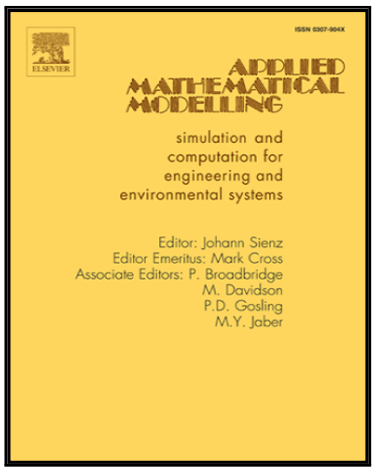

Single-machine scheduling problems with machine aging effect and an optional maintenance activity

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PII: S0307-904X(16)30026-9
DOI: 10.1016/j.apm.2016.01.038
Reference: APM 10998

To appear in: *Applied Mathematical Modelling*

Received date: 16 October 2014
Revised date: 23 December 2015
Accepted date: 12 January 2016

Please cite this article as: Manzhan Gu, Xiwen Lu, Jinwei Gu, Ying Zhang, Single-machine scheduling problems with machine aging effect and an optional maintenance activity, *Applied Mathematical Modelling* (2016), doi: 10.1016/j.apm.2016.01.038

Single-machine scheduling problems with machine aging effect and an optional maintenance activity

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Abstract

This paper considers two single-machine scheduling problems with a new type of aging effect, which is dominated by the processing speed of the machine. During the whole scheduling horizon, the machine is subject to an optional maintenance, and the duration of the maintenance depends on the length of the uptime before it. The objective is to schedule all jobs and find the location of the maintenance so as to minimize the makespan or the total completion times. The two problems are proved to be NP-complete, and two dynamic programming algorithms are proposed to solve the problems. We analyze the computation complexity of the algorithms, and show that the problems under study are solvable in polynomial time if the processing loads of all jobs are uniformly bounded.

Keywords: Aging effect, Maintenance, Makespan, Total completion times

1. Introduction

In the traditional single-machine scheduling problems, it is assumed that the machine is available from time zero to the completion time of the last job. However, in many practical settings the machine may not be available because of the need of repair, cooling or other maintenance operations. Therefore, it is more reasonable to consider the downtimes (i.e., maintenance activities) in the scheduling problems. Scheduling under such machine environment is called as the model with availability constraints [1]. In this model, the machine is unavailable to process jobs during the period of maintenance. After the maintenance, the machine will recover to its initial state and start anew. In the past decade, the scheduling problems with maintenance activities has received more and more attention. Schmidt [22] proposed a survey on different models and problems with available constrains, and an updated survey was presented by Ma et al. [19].

In addition, In the majority of the literature, it is assumed that the processing times of jobs are known constants. However, there are many settings in which the actual processing time of each job may be affected by its position or start time in the schedule. The phenomenon is defined as the time-dependent or position-dependent aging effect in the scheduling problems. In the model

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