Simulation research on crossing behavior of the pedestrians and vehicles at the Pedestrian crossing based on simulation software VISSIM

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Abstract - In this paper, the simulation software VISSIM for microscopic traffic is used to simulate the behavior of the pedestrians and motor vehicles when they cross the intersection with no signal. The practical application of this model is validated through the comparison analysis. The simulation results provide scientific means for the optimization of traffic management, scientific establishment of traffic facilities, reducing the traffic accidents, providing safety for the pedestrians and motor vehicles.

Index Terms - Traffic behavior of crossing; VISSIM simulation; Transportation project

1. Introduction

As a developing country, mixed flow of the China's urban road traffic is most obvious characteristic at pedestrian crossing where conflicts between the pedestrians and motor vehicle occur frequently. In the pedestrian crossing, pedestrians coming from both sides and the motor vehicles coming from different direction may have conflicts, so delay or accidents occur sometimes and the traffic efficiency descend [1]. In addition conflicts between the pedestrians and vehicles have negative effect on the traffic efficiency of the urban road network and the service level of the traffic.

In the coming long period, the mixed traffic flow will be the main traffic flow model of the developing countries [2], and the conflicts of the pedestrian and the vehicles at the crossing will be the important traffic problems which developing countries must face to, so further research for the conflict of the pedestrians and vehicles about the theory and practice is needed [3]. In this paper behavior of the pedestrians and vehicles at the intersection without signal is simulated by the microscopic traffic simulation software VISSIM and simulation results are compared with the practical situation. The research provide important scientific means for optimization of traffic management, scientific setting of traffic facilities, reducing traffic accidents, ensuring safety of pedestrians and vehicles.

2. Introduction of VISSIM

VISSIM is a microscopic simulation software developed by the German company PTV. As the core simulation model of the system, vehicle tracking model uses the "psycho-physical driver behavior model" developed by Professor Wiedemann from Karlsruhe University, German. In contrast to less complex models using constant speeds and deterministic car following logic, the basic concept of the "psycho-physical driver behavior model" is that the driver of a faster moving vehicle starts to decelerate as he reaches his individual perception threshold to a slower moving vehicle. Since he cannot exactly determine the speed of that vehicle, his speed will fall below that vehicle's speed until he starts to slightly accelerate again after reaching another perception threshold. This results in an iterative process of acceleration and deceleration [4].

VISSIM consists internally of two different programs, exchanging detector calls and signal status through an interface. The internal structure organization of simulation system is shown in Fig.1.
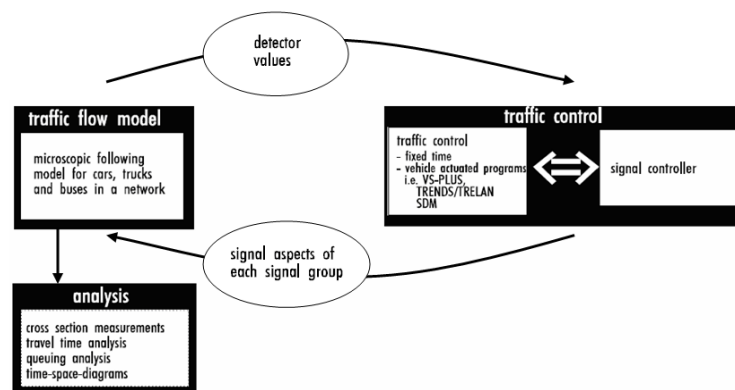

Fig. 1 The internal structure organization of simulation system

3. Simulation modeling of intersection without signal

A. Basic data

The section headings are in boldface capital and lowercase letters. Second level headings are typed as part of the succeeding paragraph (like the subsection heading of this paragraph). For establishing a good simulation model, basic data should be collected according to the simulation object and simulation requirements. The basic data of this paper includes the data of the crossroad environment and the traffic situation of the crossroad. The data of crossroad environment includes: the lane number of motor vehicle, setting way of lane, lane width, the separation way of the motor vehicle and Non-motor vehicle, Pedestrian crossing width, markers on the road and so on. The data of traffic situation of the crossroad consist of :

1) the distribution of pedestrians and vehicles

2) the parameters of pedestrians and vehicles, such as speed and acceleration at the intersection, acceleration when vehicles start

