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Research of Intersection Signal Timing Optimization

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Abstract: The urban road intersection, as the main node of road network traffic, has more prominent traffic problem, and it is of great practical significance to study how to reduce the traffic congestion rate of intersections. This paper selects a intersection of a city center and obtains the data of queue length and delay by constructing three-dimensional traffic simulation model, and analyzes the traffic problems existing in this intersection. And then use the intersection signal timing optimization software to optimize timing scheme that status quo, run simulation again to get the evaluation data optimized like queue length and delay, comparative analyze the data of the queue length and delay time before and after optimization to evaluate and improve the feasibility of signal timing scheme. The simulation can more intuitively reflect the intersection traffic problems, and the optimization of signal timing can improve the traffic situation, which embodies the value and great significance of the traffic simulation and timing optimization research.
Keywords: traffic flow; signal timing optimization; traffic control; intersection.

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1. INTRODUCTION

In recent years, with the increasing of transportation tools, urban traffic congestion has become an urgent problem to be solved. One of the basic means to solve this problem is to strengthen the signal control of intersections. The optimal design of signal timing is of great significance to improve the traffic capacity of intersections, to reduce the delay time of intersections and to dispersal vehicles tyapped in traffic congestion at intersections. Based on sufficient investigation analysis and data mining, we can optimize the intersection signal timing, and then use VISSIM to compare the actual traffic conditions before and after optimization to determine the feasibility of the optimization scheme, to improve the capacity of the intersection traffic.

2. RESEARCH IDEAS IN THIS PAPER

This paper mainly applies the VISSIM software to simulate the status quo of a intersection of a city center, and optimizes the current signal timing scheme. Optimize the status of the signal through optimization software, and then comparative analysis the evaluation index before and after optimization to verify the feasibility of the optimization scheme.

(1) Traffic investigation

Go to the scene to know about the actual situation of the position of the intersection, specificly include: the level of road, lane number, the separation condition, the distribution of bus stations,

common schedule of buses, presence of traffic violations, etc; Through the artificial investigation method, collect the data of intersection traffic, intersection signal timing parameters and so on .

(2) Simulation modeling

Using the micro traffic simulation software VISSIM to establish the simulation model of intersection and peripheral facilities, inputing the static and dynamic traffic parameters got from investigating. And construct the 3d scene model through three - dimensional drawing software.

(3) Traffic simulation of the status quo and optimization signal timing

The 3D model is converted into v3d format and then imported into VISSIM to build static 3D model to run simulation, and the traffic delay and queue length of the current intersection are obtained. Use the signal timing optimization software to optimize the signal timing of traffic simulation, and run VISSIM again, then software output the evaluation index after optimization.

(4) Simulation evaluation and analysis

Through the comparative analysis before and after the optimization of intersection queue length and average vehicle delay data, analysis the traffic running state of intersection before and after optimization, and then identify the feasibility of the optimization scheme.

3. CASE ANALYSIS

3.1 Traffic investigation

We can get as shown in table 2 from the peak hour traffic flow of intersection traffic data collected by field survey according to the vehicle type conversion coefficients. the status quo of the signal timing scheme as shown in table 1. Table 2 shows that the traffic flow of this intersection mainly comes from the two inlet channels of east and west.

Table 1 Current situation matching scheme

direction	north and south straight	North and south left	East and west straight	East and west left
The green light time(s)	36	32	36	32
The yellow light time(s)	3	3	3	3
The full red time(s)	0	0	0	1

3.2 The simulation road network is drawn

Based on the data survey of intersections, the road network is drawn on each direction of the intersection. The corresponding operation steps are as follows:

(1) Create road: select the icon in the VISSIM software toolbar, click the right mouse button in the start of the road and release it at the end of it. Then input the related data of the road according to the simulation requirement in the road related data setting dialog box following. If there were a same lane is in the opposite direction of the set path, check the Opp. Direction icon when the dialog box appears , and the road in the opposite Direction will be displayed in the road network.

(2) Road link: the next step after the lane setting is completed is the connection of the road. After click the left mouse button, click right at the end of one road and drag it to the start of the other road to complete the connection work.

The road network drawing model is shown in Fig. 1 below.

