RGV Optimization Problem Based on Genetic Algorithm

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Abstract: To analyze the working characteristics and adjustment strategies of RGV, and to consider the impact of its starting and stopping, waiting, recombination on the movement and transport capacity at the same time. Based on this foundation, the method of real time adjustment based on self-learning and modified inheritance calculation is proposed to discuss the code coding, selection, cross-fork variation and operation rule method of the method of adjustment, and the method of expert library self-learning of modified species group and proper co-solution is proposed. The high optimization calculation speed is verified through the simulation and process test, which proves that the moving force of ring shape is effective and high. This model and self-learning calculation method are feasible and effective.

1. Introduction

It is easy to cause traffic jam and reduce transportation capacity when several trolleys are on the closed track. Therefore, the improvement of transport and transport capacity is the main path of the whole automated material flow system to excavate the latent capacity.

In order to establish the mathematical model of its multi-objective optimization degree based on theoretical research and practical special point. The method of self-learning scheduling algorithm is used to enrich the knowledge of the expert library and solve the problem of the time-flexibility adjustment of circular shape. To improve the efficiency of the whole system. Reduce energy consumption, and achieve the optimal economic performance of green production.

The letters used are as follows:

T_D: The time required for RGV to complete a cargo handling operation.

t_z: RGV travel time.

t_s: RGV pick - up, unload and delivery time.

t_a: RGV positioning time, security time, communication time.

t_e: RGV Constant speed walking time.

t_w: RGV Stop waiting time.

d: The number of moving and transporting tasks completed by a RGV on a circular track from the original point.

q: The number of RGV.

$x_{R_k}^i$: It is shown that the operational status of the k_{th} RGV performing the tasks assigned to it, the j_{th} moving and transporting (The car is performing the task, and the value is 1, otherwise 0).

S_i: The distance between RGV R_k and platformO_i.

$S_{(i)}$: When assigning task changes, The distance between RGV R_k and platformO_i.

$T_{R_kS}^{j+1}$: The start time for the RGV to perform the R_k transport task.

$T_{R_kE}^{j}$: The end time for the RGV to perform the R_k transport task.

T_{OP}^{j}: j_{th} duty from the time under the duty to the time of the commencement of the operation

$x_{O_iP_j}^h$: Transport tasks assigned to the k_{th} RGV.

2. Model Analysis

The RGV moving and transporting cargo package includes three processes, namely, picking and transporting, moving and transporting and discharging.

The time between completion of a cargo transfer operation is:

$$T_D=t_z+2t_s+t_0$$

$$t_z=\sum_{i=1}^{m} t_a+\sum_{i=1}^{n} t_e+\sum_{i=1}^{p} t_w$$

RGV rule scheduling has two modes:

One is the sub-allocation and assignment mode. When there is a moving and transporting service, the management system of the adjustment is based on the current working status of the whole part, and the lifting task is assigned to the idle RGV which is closest to the moving and transporting service once, so that the task will not be further changed.

The other is to change the allocation and assignment model, a new transport of the pick-up station and station to be allocated to the nearest to the transport of duty-free vehicles. If the small car finished the original moving to move another car closer to the distance, then the new moving to move the office to re-allocation to the car.

It is easy to see that circular RGV adopted the regulation to adjust, and the compound operation was less and empty running more. Due to its closed operation track, the RGV needs to stop at the station platform when picking, unloading, and delivering, and the small cars that are easy to be built can be stopped. For its safe operation, it can require multiple restarts, stops and acceleration and deceleration in a single movement operation, which leads to low efficiency of RGV movement.

3. Model Establishment

The loop shape has many shapes, such as I, L, C, Z, T, etc. In order to study conveniently and without loss of generality, I shape is studied. The picture is a plant annular system layout display diagram.

The assumption is as follows:

1) The designated pick-up station is O_i, the unloading station is P_i, and the RGV is R_k.

2) O_1 for the origin.

