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UNDERSTANDING OF CONTINUOUS MODEL AND DISCRETE MODEL FOR SINGLE TIME IN MULTI AUTOMATIC STORAGE AND RETRIEVAL SYSTEM USING BASIC CLASS: A REVIEW

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ABSTRACT

This journal review aims to better understand the automation of control systems, especially regarding discrete and continuous data. Begin with interest in discusses storage assignment problems in automated storage and retrieval (AS / RS) systems, and more specifically class-based storage in multi-aisle AS / RS. In the first part, we develop a sustainable approach. The latter is an analytical approach based on a continuous approach of multiple discrete distributions that models the precise horizontal and vertical motion of the S / R machines in each class A, B, and C. Furthermore, the proposed model is validated by comparing it with the discrete model. For this, we have studied several configurations to compare the results given by the discrete model and the continuous model. Finally, the results obtained show that these two models are very close to each other. This is expected because the expression developed is a continuous estimate of discrete data. This journal review aims to better understand the automation of control systems, especially regarding discrete and continuous data.

Keywords: Multi-aisles AS/RS, Single-cycle time, Class-based storage, Continuous Model, Discrete model

1 INTRODUCTION

Warehouse material handling is an activity that is routinely carried out by an automatic production so that one of the important things for material handling in a factory is using automatic storage and retrieval (AS / RS). Automatic retrieval (AS / RS) has many advantages such as over conventional warehouse alternatives. advantages of automated storage/retrieval systems are savings in labor costs and floor space, increased reliability, and reduced error rates [1][2].

This system has fast and efficient handling and can operate 24 hours a day with minimal supervision. AS / RS requires serious analysis during the initial design phase [3][4][5].

A designer will determine the capacity and system throughput. For example, during the design phase, managers make decisions about rack configuration and capacity (single or multiple depths), the number of aisles and storage/retrieval machines (S / R machines), and the location of Input / Output stations (I / O Stations). After the AS / RS is implemented, making decisions for performance, these management decisions include decisions about storage policies, S / R machine location points, and scheduling [6][7][8].

Discussion topics regarding storage tasks are abundant. The first discussion develops an analytic model for the expected cycle times AS / RS payload unit. In their work, the authors consider three strategies: random storage, class-based storage, and custom storage. They show that there is a significant show in travel time by using a special retention policy as based on all responsible policies. Extend the work done by comparing the operating performance of storage management using evaluation and discrete models. Each rule is based on the estimated travel time of the S / R engine [9].

Studied the effects of various assumptions on AS / RS behavior by simulation. For unit load AS / RS, develop and compare travel time models for single and multiple command cycles. a proposed travel time model, which takes into account the

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diversity of trips with known acceleration/deceleration rates. This compacted form of travel cycle with class-based retention policies and full cycle-based retention policies has ended. These results prove that the proposed exponential travel time mode and the exponential model are well-matched and can be practical tools for designing an AS / RS in existing world applications. has developed a computerized cycle that comes in a custom storage sequence for AS / RS based on S / R engine time. presents an analytical model based on precise geometry to calculate the expected travel time for an S / R crane moving in a single command, multiple commands, or stop where the shelf can be SIT or NSIT [10][11].

Presents a closed-form travel time expression for a rack-flow AS / RS based on a continuous approach and compares it to a simulation to show that this analytical model can estimate performance measures that require less computation time than simulation. Within the same AS / RS type, heuristics are developed taking the expected fetch times. This heuristic supports an estimated increase in retrieval time. Extend this work and develop two metaheuristic algorithms, called taboo tracing and simulated annealing [12]. This metaheuristic algorithm was developed to control the rack flow of AS / RS picking machines for picking times. The results of this metaheuristic algorithm are compared with classic heuristics and analytical models in the literature. A new storage/retrieval method in Flow-Rack. for that two algorithms were developed to prove the feasibility of implementing this method. This study shows more than 60% of the average sampling time, compared to random sampling [12].

