GENERATING ROBUST AND STABLE SCHEDULES IN A SINGLE MACHINE ENVIRONMENT

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Abstract

Scheduling is a decision making process that concerns with allocation of limited resources (machines, material handling equipment, operators, tools, etc.) to competing tasks (operations of jobs) over time with the goal of optimizing one or more objectives. The output of this process is time/machine/operation assignments. In the scheduling theory, the objective is generally to optimize one or more regular performance measures such as makespan, flow-time, and tardiness. Recently, two new measures have been also used in scheduling applications: "robustness" and "stability". In this paper, we develop a new surrogate measure to achieve robustness and stability. This measure is embedded in a tabu search algorithm to generate schedules in a single machine environment subject to random machine breakdowns. The results of extensive computational experiments indicate that the proposed method performs better than the average slack method used in the literature.

Keywords: Robustness, Stability, Single Machine Scheduling, Tabu Search

1. Introduction

In scheduling practice, due to unexpected interruptions (e.g., breakdowns, new order arrivals, order cancellations, or due-date changes), planned schedules become infeasible so quickly that there is always a need for appropriate modifications. Indeed, a lack of attention to cope with these inevitable disruptions can be viewed as the major source of the gap between scheduling theory and practice. The scheduling process with the main emphasis on reactive policies to these interruptions is called as *reactive scheduling*. In the recent literature, two new criteria are brought to the attention of the researchers: robustness and stability. A schedule whose performance does not degrade much in the face of disruptions is called *robust*. By definition, the performance of a robust schedule should be insensitive to disruptions. In practice, when evaluating a scheduling system, the actual performance of the realized schedule is more important than the planned or estimated performance of the initial schedule. A schedule whose realized events does not deviate from the original schedule in the face of disruptions is called *stable*. In the scheduling process we don't only allocate limited resources to competing jobs, but we also prepare a plan for other production activities, such as setting shipments dates, releasing orders to suppliers, determining planning requirements for secondary resources such as tools, fixtures, etc. Any deviation from the planned schedule can easily disrupt these secondary plans and create so-called the system nervousness. In the literature, there are several studies to generate robust and stable schedules ([3], [4], etc.). This will be discussed in the next sections.

In this paper, we propose a new surrogate measure for robustness and stability. This new surrogate measure is embedded into a Tabu Search (TS) algorithm to generate robust and stable schedules in a single machine environment with stochastic breakdown events. Our extensive computational experiments indicate that the proposed measure performs better than the average slack method.

The rest of the paper is organized as follows: Next section is devoted to a review of the literature. In Section 3 we consider the single-machine scheduling environment subject to random machine breakdowns, and develop a tabu search scheduling algorithm that involves a surrogate measure. In Section 4, we conduct extensive simulation experiments to assess the goodness of the proposed algorithm and the surrogate measure. Concluding remarks and future research directions are given in Section 5.

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