3) The RGV dispatching management system knows the real-time positioning of all small cars.

4) The RGV can only go forward, not backward, that is, it can only go clockwise or clockwise.

5) RGV can be discharged immediately after reaching the unloading station.

6) A single RGV can carry out only one moving operation at the same time.

According to the above analysis and hypothesis, the optimization tuning problem of ring RGV can be described as:

Suppose there are k RGVS in a circular orbit ($R_1, R_2, \ldots, R_k$) and now h transport assignments ($x^1_{O_iP_j}$, $x^2_{O_iP_j}$,…, $x^h_{O_iP_j}$). Carry out the task within T time ($T^1_{OP_{min}}$, $T^2_{OP_{min}}$,…, $T^j_{OP_{min}}$). How do you adjust the RGV so that the RGV has the greatest number of lifting tasks, and reduce the starting and stopping of the RGV, plus or minus the speed, and the stopping of the RGV between each other in the same time, so that the moving time of the RGV is the shortest? When the production process is moving and transporting with the machine, how can the scheduling make it the most efficient?

According to the hypothesis, the models are as follows:

$$(max)\sum_{k=1}^{q}\sum_{i=1}^{d} x^i_{R_k}$$

$$(min)\sum_{k=1}^{q}\sum_{i=1}^{p} t_w$$

$$(min)\sum_{k=1}^{q}\sum_{i=1}^{m}t_a$$

The constraint:

$$S_i\text{-}S_{\min i} \geq 0$$

$$S_{(i)}\text{-}S_{\min(i)} \geq 0 \; or \; S_{(i-1)}\text{-}S_{\min(i-1)} \geq 0$$

$$T_{R_kS}^{j+1} > T_{R_kE}^{j}$$

$$T_{OP}^{j} < T_{OP\,min}^{j}$$

$$x_{R_k}^{i} \in \{0,1\}(k = 1,2,\dots,q)(i = 1,2,\dots,d)$$

We use improved genetic algorithms. The circular RGV optimization problem is three objective opti-mization problems. The dyeing body coding square method adopts the natural number coding square method to carry out the coding of all the service states and moving tasks of the RGV, forming a dyeing body. The coding is as follows:

$$x_{R_1}x_{O_iP_j}^{1}, x_{R_2}x_{O_iP_j}^{2},\dots, x_{R_k}x_{O_iP_j}^{h},\dots, x_{R_q}x_{O_iP_j}^{q}, x_{R_1}x_{O_iP_j}^{q+1}, x_{R_2}x_{O_iP_j}^{q+2},\dots, x_{R_q}x_{O_iP_j}^{2q},\dots, x_{R_1}x_{O_iP_j}^{nq+1},$$
$$x_{R_2}x_{O_iP_j}^{nq+2},\dots$$

ij list the number and location of pick-up and unloading station for moving and transporting. The sequence of the RGV system of the ring RGV system in the actual process cannot be changed, and the real time change is to move and transport the duty and node, which cannot be changed for the RGV that is performing the duty, but should be adjusted by using the optimization calculation results to complete the work and receive the new duty orders. Therefore, the sequence position of RGV x_{R_k} bit string cannot be changed in the chromatid body of the species group. For this reason, only the value of RGV x_{R_k} can be set to 0 when its body is intersecting and changing, namely, the intersecting fork operation of empty transport service $x_{O_iP_j}^{h}$.

The method of multi-point crossing is used for cross operations, and the cross position is $x_{O_iP_j}^{h}$ of x_{R_k}=0, The cross points are determined according to Poisson distribution:

$$P(x) = \frac{\lambda^y}{y}e^{-\lambda} \;, \mathrm{E}(x) = D(y) = \lambda = g(L) > 0$$

y is the cross point.