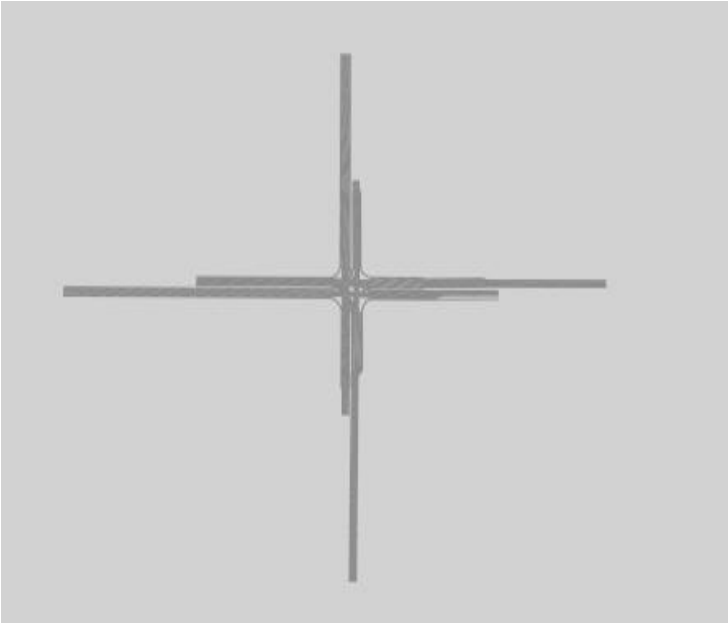

Fig. 1 Road network drawing model

3.3 Current traffic simulation

After the construction of the traffic simulation model, the performance of the design simulation model needs to be evaluated, and the evaluation indexes include the queue length, the capacity, and the d3elay level. In this paper, the two indexes of queue length and delay time are used to evaluate the feasibility of the signal timing. The simulation running time of the intersection is 3600 s, and the simulation output data is shown in Fig. 2 and Fig. 3:

