Logistics Transportation Time Optimization Based on Fuzzy Particle Swarm Optimization

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Abstract. The fuzzy particle swarm optimization (FPSO-RRB- algorithm is used to solve the logistics transportation time optimization problem, a three-dimensional particle coding method based on receiving point, particle position sequence and particle position rounding operation is proposed, the results are compared with those of fuzzy particle swarm optimization algorithm. The experimental results show that the fuzzy particle swarm optimization algorithm can effectively optimize the logistics transportation time.
Keywords: Fuzzy particle swarm optimization; logistics and transportation; time optimization; coping strategies.

The logistics of the future should be data-driven and intelligently optimized. By means of a hybrid algorithm, combining the advantages of each algorithm and making up for the shortcomings of each algorithm, a more efficient and feasible algorithm scheme is gradually formed, which is widely used in the optimization of supply chain network, the sorting of orders in a warehouse, and the balance between ordering and demand, optimization of distribution path and other fields. Because many logistics problems are similar, through in-depth study to use the appropriate algorithm to solve these problems.

1 Logistics transportation time optimization background based on fuzzy particle swarm optimization algorithm

Logistics Center is a place or organization engaged in logistics activities, can handle all kinds of transportation, storage, packaging, loading and unloading, circulation processing and other logistics operations, is the logistics information processing point. In today's supply chain management, logistics center as a link up and down the supply chain, played a vital role. Reasonable logistics center location can effectively save costs, ensure the efficient operation of the logistics system, supply chain management of strategic significance. The logistics transportation time problem is always the research domain which attracts people's attention, already many scholars have carried on the research to the location problem, proposed many kinds of methods, such as Baumolwolfe, Barycenter, Tabu Search, fuzzy particle swarm optimization, simulated annealing, analytic hierarchy process and artificial neural network. Because saving transportation cost and shortening transportation time are the primary problems that should be considered in the location of logistics center.

In the long-distance logistics transportation, the distance between two places can be considered approximately as a straight line distance, and this estimation method becomes more effective as the distance between two places increases. The common methods of environment modeling are visualization method, grid method and topology method. Because the topology method is simple in use, the environment modeling is easy, and it is more suitable for the transfer between cities, therefore, the topological method is used to model and simulate the environment. The mutation rate of the population is calculated by using the adaptive mutation probability and the secondary mutation probability, and the corresponding habitat is selected for mutation operation according to the adaptive mutation probability and the secondary mutation probability to update the optimal solution; If the number of iteration is reached, the optimal solution, that is, the optimal transportation scheme, will be output; otherwise, the iteration will proceed.

This paper presents a vehicle routing optimization method based on block matrix and fuzzy transportation time, which considers the selection of two transportation modes under the condition of fuzzy transportation time, thus, the optimal transportation scheme under uncertainty can be obtained. In order to achieve the above objectives, a logistics transportation time optimization method based on fuzzy particle swarm optimization algorithm is proposed, it includes the following steps: establishing the route optimization model based on fuzzy transportation time, circulation transportation sequence and cross distribution center assignment; initializing the solution of the route optimization model, I. E. Habitat, the block matrix is used to represent each habitat, the fitness index value of each habitat is calculated, and the initial optimal solution is determined according to the fitness index value; And judging whether the habitat is to be moved in or out according to the immigration rate and the emigration rate, and if the immigration or emigration operation is needed, the vector substitution is performed on the block matrix corresponding to the habitat to realize the immigration or emigration operation.

Vehicle routing problem (VRP) refers to a logistics distribution center that supplies goods to a certain number of demand points with different demand for goods, and on the basis of satisfying the demand points' distribution requirements, carries out reasonable route planning, finally, it achieves the goal of the shortest transportation distance and the lowest transportation cost. Because the study of this problem is of great practical significance, the heuristic has great advantages in solving the vehicle routing problem, the study of heuristic has also been enriched. Time windows and fuzzy constraints are added to the short distance open vehicle routing problem (VRP) , and the hybrid ant colony algorithm is used to solve the VRP, the problem is solved by a heuristic with a variable domain search strategy, which solves the vehicle routing problem with backhaul and time windows, and by a hybrid particle swarm optimization algorithm.

