Article No. 104

Solving a Single-Machine Scheduling With Two Competing Agents and Unavailability Consideration by a Discrete Cuckoo Optimization Algorithm

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Abstract

Recently, the multi-agent concept applied in scheduling issues has received continuing attention. Scheduling with availability constraint has been widely studied. But most papers in the multi agent environment ignore non-availability of the machine. For this reason, this paper deliberates a two-agent single-machine scheduling problem with availability constraint. The goal of this paper is to minimize the total completion times of jobs of the first agent subject to the condition that maximum tardiness of the second agent is allowed to have an upper bound. Some dominance properties are presented for this strongly NP-hard problem. And next, using these properties, discrete version of cuckoo optimization algorithm is developed (COA) for the problem. For the evaluation of the proposed COA, problem data was generated to compare it against a genetic algorithm. The results of computational experiments show the good performance of the proposed algorithm.

Keywords:

Scheduling, two agents, Single machine, availability constraint, cuckoo optimization algorithm

1 Introduction

In traditional scheduling problems, many problems are solved conventionally in a one-agent environment, but many practical situations where revealed this assumption is not applicable in many real life conditions. In aspect of applications of scheduling with two competing agents (some of them focusing on game theory aspects of the problems); Curiel et al. [1] and Hamers et al. [2] studied applications in industrial management, Kim et al. [3] focused on project scheduling, Cres and Moulin [4] focused on an application in a queuing setting, and Shultz et al. [5] considered telecommunication services. Also Agnetis et al. [6] present examples of scheduling involving multiple agents competing on the usage of common processing resources in different application environments and methodological fields, such as decision theory, artificial intelligence, and operations research. For A comprehensive review reader refer to[7].

In the other hands, most literature in scheduling problems assumes that the machines are continuously available over the planning horizon. However, this assumption may not be true in many practical situations. For instance, a machine may not be available during the planning horizon due to maintenance activities, tool changes, or breakdowns. It is clear that the maintenance activity is important to improve the quality of the products or the production efficiency of the machines. A comprehensive review of these literatures has been conducted by Schmidt [8] and Ma et al.[9].

Most of the research in scheduling with two competing agents assumes that the machines are continuously available over the scheduling horizon. However, machines might not be continuously available in many realistic situations. In this paper, we study a two-agent scheduling problem on a single machine with multiple unavailability constraint where the objective is to minimize the total completion time of jobs from the first agent given that the maximum tardiness and of jobs from the second agent cannot exceed an upper bound. To the best of our knowledge, no work has been done with scheduling problems in which multi agents and availability constraint are considered simultaneously.

Rest of paper is organized as follows; in Section 2, problem description is given. Section 3 presents some dominance properties used in proposed algorithm. Section 4 discusses the structure of proposed cuckoo optimization algorithm. The analysis of computational experiments is provided in Section 5. Finally, conclusion are presented in the last section.

2 Problem description

The problem under study can be described as follows. There are n jobs which are processed on a single machine. Each job belongs to either one of the two agents, namely AG1 and AG2. The machine is not continuously available for processing throughout the scheduling horizon, and it has multiple fixed and predefined unavailability periods. M_j is the jth unavailability period. If jobs between any two consecutive unavailability periods are considered a batch, a schedule can be viewed as batches of jobs separated by unavailability periods. The objective of the problem is to find a schedule that minimizes the total completion time of the jobs of AG1 with the restriction that the maximum tardiness of the jobs of agent AG2 does not exceed a given upper bound UB. Assumptions made in this paper are as follows: