An imperialist competetive algorithm for multi agent scheduling problem under periodic maintenance

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Abstract

Scheduling with availability constraint and maintenance activity has been widely studied. However, multi-agent scheduling with simultaneous considerations of availability constraint and maintenance activity has hardly been considered until now. In view of this, this research focuses on the problem of scheduling jobs that come from two agent on a single machine that requires periodic maintenance with the objective of minimizing the total completion time of the jobs of the first agent while keeping the maximum tardiness of other agent below or at a fixed level UB. We present some new dominance properties for this strongly NP-hard problem. Next, using these properties, we develop a novel imperialist competitive algorithm for the problem. For the evaluation of the proposed ICA, 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; imperialist competitive 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. (Curiel, Pederzoli, & Tijs, 1989) and Hamers et al. (Hamers, Borm, & Tijs, 1995) studied applications in industrial management, Kim et al. (Kim, Paulson Jr, Petrie Jr, & Lesser, 2000) focused on project scheduling, Cres and Moulin (Crès & Moulin, 2001) focused on an application in a queuing setting, and Shultz et al. (Schultz et al., 2002) considered telecommunication services. Also Agnetis et al. (Agnetis, Mirchandani, Pacciarelli, & Pacifici, 2004) 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.

Agnetis et al. (Agnetis et al., 2004) and Baker and Smith (Baker & Smith, 2003) were the pioneers that brought the concept of multi-agent into the scheduling problem. Many research has been conducted to peruse the multi agent concept in scheduling under different machine environments and various criteria. For details on these researches, the reader may refer to (Perez-Gonzalez & Framinan, 2013)

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 (Schmidt, 2000) and Ma et al.(Ma, Chu, & Zuo, 2010).

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 periodic maintenance where the objective is to minimize the total completion time of jobs from the first agent given