2 Logistics transportation time optimization scheme based on fuzzy particle swarm optimization algorithm

Particle swarm optimization, proposed by Kennedy and Eberhart in 1995, is an evolutionary computing technique derived from simulations of social behavior, such as bird and fish predation. The PSO algorithm randomly produces an initial population and gives each particle a random velocity. During the flight, the velocity and trajectory of the particles are dynamically adjusted according to their own flight experience and that of their companions, the whole group has the ability to fly to a better search area. Particle swarm optimization has been widely used in function optimization, neural network training, fuzzy system control, pattern recognition and engineering applications, it is proved that the optimal solution can be obtained with less computational cost.

Particle swarm optimization (PSO-RRB- is applied to solve the location problem of logistics center. In a 2-d search space, the population is made up of M particles, where the position vector of the I particle represents the feasible address coordinates of a logistics center on the plane. The fitness value fi of the first particle is calculated from the logistics cost formula of the objective function of the location problem. The first particle evolves to the individual optimal position found in the G generation, and the whole particle swarm iterates to the global optimal position found in the H generation. From generation H to generation H + 1, the velocity and position of the I particle in the j-dimensional subspace can be adjusted.

As an optimization, the route optimization model based on fuzzy transportation time, circulation transportation sequence and cross distribution center assignment is established, and the optimization goal is to maximize the satisfaction of the manufacturer, s is the fitness function of vendor satisfaction, G is the vendor set, G is the vendor G, K is the vehicle set, K is the vehicle k, rKG is the manufacturer G's satisfaction and the manufacturer's order is transported by the circulating transport vehicle K, WKG is the weight of the manufacturer G's satisfaction and the manufacturer's order is transported by the circulating transport vehicle k, wLG is the weight of manufacturer G's satisfaction and the manufacturer's order is transported through the cross-distribution center L, S is the supplier set, I is the supplier I, [CG, DG -RSB- is the time window required by manufactuG.r g, dig is vendor G's order to vendor I, and DG is vendor G's order to all vendors.

The YIKG and xilg in the objective function are the decision variables, and the BKG1, BKG2, and BKG3 in the objective function are the fuzzy time of arrival of the order from the manufacturer G that is transported by the circulating transport vehicle k, the fuzzy time is the fuzzy number of BKG, and BKG is the time when the vehicle K reaches the manufacturer G through circular transportation. In the formula bkg = BKI + stki + tig, k ∈ K, g ∈ G, I ∈ S, bKI is the time when the circular transport vehicle k arrives at supplier I, stki is the service time of the circular transport vehicle K at supplier I, TIG is the transport time from supplier I to manufacturer G, stki = γdigyikg, γ is the loading or unloading time per unit product, Dig is the order from G to supplier I, and YIKG is the decision variable FLG1, FLG2, and FLG3 in the objective function are the fuzzy times of order arrival for the manufacturer G through the cross-distribution Center L, which is the fuzzy number of FLG, fLG is the time for the vehicle to arrive at manufacturer G through the cross-distribution Center L, FLG = ALG + TLG, L ∈ L, G ∈ G, and ALG is the time for the Order of manufacturer G to leave the cross-distribution center L, tLG is the transportation time from the cross-distribution Center L to the manufacturer G, γ is the loading or unloading time per unit product, tilg is the initialization time of the vehicle transportation to the manufacturer G through the cross-distribution Center L, q is firm Q, DIQ is firm Q's order to supplier I, xilq and xilg are decision variables, and til is supplier I's shipping time to cross-distribution center L, dig's an order from supplier I for firm G.

