Multi-objective AGV scheduling in an FMS using a hybrid of genetic algorithm and particle swarm optimization

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Abstract

Flexible manufacturing system (FMS) enhances the firm’s flexibility and responsiveness to the ever-changing customer demand by providing a fast product diversification capability. Performance of an FMS is highly dependent upon the accuracy of scheduling policy for the components of the system, such as automated guided vehicles (AGVs). An AGV as a mobile robot provides remarkable industrial capabilities for material and goods transportation within a manufacturing facility or a warehouse. Allocating AGVs to tasks, while considering the cost and time of operations, defines the AGV scheduling process. Multi-objective scheduling of AGVs, unlike single objective practices, is a complex and combinatorial process. In the main draw of the research, a mathematical model was developed and integrated with evolutionary algorithms (genetic algorithm (GA), particle swarm optimization (PSO), and hybrid GA-PSO) to optimize the task scheduling of AGVs with the objectives of minimizing makespan and number of AGVs while considering the AGVs’ battery charge. Assessment of the numerical examples’ scheduling before and after the optimization proved the applicability of all the three algorithms in decreasing the makespan and AGV numbers. The hybrid GA-PSO produced the optimum result and outperformed the other two algorithms, in which the mean of AGVs operation efficiency was found to be 69.4, 74, and 79.8 percent in PSO, GA, and hybrid GA-PSO, respectively. Evaluation and validation of the model was performed by simulation via Flexsim software.

Introduction

General

In today’s competitive market, customer satisfaction plays a key role in companies’ market share. Therefore, organizations have shifted their strategy from manufacturing large quantities of a single product to a range of products, and improving the quality and on-time delivery. To meet these challenges, organizations should have a flexible manufacturing platform. In automated manufacturing environments, FMS provides wide flexibility and concurrent production of a wide variety of parts in small capacities. It comprises material handling...