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Grey Wolf Optimizer Algorithm for the Two-stage Assembly Flowshop Scheduling Problem with Release Time

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Highlights

► Studying two-stage assembly flowshop scheduling problem with release time of jobs. ► Finding the jobs sequence such that completion of the last processed job (makespan) is minimized. ► Proposing a newfangled algorithm called Grey Wolf Optimizer (GWO) inspired from living and haunting behavior of wolves for solving the studied problem. ► Developing a lower bound as well as several heuristic algorithms.

Graphical abstract**G.M. Komaki**
Vahid Kayvanfar

Abstract

This article addresses the two-stage assembly flowshop scheduling problem with release time of jobs which is applicable in many industrial areas such as computer manufacturing industry, fire engine assembly plant,etc. The first stage of the problem is called “fabrication stage” and includesidentical parallel machines while the second stage is called “assembly stage”with a single assembly machine. The jobs have components which they need to be firstly processed at the fabrication stage and then they should go under assembly operation at the assembly stage.The goal of this research is to find the jobs sequence such that completion time of the last processed job is minimized. For this problem,several heuristic techniquesas well as a lower bound are developed. Also, a novel meta-heuristic algorithm called Grey Wolf Optimizer (GWO) which is inspired by living and haunting behaviour of wolves is then proposed. An extensive statistical analysis is conducted to compare the performance of the employed algorithms on randomly generated instances.The obtained results indicate that the methods based on Johnson’s algorithm yield better results than the other heuristic algorithms. Moreover, the consequences show that the proposed LB is tight enough. Finally, the experiments show that the GWO outperforms the other employed well-known meta-heuristic algorithms.

Keywords: Assembly flowshopscheduling; makespan;release time; Grey Wolf Optimizer.

1. Introduction

This paper deals with the two-stage assembly flow shop where the first stage is machining (or fabrication) stage includes identical parallel machines while the second stage is assembly stage with a single machine. Jobs have m components and m+1 operations where the first m operations should be processed at the first stage and the last operation should be processed at the assembly stage to join the processed components at the first stage. This production system combines parallel machines and flow shop systems, andis able to produce a large volume of a variety of products in less production cost and time. Many applications in production industries fit into this system. For instance, Lee et al. (1993) presented an example of this system in a fire engine assembly plant. Potts et al. (1995) reported application of the assembly flow shop in computer