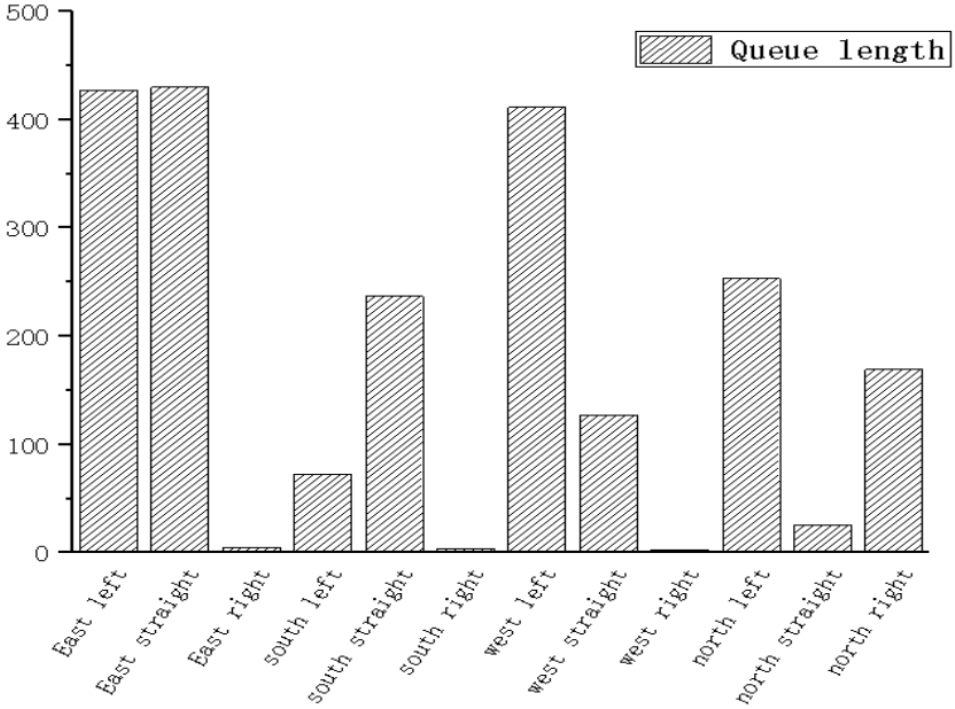

Fig. 2 The queue length of current

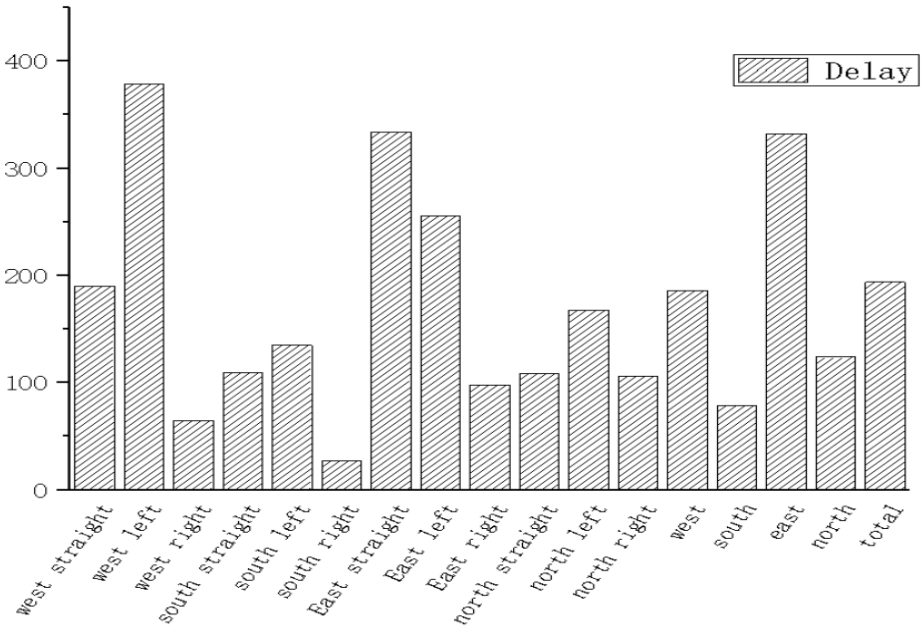

Fig. 3 The delay of current

3.4 Signal timing optimization and traffic simulation

In this paper, the signal timing optimization system software is a traffic simulation software used to control and optimize the signal timing. The software does not have much requirement for the required hardware, and the operation is simple and has a high analysis and simulation ability of the actual traffic flow. As shown in table 2, the optimized signal period is 140 s.

Table 2 optimize signal timing scheme

direction	north and south straight	North and south left	East and west straight	East and west left
The green light time(s)	28	26	29	45
The yellow light time(s)	3	3	3	3
The full red time(s)	0	0	0	0

3.5 Analysis and evaluation of simulation results

Run the traffic simulation according to the optimized signal timing scheme, the traffic simulation diagram is shown in Fig. 4. The comparison diagrams of the traffic simulation queue length and the delay before and after optimization are shown in Fig.5 and Fig. 6.

