The Influence of Open Community on Traffic Based on C ++ Simulation Model

Haoming Guo[1, a]

[1]North China Electric Power University, Beijing 102206, China

[a]738800271@qq.com

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Abstract. In this paper, a road evaluation model based on rough set theory is established. Based on the improved cellular automata improved NaSch vehicle simulation model, two kinds of models are combined and analyzed by using the correlation theory of nodal variance. Road structure, community structure and traffic volume on the road before and after the opening of the comprehensive impact of road conditions. Our model is based on a well-defined cell-road-vehicle model that transforms the corresponding parameters by customizing the corresponding rules that conform to the laws of the physical and behavioral laws to obtain data in different states, and a wide range of data can help us in the right Algorithm evaluation system to obtain a more comprehensive law, from a variety of angles to consider the opening of the surrounding roads on the impact.

Background

In 2016, the State Council issued a number of opinions on the promotion of the street system, in principle, no longer building a closed residential area, built residential quarters and units to be gradually open. And whether the open community can optimize the road network structure, improve the road capacity to improve the traffic conditions, and how to improve the effectiveness of the debate has become the focus of people. After the opening of the district, the density of the road network increased, the road area increased, but the ability to enhance the traffic capacity is also related to the area, location, external and internal road conditions and many other factors, while the surrounding area on the main road into and out of the intersection of vehicles increased, may also affect the main road passing speed. And the district open to increase the number of road crossings, the speed of the vehicle at the intersection will be significantly slowed down. So the impact of different road environments and cell structures on the local network and the overall road network is different.

Evaluation system model

A.Evaluation of traffic conditions

a.intersection indicators According to the traffic characteristics of the intersection and the role of the urban road intersection, the urban road intersection evaluation index includes:Intersection traffic volume V (equivalent car / hour), saturation S, average delay time d (seconds), queuing length q, signal] intersection secondary queuing rate κ , efficiency index I

b. link indicators The road index includes the road traffic Q (vehicle / hour), road length L (km) two basic indicators, can be obtained through direct measurement; also includes road travel time (minutes), road average speed (km / hour), travel (Minute / km), delay (minutes), total delay (minutes •car), delay rate (min / km), relative delay rate (min / km), acceptable travel time (minutes), acceptable travel rate (minutes / km) The

c. regional indicators Regional Mobility Index MI:

$$\mathrm{MI}=\frac{P\times\bar{v}}{\sum_{i=1}^{n}\gamma Q_i v_i}$$

MI - regional mobility index, which is between 0 and 1;P-peak hours Area Number of passengers on the road (person / hour);V - the average speed of the traveler on the road (km / h);Q i - the maximum passing capacity per hour of the road i from the flow state (equivalent car / hour);V i - road i on the white by the flow rate (km / h); Γ -equivalent car passenger number (person / car).

B.Model simplification

a. Simplified method based on rough set theory Using the kernel and reduction in the rough set theory, we can filter the indexes of complex systems and achieve the purpose of simplifying the index system. The above factors are summarized as the evaluation system X = X {x 1, x 2 ... xn} For the system S, the index system is X = X {x 1, x 2 ... xn}, and each index has M data. If it is expressed as a relationship between the two indicators, then the information matrix of the system can be expressed by an m × n matrix X.From the rough set theory, the indicators in X e are indispensable to describe the system, and the construction of X is generally based on the method of discernible matrix. The establishment of the discernibility matrix D is the key. For the index system X of system S, D is a subset of X by the composition of the m-order matrix according to the above method using MATLAB software to standardize the data discretization and kernel processing We determine the system core indicators are: I = {x 1, x 2, x 3} Respectively, the average traffic speed I 1, the traffic density I 2, and the time I 3.

Vehicle model

Cellular automata model

Because the cellular automata model has a high degree of spatial discretization, time discretization and state discretization, the system can be deduced by developing evolution rules, and the traffic system is essentially discrete. Therefore, the cellular automata model is Widely used in the field of traffic simulation. 1992 Nagel et al. Proposed the most well-known cellular automata NaSch model, which divides roads into discrete lattice, displacement, velocity, time, acceleration and other parameters are discretized, through the development of acceleration, deceleration and random slowening rules.

B. Improved NaSch model

a.Build rules (T) and xn (t) denote the distance between the first n vehicles and the vehicle in front of the distance, and the number of vehicles is n, The speed and position of the vehicle, V max represents the speed limit of the road (that is, the maximum speed that the vehicle can achieve). The probability of the slow start of the vehicle in the acceleration rule is p 1, and the random probability of the vehicle in the random rule is p 2.

b. Evolution rules

(1)Acceleration rules: consider the driver's driving habits are different, we set a certain probability of slow start. Vn (t + 1) = vn (t) + 1 at v p (t + 1) = v and vn (t + 1) = v Max.

