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Research Article

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Performance of a genetic algorithm for solving path in traffic network

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ABSTRACT

Obtaining of the shortest path set plays an important role in traffic network calculation n .However, most of existing algorithms do not consider the delay in the intersection and are not suitable for finding path set , and the effect of them is not ideal . Decision variables are the location of park and ride facilities, train stations and the frequency of public transport lines. For a case study the Pareto set is estimated by the Non-dominated Sorting Genetic Algorithm .By considering above problems , the encoding method of genetic algorithm(GA)is analyzed and encoding space and solution space are compared .After that , the encoding method based on path is adopted and a mutation operator is designed considering the intersection delay to overcome the complexity .At last , the designed GA and the GA of priority based encoding method are used in a group of networks ,which are generated by using a random network generator , and the calculation results of them are also analyzed .The result verifies the efficiency of the designed GA .

Keywords: traffic network; genetic algorithm; encoding method; efficiency

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INTRODUCTION

In the urban traffic network planning, traffic assignment is a key step in the process of urban traffic demand forecasting; The commonly used traffic assignment algorithm based on the shortest path, At the same time, the calculation of the shortest path using traffic distribution algorithm is one of the most basic and most important part, A large number of studies have shown that Iterative algorithm in a large network equilibrium assignment problem that more than 90% of the amount of calculation of flowers spending on the shortest path search. in addition, The shortest path is a very important part in urban traffic route guidance system, transportation, consulting, city traffic management system, urban traffic emergency treatment and rescue system. For transport network, Its size is usually larger, Moreover, in practical application, Due to the change of environment and the influence of various factors, it usually requires the third short circuit in the most short circuit, etc. The shortest circuit set is required in transportation network, On the other hand, in the actual urban traffic network, intersections are delayed, the path intersection delay has a great influence on impedance calculation and route choice. A label algorithm is proposed in this paper to solve the most shortest circuit problem .the direction of the node points delay. This method is simple, but can only get the shortest path, not collection of paths, as well as When the network is bigger When this method is not ideal, the real-time path searching problem under large-scale traffic network is studied, and proposed effective path generation algorithm, we can see from that a Collection of practical shortest path search algorithm becomes the key point to solve the traffic problems.

DEFINITION

The transportation network design problem is often solved as a bi-level optimization problem, to correctly incorporate the reaction of the transportation system users to network changes, as is argued by. In our research, the network design problem is regarded as a bi-level system as well (see Fig.1). The upper level represents the behavior of the network authority, optimizing system objectives. In the lower level the travelers minimize their own generalized costs (e.g., travel time, cost), by making individually optimal choices in the multimodal network, considering variety in travel preferences among travelers. The network design in the upper level interacts with the behavior of the travelers in the network: the lower level. This is put into operation by a transport model, which assumes a stochastic user equilibrium (no driver can unilaterally change routes to improve his/her perceived generalized travel costs). For any network design the planner chooses, the transport model yields a network state (e.g., travel times and loads), from which the values of all objective functions can be derived. The equilibrium in the lower level is a constraint for the upper level problem.

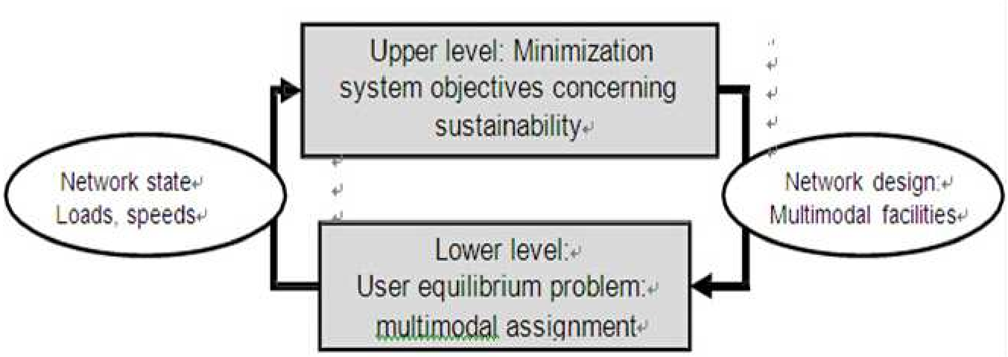

Fig.1 The Optimization Problem

IMPROVED GENETIC ALGORITHM

The Genetic Algorithm is firstly put forward by J.Holland, and re-identified and deduced by Hollanl later on. Its core idea is every outstanding individual will appear the direction of index increasing in every dynamical population biology. That is to say, it is convergent, so it can be applied in practice preferably. This algorithm is a randomly searching and calculating method which has better adaption and flexible optimized object, so we do not need the successive optimized object, or the optimized object to differentiate, or has the good stability and parallel searching ability. At the same time, the genetic algorithm does not need the initial solution, and arbitrary initial population biology can operate and outcome. We use randomized optional strategy in this algorithm, that is to say, it makes the outstanding individual go to the next generation through the survival of the fittest, and then after the cross - fertilization and Genetic behavior, it realizes weakness or disappearance.

