RGV Dynamic Scheduling and Process Optimization Model based on Greedy Strategy

Liu Chen

College of Computer Science and Technology, Jilin University, Changchun, Jilin, 130012, China

1393239448@qq.com

Keywords: Greedy strategy, Scheduling optimization, RGV dynamic scheduling, Process allocation

Abstract: This paper constructs a dynamic scheduling simulation model of greedy strategy and a model of maximum efficiency process scheduling optimization model for the problem of RGV dynamic scheduling. Firstly, by calculating the expected path length, the minimum expected path length process allocation optimization model is established, and the optimal solution is solved by MATLAB software. Combined with the given examples, the CNC process assignment under the specified parameters is determined. After that, through the two-process CNC combination allocation method, a two-process greedy strategy scheduling simulation model was constructed. In order to determine the specific combination of the process, we set the maximum efficiency process scheduling optimization model with the highest efficiency and the process combination allocation as the decision variables. Because the model is more complex, this paper introduces a genetic algorithm to solve it. Finally, the dispatching result of the three sets of fault-free conditions under the three sets of specified parameters is 187, 85, and 241 pieces of materials processed in one shift.

1. Introduction

With the rapid development of information technology and automatic control, the processing workshops are increasingly turning to automation and intelligence. The RGV is a rail-mounted automatic guided vehicle that can run freely on a fixed track. The key to using RGV as an auxiliary equipment for intelligent processing workshops is to control its accurate and efficient response to the CNC (Computer Number Controller) requirements. Therefore, studying the dynamic scheduling problem of intelligent RGV and constructing a series of efficient mathematical models have certain significance for promoting the development of intelligent processing workshops.

2. Greedy Strategy Scheduling

For the greedy strategy scheduling of the two processes, this paper adopts a two-step process CNC pairing to simplify the problem. That is, for each first process CNC, there is only one second process CNC corresponding thereto. Through this pairing method, this article greatly simplifies the complexity of the problem. According to this, the new process of the two-process greedy strategy scheduling simulation model is: for each CNC response, determine the process steps. If the process is the first process, the RGV responds to the corresponding second process CNC immediately after the response. If the process is a second process, the RGV does not respond to the process.

The above model is solved by MATLAB programming, and the one-dimensional row vector is used to store the remaining task time of each CNC. Use RGV to poll the CNC to reduce the entity, improve efficiency, and reduce the complexity of the algorithm. And adopt the idea of divide and recursively, and gradually solve the problem from the bottom up.

The optimal CNC pairing method in this model has not been determined. The model was solved by combining the three sets of sample parameters. The number of processed materials in the three working groups corresponding to the three sets of parameters was 187, 85 and 241. The following table shows the partial solution results of a process greedy strategy scheduling simulation model

under the first set of parameters.

Table 1 Partial solution results of the second set of process greedy strategy scheduling simulation model under the first set of parameters

Processing material serial number	CNC number of process 1	Feeding start time	Cutting start time	CNC number of process 2	Feeding start time	Cutting start time
1	CNC#6	35	366	CNC#5	67	398
2	CNC#2	366	770	CNC#1	398	490
3	CNC#4	770	913	CNC#5	490	548
4	CNC#8	913	965	CNC#3	548	606
5	CNC#2	965	1354	CNC#5	606	802
6	CNC#4	1354	1413	CNC#3	802	945

3. Maximum Efficiency Operation Scheduling

In order to determine the optimal CNC pairing method in this model, this paper establishes the maximum efficiency process scheduling optimization model to solve the optimization problem. The model is constructed as an abstract function $M(\delta)$, where the independent variable δ is a set of possible CNC pairing methods, and the dependent variable M is the number of pieces of material that can be processed in one shift of work in the paired mode. According to this, the maximum efficiency process scheduling optimization model can be constructed as follows.

$$\text{Max } M(\delta)$$

s.t.

δ is a set of possible CNC pairings that match the results of model

For the above optimization model, the traditional optimization method has been difficult to play its role. This paper chooses the genetic algorithm to find its optimal solution. Genetic algorithm is a highly parallel, stochastic, adaptive search algorithm developed by reference to natural selection and evolutionary mechanisms, suitable for dealing with complex and nonlinear problems. It generally includes population initialization, individual evaluation and selection, crossover, mutation, and judgment of termination conditions.

Population initialization is the encoding of genetic individuals. Next, this article takes Example 3 as an example for analysis. A total of 6 first-stage CNCs, numbered 1, 2, 3, 4, 5, and 6; a total of 2 second-stage CNCs, numbered 1, 2, one of which is shown in the following table.

Table 2 Individual coding

1	2	2	1	2	1
1	2	3	4	5	6

The individual code indicates that the first process CNC of No. 1, 4, and 6 is paired with the second process CNC of the first process; the first process of the second, third, and fifth CNCs is paired with the second process of the second process CNC.

Next, calculate the function value of the objective function. That is, the value of $M(\delta)$ is calculated. The individual code is input into the model abstract function, and the return value of the single-shift processing material is the target function value. Then cross-operation is performed to apply the crossover operator to the group, and a global optimal solution can be generated.

The mutation operation applies the mutation operator to the population. That is, changes in the gene values at certain loci of individual strings in a population can produce diverse individuals.

Finally, it is judged whether the termination condition is satisfied, including the maximum iteration algebra, whether the fitness meets the requirements, and the like. This paper uses MATLAB's genetic algorithm toolbox to solve. The solution results are as follows.

Table 3 Solution results of genetic algorithm

1	1	2	2	1	2
1	2	3	4	5	6

The individual is decoded and the results of the model are obtained.

Table 4 Model solution results

1	1	1	2	2	2
2	3	4	5	6	8

4. Conclusion

In this paper, for the problem of dynamic scheduling of RGV, a dynamic scheduling simulation model of greedy strategy and a model of maximum efficiency process scheduling optimization model are constructed. Through the two-process CNC combination allocation method, a two-process greedy strategy scheduling simulation model is constructed. In order to determine the specific combination distribution method of the process, we set the maximum efficiency process scheduling optimization model with the highest process efficiency as the goal and the process combination distribution method as the decision variable.

References

[1] CHEN Yun, SUN Qiyuan. Study on the scheduling of linear reciprocating 2-RGV system based on TS algorithm [J]. Industrial Engineering and Management, 2015, 20(5): 80-88.

[2] Wu Yuming, Liu Yongqiang, Zhang Dong, Zhao Han. Research on dynamic scheduling of RGV based on genetic algorithm [J]. Lifting and transporting aircraft, 2012, (6): 20-23.