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Dynamic Scheduling Model of Rail-Guided Vehicle (RGV) Based on Genetic Algorithms in the Context of Mobile Computing

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ABSTRACT

Track guidance vehicle (RGV) is widely used in logistics warehousing and intelligent workshop, and its scheduling effectiveness will directly affect the production and operation efficiency of enterprises. In practical operation, central information system often lacks flexibility and timeliness. By contrast, mobile computing can balance the central information system and the distributed processing system, so that useful, accurate, and timely information can be provided to RGV. In order to optimize the RGV scheduling problem in uncertain environment, a genetic algorithm scheduling rule (GAM) using greedy algorithm as the genetic screening criterion is proposed in this paper. In the experiment, RGV scheduling of two-step processing in an intelligent workshop is selected as the research object. The experimental results show that the GAM model can carry out real-time dynamic programming, and the optimization efficiency is remarkable before a certain threshold.

KEYWORDS

Dynamic Scheduling, Genetic Algorithm, Greedy Algorithm, Mobile Computing, RGV

1.INTRODUCTION

In order to improve efficiency and reduce costs, automation control has been paid more and more attention and rapidly popularized in various application fields, especially in the industry (Konak et al., 2006). In the industrial automation system, as a material handling equipment in the production process, the efficiency of RGV will directly affect the production efficiency of the whole system.

RGV was first used to transport materials along inherent routes in intelligent workshops and automated warehousing environments. RGV is dynamic and complex, which determines that it needs to be able to process data reliably in a mobile environment, and mobile computing can solve this problem. Scholars have proved that in workshop or FMS environments, the scheduling of materials to machines has been proved to be NP-hard problem (De Guzman et al., 1997; Martinez et al., 2006). Previous studies focused on RGV routing and scheduling as well as deadlock and conflict avoidance. Singh and Tiwari (2002) proposed an intelligent agent framework to find the shortest conflict-free

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path. Nishi et al. (2005) provided the mathematical model of routing problem, which was solved by Lagrange decorative positioning technology. Ghasemzadeh et al. (2009) proposed a collision-free scheduling and routing in grid topology.

Another method we use here is genetic algorithm, which in its most general usage refers to a family of computational models involving the idea of evolution. This algorithm was firstly introduced by John Holland and his students (2008). And this approach is often viewed as a function optimizer. It applies the process of "survival of the fittest" to optimize the efficiency of the function. Whitley et al. (1994) categorized the genetic algorithms into three steps. It begins with the random choice of the initial population. Then the fitness of each in the population is evaluated and those genes with higher fitness, or represent a better solution of the target problem are allocated greater chances to reproduce. The last step is to construct the genes of the next generation which can give a better solution. Inspired by its broad usage and the high efficiency, we try to apply this general method to our modeling.

However, this algorithm, which only considers local optimum, gradually loses its function with the expansion of its application industry and operation scale (Ulusoy et al., 1997). In the follow-up study, Deroussi et al. (2008), Kulich et al. (2016) and Li et al. (2017) proposed a method that combines greedy search heuristics (finding a feasible solution and setting delay boundaries), column generation and branching and clipping processes. Reddy et al. (2006) and Hu et al. (2017) proposed a multi-objective genetic algorithm for scheduling jobs and AGV simultaneously. Some scholars proposed a hybrid simulated annealing based job scheduling and AGV synchronization scheduling method (Cordeau et al., 2002).

In recent years, the research of edge calculation and fog calculation also provides a new idea for this paper. Chang et al. (2018) and Camilius et al. (2018) have developed a framework called edge process enabled Internet of thing. Kaushik et al. (2019) propose an event based efficient deployment algorithm for relocation of redundant sensors to the event location to achieve full coverage. Chen et al. (2017) introduced the multi criteria decision making (MCDM) method to select the migration target host. Soo et al. (2017) provides new insights about how distributed systems can achieve the high-performance process migration in the edge networks.

In this paper, the greedy algorithm is used to optimize the genetic algorithm and incorporate the failure into the study, which makes the algorithm more practical. In order to validate the effectiveness of the algorithm, we selected three groups of data to test. The experimental results show that the model can quickly dynamic programming route.

2. MAIN FOCUS OF THE ARTICLE

Many researches now studying the rail guided vehicle (RGV) mainly focus on the loading/unloading under certain distributions of the equipment. And most of them use artificial intelligence and machine learning to find the most efficient solution. But these methods require a great deal of data and cost much time. Meanwhile, what we are trying to solve is to figure out the optimal distributions of the equipment to save as much time as possible. So, from the perspective of the problem, what we are interested is a little bit more difficult and complicated since there are more uncertainties. Moreover, from the perspective of the modeling, we don't have so much data that we can rely on to do the experiment and we need the models to give better solutions as soon as possible. On the whole, there are not so many researches we can refer to and we construct this dynamic model in a creative way.

Considering that enumeration method can cost pretty much time and the universality of the genetic algorithm, we take an attempt to apply this method. Involving the idea of natural evolution, this dynamic model we use can save much time when finding the optimal solution. And in order to avoid the complexity of enumeration method, we optimize the genetic algorithm using greedy algorithm, which focus on the local best.