The particle swarm optimization (PSO-RRB- coding is similar to the fuzzy particle swarm optimizatiFPSO-RRB-pso) double integer Theing. the number above the first layer segment indicates which vehicle the customer will be assigned to, the greatest advantage of the representation method is that every customer demand point can get the vehicle delivery service, and the demand of each demand point can only be completed by a certain vehicle, so that the calculation of the feasible process of the solution is greatly reduced.

3 Logistics transportation time optimization experiment based on fuzzy particle swarm optimization algorithm

In the selection operation of fuzzy particle swarm optimization, the first step is to calculate the fitness value of each chromosome, the second step is to calculate the proportion of the total, and the third step is to sort according to the fitness value from large to small.

According to many research theories, the computer uses the algorithm to process the data, the sort time accounts for 25% of the total processing time, then enhances the sort time to be able to enhance the algorithm processing efficiency. In this paper, it is reasonable to introduce fast sorting into the selection operation of fuzzy particle swarm optimization algorithm, and there is no conflict. It can not only improve the ranking time of fuzzy particle swarm optimization algorithm, but also improve its overall time.

The analysis of the efficiency of quick sort shows that it is still the best method with the lowest time complexity by many theories, experiments and comparisons. When the record is large, then should choose fast sort, from the average time performance point of view, other sort slightly inferior to fast sort and merge sort, these two methods when the input size is large, fast sort will prevail. Fast sorting is characterized by extremely fast sorting, less data movement, and eventually make the sequence from small to large sorting. Fast sorting algorithm is currently the most practical algorithm, is very suitable for dealing with complex problems, when the scale of the problem is larger, the execution time of using the algorithm is longer, compared with other algorithms, the efficiency of using fast sorting is higher, it's even more effective. The efficiency of the algorithm is usually measured by time complexity and space complexity, and the running time of the algorithm is obtained by comparing the time complexity of the algorithm under the premise of guaranteeing the same storage space, that is, S (N) .

In view of the characteristics of the optimization problem of logistics distribution route, a genetic algorithm is constructed to solve this kind of phenomenon, which includes the selection of the most classical fitness function with simple design, and the introduction of the fast sorting method in the selection operation, the main reason is that the complexity of genetic algorithm has been reduced. Select the natural number of the code, 0 as the starting point (distribution center) , every other integer for each customer point. Suppose there are 10 requirement points, 1 to 10 representing 10 different requirement points, and by starting with 0 and ending with 0, when a vehicle is delivered, it leaves the distribution center and returns to the distribution center. K distribution paths are randomly generated from each demand point, and then k distribution paths constitute the initial population, the size of the initial population is K.

The principle of proportional fitness calculation is that the feasible solution of the problem is substituted into the model equation to get the target value. If the value is smaller, the fitness is better. This method is simpler than the sort-based fitness calculation, convenient. According to the data, the fitness function can be designed according to the need of solving the problem. There are many fitness functions at present. The selection and design of fitness function is as simple as possible to minimize the time complexity of calculation, the fitness function will affect the convergence speed of genetic algorithm and whether a satisfactory solution can be found, and whether it reflects the genetic algorithm "survival of the fittest" characteristics. According to the calculation method of fitness function, the first step calculates the fitness value of each chromosome, the second step sums all fitness, and then calculates the fitness of each chromosome as a proportion of the total, at last, the quick sort is introduced to replace the common sort, because the quick sort can reduce the time complexity of the genetic algorithm.

4 Conclusion

Fuzzy particle swarm optimization (FPSO-RRB- has strong computing power in path planning, and it can adapt to many complex terrain with strong global searching power, can be used to search the parameters of the fuzzy particle swarm optimization algorithm. The results of simulation and contrast experiments show that the algorithm can optimize the distribution route, reduce the distribution cost and improve the distribution efficiency.

However, this algorithm depends too much on the length of the road, and many problems need to be considered in practical engineering. In the future, it will be studied more carefully by introducing road complexity factor.

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