(2) deceleration rule: consider the need to maintain a certain safety vehicle distance, if v n (t)> gap, then v n (t + 1) = gap.

(3) random rules: consider the driver's mental state, we set a certain probability of random slowdown. V n (t + 1) = max (v n (t + 1) - 1, 0) at the probability p2 if v n (t +1) = v max.

(4) Vehicle location update rule: x n (t + 1) = x n (t) + v n (t + 1).

c. Intersection rules

The vehicle should be considered for the minimum safety clearance with the destination lane before and after the lane

(T) = d 'i (t) + min (v k (t + 1), d' k (t)) - v i (t)

(T) = d ji '(t) - min (vj (t + 1), d' j (t)) + v i (t)

In the second equation, d fore (t), d back (t) are the instantaneous distance between the vehicle i and the nearest neighbor k and the nearest neighbor j at the time t + 1; d 'ik (t), Dj'i (t) is the distance of the vehicle i in the corresponding position i 'of the lane and the nearest neighbor k and the nearest neighbor j; tk (t + 1), vj (t + 1) D 'j (t), t' j (t) are the distance between vehicle k and vehicle j and its leading vehicle at time t; vi (t) is the time of vehicle i speed. (T) = xk (t) -xj (t) -1 (3) In order to ensure the safety of the vehicle lane, that is, the vehicle i is the vehicle's vehicle, In the course of the road will not be associated with the adjacent lane before and after the conflict, lane to meet the minimum security clearance:

$D_{fore}(t) \geqslant 0 \quad D_{back}(t) \geqslant 0$

The driver is expected to lane a lane, to meet the minimum safety gap conditions, the lane conditions are divided into three cases discussed below:

(1) When $d_{fore}(t) \geqslant 0$, $d_{back}(t) \geqslant v_j(t)$, the vehicle i to the purpose of a lane lane does not affect the target lane near the front k does not affect the proximity of the car j, And the distance between the larger space, that is, lane success.

(2) When $d_{fore}(t) \geqslant 0$, $0 \leqslant d_{back}(t) < v_j(t)$, the vehicl does not affect the direction of the front lane near the car k travel, it will not affect the nearest neighbor j But the lane space is small, taking into account the psychological differences between the different drivers lane, set the lane change probability p_{change} • rand () <p_{change}, where rand () that between (0,1) to take random number.

(3) When the $d_{fore}(t) < 0$, and the purpose of a lane before the distance of the nearest car has not met the requirements of the vehicle i lane, it can not change. In the course of changing, in order to ensure the safety of driving, the lane is not accelerated at the original speed, that is, $v_i(t+1) = v_i(t)$, the position of the lane is updated at $X_i(t+1) = x_i(t) + v_i(t)$ $D'_i(t) = x_{i+1}(t) - x_i(t) - 1$

C.Simulation experiment

a.Experimental parameter setting

According to the above rules, we use the program language on the open area before and after the vehicle driving simulation simulation, as shown below, in the initial simulation experiment we assume that the district is a 600m × 600m well word area, the district has four lanes around, The vehicle travels along a road with traffic lights at the intersection and 20 seconds every 20 seconds. Each "cell grid" is 3m × 3m, each car occupies two "cell grid". The input parameters are the road speed limit and the number of vehicles, and the output data is the average vehicle speed and the average reach time.

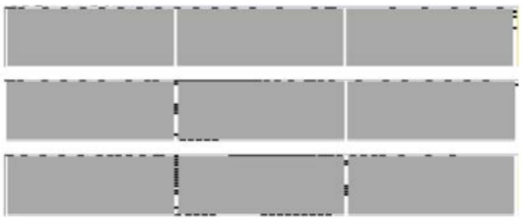

Fig.1 Analysis of road simulation effect after community opening

b.Experiment and result analysis

We have tested the road speed limit of 30km / h, 60km / h, 80km / h, in order to compare the district before and after the opening of the road congestion, we set each every second, every 2 seconds into the road a car. After the traffic flow is stabilized, the average traffic speed of the road is tested every 1 second, and the average time of the vehicle is measured every 40 seconds. The curve is shown in Fig. 5 and the table below