The initial form of a mathematical expression for the expected throughput rate in an AS / RS system. then develop a time expression. The expected SC for commutation-based storage and class-n storage. the approach for class 2 based storage in optimally designed racks (square shelves) analyzes a formula that reduces the expected travel time of SC or DC and constructs a structure for a dual command cycle trip time model under class-based assignments expected travel time of selected handling equipment in a three dimensional palletized storage system [13][14].

In this paper, we restrict our attention to class-based storage, in this methodology of storage, the products are organized in classes by contribution to their rotation frequency.

After the state of the art, the number of a class is limited to three: "A" is the class of items that have a faster rotation, "B" class includes second-fastest articles, and "C" covers the rest. The average cycle time of the S/R machine is an important parameter in this policy because it enables optimization when designing new systems for the design of classes and calculating the throughput of the system.

Several models have been developed to study assignment problem (class-based storage) in unit load AS/RS, such as retrieval systems design is provided for a range of issues such as system configuration, travel time estimation, storage assignment, dwell point location, and request sequencing. The majority of the reviewed models and solution methods apply to static scheduling and design problems only. Requirements for automated retrieval systems are, however, increasingly of a more dynamic nature for which new models will need to be developed to overcome large computation times and finite planning horizons and improve performance. retrieval systems design is provided for a range of issues such as system configuration, travel time estimation, storage assignment, dwell point location, and request sequencing. The majority of the reviewed models and solution methods apply to static scheduling and design problems only. Requirements for automated retrieval systems are, however, increasingly of a more dynamic nature for which new models will need to be developed to overcome large computation times and finite planning horizons and improve performance [11].

In this paper, the authors consider the cycle time of multi-aisle AS/RS with class-based storage. Initially, they present a discrete model to determine the average single cycle time of the S/R machine for each class of a multi-aisle system [11] Then, they develop an approximated continuous model. The developed models include many results. They are appropriate mathematical support for analyzing, assessing, and optimizing storage strategy.

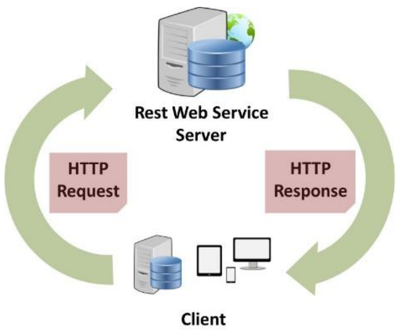

Figure 1 REST API architecture

2 METHODOLOGY

2.1 Class-Based Storage In Multi AISLES AS/RS

In this research, we consider an AS/RS, where there are several aisles. Each aisle contains a storage rack on both sides. All these aisles are connected by a common aisle positioned perpendicular to racks. The system includes a deposit/delivery station (D/L station) located in the lower-left corner of the AS / RS. There is also a single storage/retrieval machine (S/R) dedicated to the aisles of the system, which can move simultaneously in vertical and horizontal directions. This movement is called Chebyshev displacement. Therefore, the travel time between two points is equal to the maximum of the horizontal and vertical displacements

