Order picking algorithms for a two-carousel-single-crane automated storage and retrieval system

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Abstract

In practice, automated storage and retrieval carousel systems access orders through a first-come, first-served basis requires a longer storage and retrieval period with cleavage for reducing order access time. We developed a single-command mathematical model of a two-carousel-single-crane system based on storage and retrieval issues of the

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two-carousel-single-crane automated storage and retrieval system. Furthermore, based on these features, we developed a heuristic method to decide the sequence of storage and retrieval for both the single-layer-single-crane and two-carousel stages to design the final storage and retrieval operations of the two-crane-single-crane system. The researchers conducted a process to determine the operation with the shortest storage and retrieval sequence, which was then compared to a simulated annealing process to identify their advantages and disadvantages.

Keywords: two-carousel-single-crane system, order picking, simulated annealing

1. Introduction

In distribution warehouse, the efficient of order picking is important. It has been shown by Bozer and White [1] that order-picking operations account for about 65% of the total operating cost of a warehouse, and their travel time accounts for roughly 50% of all order-picking operations from Vaughan and Petersen [13]. Thus the manager is interested in finding the most economical picking operation and reducing the distance travelled time spent [1].

A carousel is an automated storage and retrieval system which is widely used in modern warehouses as one of major technologies for small parts' storage [11]. A typical AS/RS performs regular order picking operations on the basis of first-come-first-serve (FCFS). The FCFS is simple in applications. However, it may not be an efficient approach.

Order picking sequence is the major influence on picking cost and time. The problems of order picking sequence can be recognized as travelling salesman problems (TSPs) [7]. It is recognized to be a NP-hard problem, and it's extremely difficult to obtain optimal solutions for large-scale problems within a tolerable computation time.

Several researchers pay efforts to find the shortest distance by rearranging order picking sequence [8][10][3][5][4][2][14][11]. Hwang and Kim [9] measure analytically the effects of double shuttle of the storage/ retrieval machine on the throughput that is better than standard carousel systems. Park *et. al.*, [13] derived expressions for the throughput and picker utilization of a carousel system consisting of two carousels and one picker. This Paper discusses the order picking sequence in two-carouselsingle-crane systems. A mathematical model is developed first and a heuristic method for solving the order picking sequence is also provided. The simulation experiment and statistic analysis indicates the heuristic method developed in this paper is an efficient operational approach.