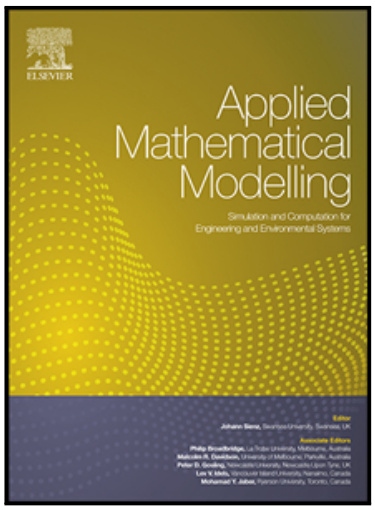

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Metaheuristic algorithms for balancing robotic assembly lines with sequence-dependent robot setup times

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Abstract: Industries are incorporating robots into assembly lines due to their greater flexibility and reduced costs. Most of the reported studies did not consider scheduling of tasks or the sequence-dependent setup times in an assembly line, which cannot be neglected in a real-world scenario. This paper presents a study on robotic assembly line balancing, with the aim of minimizing cycle time by considering sequence-dependent setup times. A mathematical model for the problem is formulated and CPLEX solver is utilized to solve small-sized problems. A recently developed metaheuristic Migrating Birds Optimization (MBO) algorithm and set of metaheuristics have been implemented to solve the problem. Three different scenarios are tested (with no setup time, and low and high setup times). The comparative experimental study demonstrates that the performance of the MBO algorithm is superior for the tested datasets. The outcomes of this study can help production managers improve their production system in order to perform the assembly tasks with high levels of efficiency and quality.

Keywords: Assembly line balancing; robotic assembly line; sequence-dependent setup times; metaheuristics

1. Introduction

Assembly lines have been extensively used in the consumer electronics and automobile industries for the assembly of different products [1, 2]. Due to increasing human labor costs and customers' mounting demands for a variety of products, industries are utilizing robots in assembly lines in order to improve production flexibility and product quality [3]. Robotic assembly line balancing (RALB) problems have been receiving increased attention in the last few years. RALB is defined as assigning a set of tasks to workstations in balanced form by allocating the best robot to each task at each workstation. Some contributions on RALB focus on type I robotic assembly line balancing (RALB-I) problems to minimize the number of workstations, while type II robotic assembly line balancing (RALB-II) problems are concerned with the optimization of cycle time [4]. Simple