Compared to other algorithms, the genetic algorithm has its own merits. The genetic algorithm adopts the evolution mechanism, and it carries out the searching process in the whole situation, averting the localization. Even if the adaptive function is discontinuous or irregular, the genetic algorithm can find the optimized solution of whole situation. And also, it has wonderful parallel processing and can realize the combination with other algorithms, especially adapted to the issues which have large scale and broad distribution.

We define a decision vector y (or a solution), that consists of V decision variables: y = {y1 , , yv , , yV} . Y is the set of feasible values for the decision vector y (also called decision space). The objective vector Z (consisting of W objective functions, Z = {Z1 , , Zw , , ZW }) depends on the value of the decision vector y . Every Z is part of the so called objective space, and in principle Z may be any value in W, but depending on its meaning, an objective function may be subject to natural bounds.

Mathematical model is as follows:

$$Min\ \ Z=\sum_{i=0}^{n}\sum_{j=0}^{n}\sum_{k=1}^{m}c_{ij}x_{ijk}+Fm \quad (1)$$

$$ST:\ \sum_{i=1}^{n}q_iy_{ik}\le Q,\ k=1,2,\cdots,m \quad (2)$$

$$\max\sum_{i=1}^{n}q_iy_{ik},\ k=1,2,\cdots,m \quad (3)$$

$$\sum_{i=0}^{n}\sum_{j=0}^{n}c_{ij}x_{ijk}\le L,\ k=1,2,\cdots,m \quad (4)$$

$$\sum_{k=1}^{m}y_{ik}=1,\ k=1,2,\cdots,n \quad (5)$$

$$\sum_{k=1}^{m}y_{0k}=m \quad (6)$$

$$\sum_{i=1}^{n} x_{ijk} = y_{jk},\ j = 1,2,\cdots,n,\ k = 1,2,\cdots,m \quad (7)$$

$$\sum_{j=1}^{n} x_{ijk} = y_{ik},\ i = 1,2,\cdots,n,\ k = 1,2,\cdots,m \quad (8)$$

$$x_{ijk}(x_{ijk} - 1) = 0,\ i = 1,2,\cdots,n,\ j = 1,2,\cdots,n,\ k = 1,2,\cdots,m \quad (9)$$

$$y_{ik}(y_{ik} - 1) = 0,\ i = 1,2,\cdots,n,\ k = 1,2,\cdots,m \quad (10)$$

Constraint (1) ensures the minimum total cost optimization goal; Constraint (2) ensures that distribution vehicle amount is no greater than the sum of the vehicle's weight; (3) a delivery vehicle distance cannot exceed the maximum range of vehicles; (4)distributes delivery vehicle distance cannot exceed the maximum range of vehicles; (5) represents the customer only by a vehicle to its distribution services.(6) Distribution center sending out M cars. (7),(8) represent the relationship between the two variables.(9-10) are cancellation loop vehicle distribution path.

SOLUTION METHOD

The straight-line distance of the selecting coordinate in the field is the practical distance of the nodal point. Transform the limitation of obeying the resource-constrain to the losing distance. We must estimate the total pcuwhich we need in the whole dispatching mission, making ∂=0.86, the pcusatisfying $m = [\sum_{i=1}^{n} q_i / \partial Q] + 1 = 3$.

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We can learn from the detailed data from this chart that the vehicle dispatching issue under loading resource-constraint can be reasonably optimized in driving routine, length,capacity tonnage and so on. And the iteration time as well as the time of calculation is less than former, the most important is the prime cost is much less. however, the vehicle dispatching under condition of time window resource-constraint is not satisfying with the punishing cost caused by time window, so it has to sacrifice the length to insure the time so as to meet demand, so the dispatching cost is much higher. We can see in the experimental example, the improved genetic algorithm can not only better optimize the localized demand vehicle dispatching issue under the condition of multi-resources constrain, but also can improve the efficiency of solving and the convergence of the overall situation.

CONCLUSION

Path in the traffic network calculation plays an important role;The calculation speed for computing will produce great influence to the network,In addition, sometimes used in the traffic network in addition to the shortest path of the other path. As a result, the genetic algorithm used to calculate process to get a set of path set is very convenient. At the same time, the traffic network scale is compared commonly big, and intersection has delayed, So when looking for a transportation network path need to consider the cost of the intersection. Coding method based on genetic algorithm is analyzed in this paper. Considering the coding space and the path to the solution space, an encoding method based on the path, Results show that the genetic algorithm is effective.

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