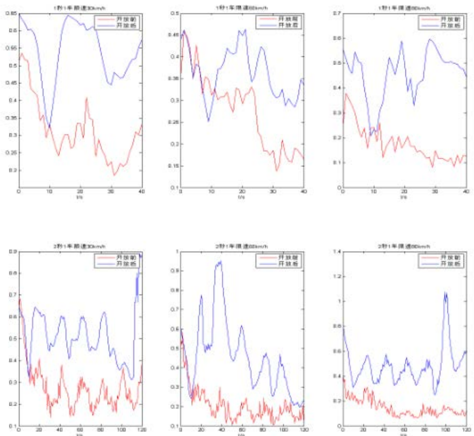

Fig.2 The average speed of the road under different conditions

It is clear from the image and the average reachable time we can calculate. For different road speed limits and traffic flow, the average traffic speed after open area is larger than that before opening, and the average reach time after opening is smaller than that before opening , Indicating that the community open to the surrounding road congestion situation does have a certain mitigation effect.

Urban road network topology model

A. Model analysis

After investigation we concluded that the type of internal road structure of the district are as follows:

Fig.3 Community internal structure diagram

The influence of the internal roads on the traffic network is equivalent to the speed of the outside and the inside of the district. Combining the surrounding road structure, the speed a is related to the urban road network characteristics. The characteristics of the road network refers to the complex system in the case of external interference under the circumstances of the system or the overall impact on the network function characteristics.

B.Urban road network characteristics evaluation indicators Urban road network characteristics Commonly used evaluation indicators are node degree, the center of the degree of syndromes. The node degree is the number of edges connected to the node, and the number k of adjacent nodes k in the network is called the degree of node v i. The average of all nodes in the network is averaged. The number of nodes is divided into the number of nodes and the number of edges, reflecting the importance of nodes or edges in the network. The number of nodes (edges) is the ratio of the number of nodes (edges) to the number of shortest paths across the network in all the shortest paths in the network. Calculated as follows:

$$B_i = \sum_{i,j,k\in V(j\neq k)} \frac{n_{jk}(i)}{n_{jk}}$$

The smaller the variance of the node in the urban road network, the better the uniformity of the road network, the smaller the difference of the importance of the node, the stronger the ability of the road network to resist the destruction, that is, the urban road network The smaller the vulnerability, so it is reasonable to use the node variance as the evaluation index of urban road network vulnerability. Urban road network node variance D (k) is calculated as follows:

$$D(k) = \frac{1}{N}\sum_{i=1}^{N}(ki - \bar{k})^2$$

C. Urban road network simulation modeling

The model mainly includes the urban road network module, the residential road network module, the connection strategy module and the index analysis module. The urban road network module is mainly used to simulate the urban road network. The residential road network module is the representative of the residential road network structure. The connection strategy module is to determine the connection way of the two road networks. As the simulation input, the index analysis module is mainly different The new network formed under the connection strategy is used to calculate and analyze the indicators as part of the simulation output. Mainly follow the steps below:

(1) the initial urban road network G 0 is m 0 = 3, m = 3 has m 0 nodes of the initial network, each time the introduction of a new node and m existing nodes connected, m □ m 0) to generate a node N 0 = 300 nodes, mt = 891 side of the scale-free network (the required scale-free network needs to go through t step);

(2) to collect a district road network structure data, to determine the district road network G 1, node N 1,

(3) Select the node that can be connected with the cell in the original urban road network. Define the point set V 0 as the point set of the selected node in the original network, select the node in the cell network that can be connected with the original network, As the point set of the selected nodes in the cell network, V 0 and V i are connected according to the connection strategy of the cell to form a new network G, and the number of newly connected nodes is v.

(4) The simulation results are analyzed and evaluated, and the urban road network model is calculated according to the input strategy. The experimental results are output in the form of chart.

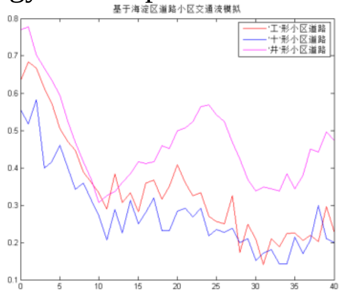

Fig.4 Vulnerability Indicators of Different Road Network Models

The model draws the following conclusions:

1) district internal road and the surrounding road is similar, it should open the district, so as to strengthen the road section of the road network construction, improve the urban road system

2) district internal roads and the surrounding sections of the difference is not recommended, open the district is not recommended. The development of the district may lead to the intersection of the secondary queuing rate increased, thereby reducing the speed of traffic, resulting in the next intersection of congestion.

3) In other conditions are exactly the same conditions, the district is divided into "well" shape, "workers" shape, "ten" shape of the road to the contribution of urban road network capacity to Haidian District, a district, for example, you can see Out of the "well" shaped road the best, "ten" shaped second, "workers" shaped road is poor.

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