The crossover probability P_c and mutation probability P_m of the adaptive genetic algorithm change automatically with fitness. The calculation is as follows:

$$P_c = \begin{cases} P_{c1} - \dfrac{(P_{c1} - P_{c2})(f' - f_{avg})}{f_{max} - f_{avg}}, f' \geq f_{avg} \\ P_{c1}\,, f' < f_{avg} \end{cases}$$

$$P_m = \begin{cases} P_{m1} - \dfrac{(P_{m1} - P_{m2})(f - f_{avg})}{f_{max} - f_{avg}}, f \geq f_{avg} \\ P_{m1}\,, f < f_{avg} \end{cases}$$

f_{max}: Maximum fitness in a population.

f_{avg}: The mean fitness of each generation group.

f': Larger values of fitness in the two bodies to be intersected.

f: The fitness value of the variant body.

P_{c1}, P_{c2}: Fixing the maximum and minimum crossover probability.

P_{m1}, P_{m2}: Fixed maximum and minimum mutation probability.

It can be seen from the above formula, When the fitness degree of each body of a species group tends to be one or the local optimal. P_c, P_m increase, and when the group ratio is relatively dispersed, P_c, P_m decrease. The fitness value is higher than that of the group, P_c, P_m are lower, they can be carried into the daughter, otherwise, they will be eliminated. The adaptive acculturation method guarantees the accretion property of the accretion algorithm, and maintains the diversity of the group at the same time.

The establishment of fitness function is not discussed here because of the tedious process.

4. Scheduling implement

When the new relocation and transportation work of the midwifery in the process of pro-duction, the system first relies on expert database knowledge and learning according to the actual working conditions of the RGV and the ownership of the moving and transportation task, and gives a compromise solution to the optimization calculation. Phylogenetic algorithm means that the loop RGV roots are properly interpreted to perform the moving task. The main step of self-learning genetic algorithm is as follows:

1) Based on the real time working status of RGV, moving and transporting duty and other working conditions, the appropriate co-solution in the conclusion module of professional library is searched. If the appropriate co-solution is found, the handling and transporting duty of RGV shall be performed according to the proper co-solution.

2) The first initial subspecies group is generated randomly into an initial subspecies group with one and a half chromosomes. A color separation system was randomly selected from the data of the same kind of working conditions of the generalization-library module.

3) Calculate the limit point, the ideal point and the weight of self – adaptation.

4) The post - regret and adaptation values of the body of a group are calculated separately. Arrange the body from small to large according to the fitness value and find out the optimal body to judge whether the convergence conditions of full feet are satisfied, such as step 11 of full feet.

5) Each subpopulation transmits its own optimal individual to its whole subspecies group and accepts the best body of its subspecies group.

6) The independent row selection and replication operation of each subspecies group were performed by the method of roulette.

7) To calculate the probability of intersecting fork P_c and to modify each subspecies group by the self-adaptive transfer algorithm. The good individuals are preserved to the next generation at an approximate rate of 1.

8) To calculate the probability of intersecting fork P_m,.Variation operations of adaptive genetic algorithm for each subspecies group modification. The best body is preserved by probability 1 to the next generation.

9) Keep the elite. If the optimum fitness of the previous group is less than that of the current group, then the best fitness of the previous group is directly compounded to the worst individual in the current group.

10) If the number of cycles is full, the result of optimization calculation is given. If not, return to step 3.

11) The compromise solution is stored in the result module of expert database, updated knowledge and output the compromise solution.

12) According to the agreed demodulation degree RGV operating operations.

5. Summary

The self-learning theory was introduced into the genetic algorithm, and the initial group regulation model was adopted. The compromise solution of the new expert library through constant learning was adopted, which not only guaranteed the validity of knowledge, but also ensured that the standard model of knowledge library was expanded without limit. The knowledge of the expert database used for the verification regulation can improve the speed of the optimization meter,

eliminate the defect of the precision of the optimization calculation, and the real-time performance of the verification optimization is very effective in solving the NP flexibility optimization problem of the group optimization domain.

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