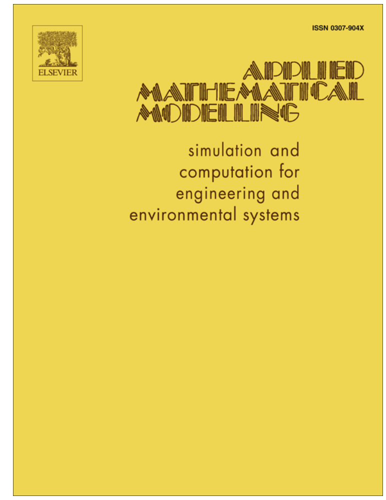

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Minimizing maximum tardiness and delivery costs with batch delivery and job release times

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Abstract

Due to high delivery costs, manufactures are usually required to dispatch their jobs as batches. This, however, causes a number of crucial problems in scheduling-related objective functions such as minimizing maximum tardiness. The current paper addresses scheduling a set of jobs with specific release times that are to be processed by a single machine and dispatched to a customer or another machine in a batch delivery condition. Each batch has a particular delivery cost. The aim is to minimize the costs of maximum tardiness plus delivery. First, a mixed integer programming (MIP) model is developed and solved by CPLEX solver within the GAMS modeling environment. Then, a branch and bound (B&B) algorithm is developed based on the LP relaxation of the MIP model. Using heuristics, appropriate values for upper and lower bounds are predicted. The heuristics and pruning rules can lead to the solution of large problems at logical run times. As the problem can be deduced to be NP-hard, the MIP model is not expected to be solved for extremely large sizes in reasonable (*i.e*. polynomially-bounded) CPU time. Hence, with the help of the exploited features/properties of the problem, two metaheuristic algorithms, *i.e*. a fast discrete particle swarm optimization (DPSO) and a genetic algorithm (GA), are developed. Finally, computational results are presented in order to analyze and verify the solutions.

Keywords: Batch Delivery, Maximum Tardiness, Release Time, Branch and Bound (B&B) Algorithm, DPSO Algorithm, Genetic Algorithm (GA)

1. Introduction

The problem of scheduling customer orders has always been of great importance to manufacturing and production managers. Traditionally, minimizing the costs corresponding to managerial decisions on the shop floor has been mostly emphasized in the literature (Karimi-Nasab *et al.* 2013). On the other hand, the production manager tries to avoid customer dissatisfaction as much as possible. To elaborate further, when jobs are processed, it is necessary to deliver them promptly in order to avoid tardiness which may result in customer dissatisfaction and higher costs. Moreover, one advantage of dispatching products as batches is decreasing delivery costs although it may affect tardiness. Hence, establishing a trade-off between the two types of costs, including scheduling and delivery**,** is needed. However, if a production manager has no clear sense of the cost coefficient due to tardiness, they can consider the problem as a bi-objective problem by minimizing the maximum tardiness along with minimizing the batch delivery cost. However, in the current paper, the production manager is supposed to know the related cost factors. Without the loss of generality, there are simple approaches (*e.g.* LP-metric) which can solve such problems in a manner similar to single-objective ones (Karimi-Nasab and Aryanezhad 2011).

In a three-layer supply chain, raw materials are first provided by suppliers, then dispatched to manufactures, and finally when processed, finished products are delivered to customers. Therefore, from manufactures' perspective, orders have specified release times (*i.e*. time taken to receive orders from suppliers). Thus, maximum tardiness in a supply chain can be regarded as a significant index for on-time deliveries because it reflects the worst service level with respect