3) the parameters of pedestrian flow and motor traffic flow, such as static density and queuing feature of pedestrians , characteristics of traffic flow and so on;

4) clearance when pedestrian pass or refuse the vehicle flow and maximum waiting time

B. Parameter settings of the simulation modeling

a) Flow setting. According to survey and sample, we find that at common period the average pedestrian flow is 600 people per hour, the vehicle flow is 560 cars per hour; and at the peak period the average pedestrian flow is 900 people per hour, the vehicle flow is 860 cars per hour. b) Speed setting. According to the video data, we get the actual speed sample of the pedestrians and vehicles at the intersection, the average speed of people is 1.26 m/s, the average speed of vehicle is 7.63 m/s. c) Parameter setting of the road. In order to establish and research the model, we just research the traversing behavior of the pedestrians and vehicles at the one-way street, so the practical simulation road is described by Fig.2.
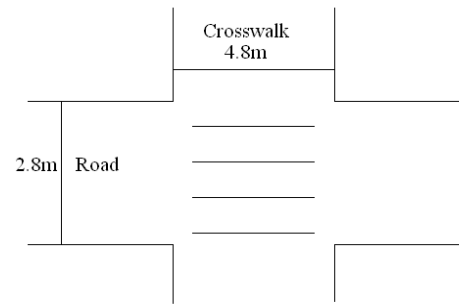
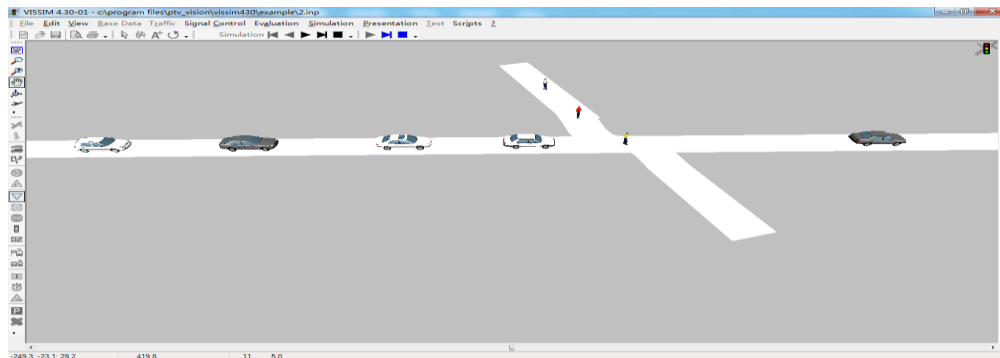

Fig. 2 The schematic diagram of the road

Fig.3 3-D simulation results

4. Simulation

Pedestrian crossing is the conflict area of the pedestrians and vehicles when both of them want to cross, and also they want to avoid conflicts. We will simulate the two situations, "car stop for people" and "man stop for the car".

Car stop for people. This situation actually gives the passing right to pedestrians, namely pedestrians are preferred. According to the actual traffic situation, the minimum distance to the head of the car is set as 10 meters, and the minimum time distance 3 seconds. Three dimensional simulation is shown in fig.3.The comparison of simulation results and the actual results is shown in TABLE I.

TABLE I Comparison results of the simulation value and actual value of the passing time

	pedestrian	vehicle
simulation value / s	2.48	0.76
actual value / s	2.56	0.8
Relative error / %	3.1	5.0

Car stop for people. This situation actually gives the passing right to the vehicle, namely vehicles are preferred. According to the actual traffic situation, the minimum distance

to the head of the car is set as 3 meters, and the minimum time distance 4 seconds. The comparison of simulation results and the actual results is shown in TABLE Ⅱ.

TABLE Ⅱ   Comparison results of the simulation value and actual value of the passing time

	pedestrian	vehicle
simulation value / s	2.09	0.6
actual value / s	2.15	0.57
relative error / %	2.8	5.3

According to above analysis, the data which is got from simulation system is not quietly different from the actual data and the data errors are about 5%.So the simulation model can be used to simulate the crossing behavior of the pedestrians and vehicles at the pedestrian crossing.

5. Conclusion

According to case analysis, we find that VISSIM simulation system can simulate accurately real traffic phenomenon, and its errors are in an acceptable range. Therefore, when we do theory research of the traffic or Engineering Project Evaluation, we can use the software simulation to replace the low efficiency way of obtaining the original data.

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