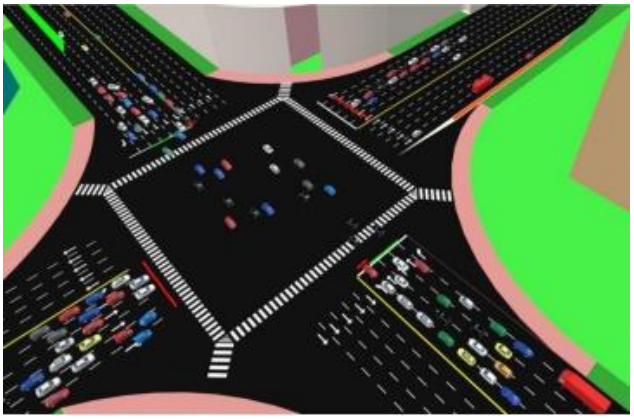

Fig.4 The traffic simulation diagram of the optimized signal timing scheme

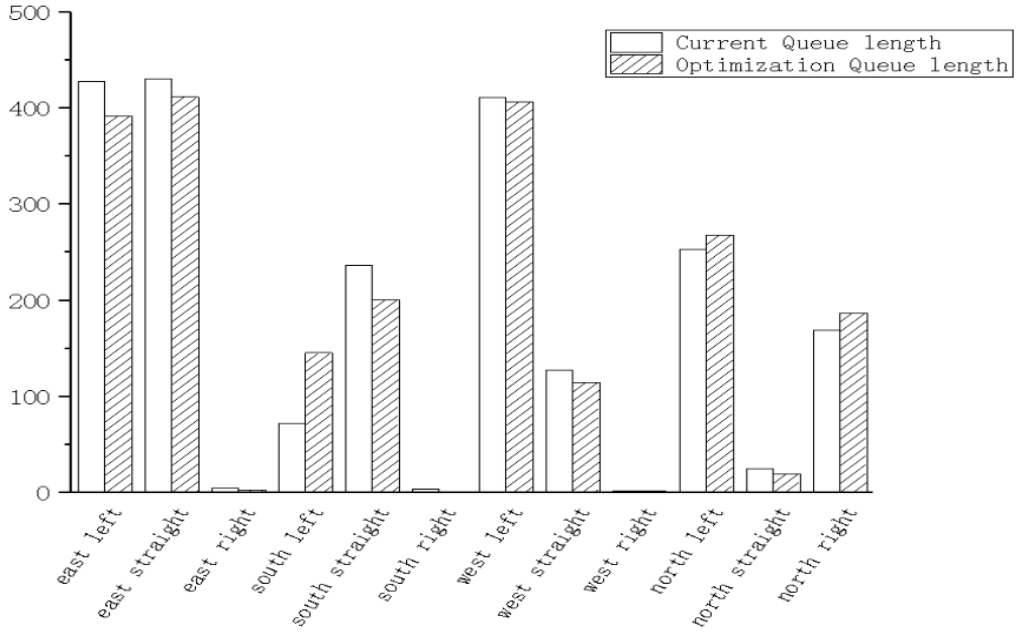

Fig. 5 Comparison of queue length

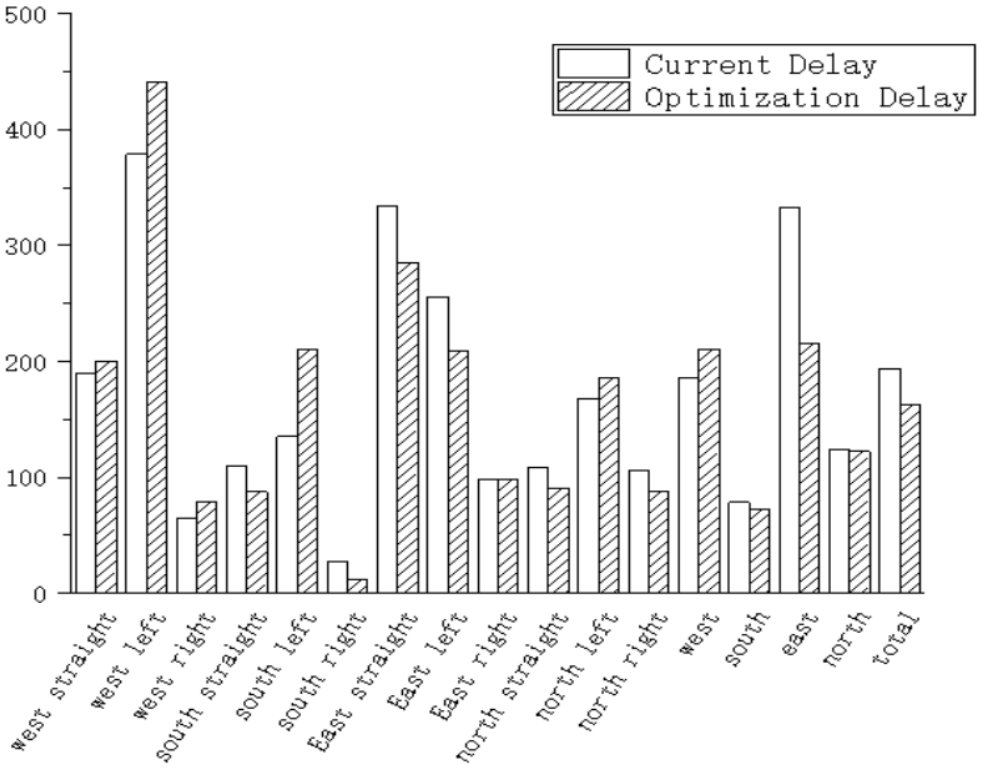

Fig. 6 Comparison of delay time

According to the comparison diagyams, we can know that the improve percentage of queue length before and after optimization is as follows: 0.08,0.04, 0.37, 0.04,0.15, 0.29,0.01, 0.1,0.29, 0.06,0.23, 0.23. The increase percentage of the delay time before and after optimization is: -0.05, -0.16, -0.21, 0.20, 0.56, 0.59, 0.14,0.60,0,0.17,-0.17,-0.13,0.07,0.01,0.16.

4. CONCLUSION

This design selects the intersection of a city center and analyzes the practicability of the existing signal timing scheme. Through the field investigation of the intersection, collect relevant information to build the intersection traffic simulation model based on VISSIM so as to intactly present traffic status of this intersection and adjust the related parameters to make the model more close to the actual situation. Under the current signal timing scheme, we can find the actual problems of intersections according to the evaluation index data output by the traffic simulation. And evaluate the feasibility of the improved scheme by analyzing the simulation results after optimization. Compared the queue length and delay time before and after optimization we can conclude that the two evaluation index all get improved after optimization. It shows that the signal timing scheme optimized has good practicability. It can produce good practical application effect and improve the traffic condition of the intersection.

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