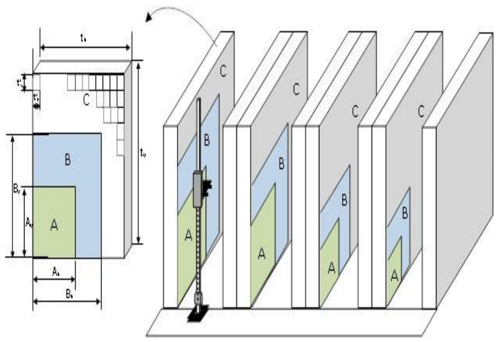

Figure 2 Class-based storage in multi-aisles AS/RS

Figure 2 shows class-based storage is:
M: The number of racks in the system
M/2: The number of aisles in the system
N_H: The number of bins per line
N_V: The number of bins per column
B_H: Boundary limits per line of class B
A_V: Boundary limits per column of class AB_V: Boundary limits per column of class B
t'_H: The horizontal traveling time from a cell to the next cell
t'_V: The vertical traveling time from a cell to the next cell
t'_P: The traveling time from an aisle to the nearest one in a multi aisle AS/RS and $t'_P = 3*t'_H$
t_H: Time necessary to traverse the length of a rack or the length of an aisle;
t_V: Time necessary to traverse the height of the rack
t_P: Time necessary to traverse the main aisle in a multi aisle AS/RS
E(SC): Expected single cycle time
E(SCBS): Expected single cycle time in class based storage

2.2 Discrete Models Of A Multi Aisle AS/RS In Class-Based Storage

The discrete model applied in the previous model, allows us to develop a system of mathematical expressions for computing the travel time of the multi aisle AS/RS with class-based storage assignment [11]. The travel time model depending on the value of the order picking proportion α, β and γ is presented as follow.

The exact distribution g_p (k) can be approximated by the continuous uniform distribution as shown in Figure 3., while the exact distribution $g_h(k)$ can be approximated by the continuous triangular distribution as shown in Figure 2.

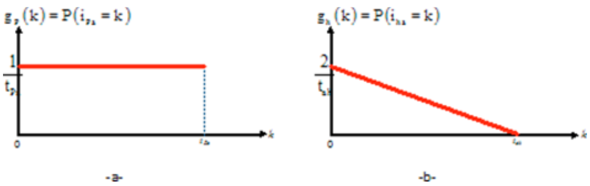

Figure 2 Approximate continuous distributions of the random variable

$$E(SCBS) = \alpha E(sca) + \beta E(scb) + \delta E(scc)$$

where E sca: Expected single cycle time of class A, E scb: Expected single cycle time of class B, and E scc: Expected single cycle time of class C.

The main idea of this method is based on continuous approximation of probability laws modeling the movements of the S/R machine.

3 RESULTS AND DISCUSSIONS

To evaluate the accuracy of mathematical expressions developed in section three and four, we have taken a variety of configurations with multiple dimensions of class A, B, and C. We conducted a comparison of the results given by the continuous expression with those given by the discrete expression, knowing that it gives accurate results. The results are shown in figure 3, whereas Small average travel time differences were found according to the different analytical approaches developed previously. This is predictable because the developed expressions are a continuous approximation of discrete data.

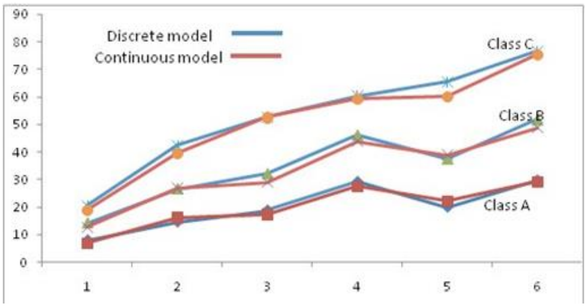

Figure 3. Comparison between the results given by the continuous model and discrete model for the three classes

4 CONCLUSIONS

The results of the review regarding the average cycle times of storage/retrieval AS / RS multi-aisle with class-based storage (A, B, C) are as follows:

1. This expression is determined using a continuous approach which considers the side of the shelf as a place where storage or retrieval can be made at any point,
2. Estimates of these expressions are compared, for validation, with the exact expressions obtained from the discrete approach,
3. The Continuous Model has been approximated but is in the form of a simple analytical expression and can be calculated by hand,
4. The Discrete Model is precise but very complex. It takes computer computation time to obtain cycle times for a particular configuration,
5. The storage/retrieval average cycle time expression developed in this study can be used to compare the results provided by this retention policy with other types of retention tasks such as random storage, and
6. Optimize cycle times and design new systems. evaluate and determine the policies to be taken.

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