and are capable of generating good solutions in reasonable amounts of time. Such solutions are usually not achievable with exact algorithms, which is why metaheuristics have emerged as a practical alternative to addressing problems of this type. This study presents a novel multiobjective metaheuristic called a memetic algorithm with compromise search (MACS) that is adapted for solving parallel machine scheduling problems. A real-life case study and a set of theoretical problems were used to test the performance of the algorithm. The case study corresponds to a classical problem in the sawmill industry related to molding production. This process consists of several steps, and the scheduling of the molding machines is one of the critical issues. This step can be categorized as a parallel machine scheduling problem with setup dependence and due dates. The paper is structured as follows. Section 2 presents a brief overview of the related literature. Section 3 explains the methodology and the proposed algorithm. Section 4 presents the case study, problem formulation, and the experimental results. Section 5 presents conclusions and recommendations.

2 Background

Multiobjective optimization can be defined as an optimization problem that presents more than one objective function. The main complication of this type of problems is the subjectivity of the optimal solution. Multiobjective problems have a different optimal solution for each decision maker involved in the process. For this reason, a good multiobjective technique is one that can generate the maximum number of alternative solutions. This set of solutions is referred to as the Pareto frontier, and it contains all of the solutions that are not dominated. The dominance concept for a minimization problem can be defined as follows:

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