Car-pedestrian accident reconstruction based on Pc-Crash

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Abstract: *A car-pedestrian accident reconstruction method based on Pc-Crash was proposed.As the simulation platform, the accident scene and the car-pedestrian multi-bodies model was constructed,and then simulated the accident by using the significant evidences which are contact positions of car-pedestrian and final rest positions of car and pedestrian. Further ,the other accident information was used to verify the rationality of the simulation results [1] . A car-pedestrian collision accident, for example, demonstrates the steps.The Acceleration of the pedestrians' head in simulation can reflect the time of head injury and valuable suggestions of vehicle arrangement structure are put forward from the angle of the automobile manufacturer for pedestrian protection . Examples show that using this method to reproduce the results not only more objective, but also provide more effective information for accident identification [2].*
Key words: *accident reconstruction; Pc-Crash; accident information; simulation*

I.INTRODUCTION

In recent years, the car - pedestrian collision has become a heavy road traffic accident. To form and strengthen the car accident of research, which is beneficial to dentify the responsibility of traffic accidents. So the car-pedestrian accident again has now become a research hot topic at domestic and abroad, and there are many reconstruction methods,such as ejection,drop analysis,multi-rigid-body,finite element,digital dummies and so on[3]. Some methods generally should be assisted by simulation software after implementation, according to pedestrian throwing distance, car-pedestrian position,vehicle deformation and pedestrian injury for a circumstance acquire the information of accident,and then realize the reconstruction of the accident analysis.

Pc-Crash is an accident reconstruction analysis software which is extensively applied in the domestic and abroad, the mechanics of rigid body of the car , multi-rigid-body model has been a certain degree of validation [4].This software has the modeling easy,short simulation time,lifelike simulation interface image, and analysis results are easy to extract characteristics.At present, about the car- pedestrian accident reappearance studies are relatively rare[5] . This article will be Pc-Crash as the simulation flat, make full use of available accident information, research based on the software of the car-pedestrian accident reappearance analysis method, and finally the parties will be given a case to present the steps of method[6].

II. Pc - Crash software

PC-Crash is a traffic accident reappearance analysis software and was developed by the Austrian Dr Steffan. PC-Crash, according to the characters of traffic accident scene, such as the displacement of the car after the collision, damage degree, drag marks of the length, road conditions, etc., by using the basic theory of mechanics of conservation of momentum and energy conservation, and verification by reasoning process of the accident. In this paper, the study of traffic accident reproduction is using this software, now has grown to 10.0 PC – Crash software version[7]. Compared with the previous PC – Crash other version, in the latest version of the finite element module is added to make it late accident reconstruction and analysis ability to get a higher degree of development.

Using the software realize the reappearance analysis, can make full use of accident in a variety of effective

information, mutual support the rationality of the results.Generally follow the following steps: (1) the scene of the accident reconstruction;(2) car , model is established;(3) simulation analysis and result;(4) the simulation results of inspection certificate;(5) the simulation result uncertainty evaluation[3] . The following will be a real thing so the case as an example, to demonstrate how to use Pc - Crash realize the car - pedestrian analysis

III. The accident is introduced

At 21:52 on July 26,2015,from Rongle West Road to Yushu Road about 150 meters in the east in Songjiang District,firstly the left front of Shanghai Volkswagen Passat collided with pedestrian's right leg,and then pedestrian's hip collided with the hood,lastly head crashed with the A column of this car.The driver was not injured.

The front of Shanghai Volkswagen Passat crashed slightly, The Shanghai Volkswagen Passat is equipped with DAB and PAB,and they weren't deployed in the accident.This accident made the pedestrian dead promptly.
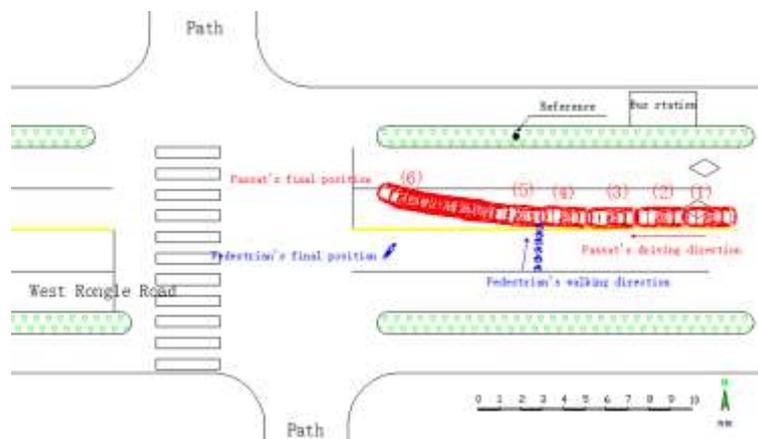

Fig.1 Sketch of the accident

IV. The accident reappearance analysis

The analysis of accident reappearance is a core content for the accident vehicle speed identification. This paper will use Pc-Crash to study the speed of the car when vehicle collisions occur.

3.1 The scene of the accident reconstruction

This step is mainly based on the scene of the accident information and figure the scene of the accident field sketch, build 2 d or 3 d model of the accident site . This step can be through the first enter the scene of the accident or the figure sketch pictures, press scaling, then on the basis of the use of Pc – Crash in the three dimensional way road generated module implementation . In this paper, the accident on the highway flat, only to the scene of the accident, do not need to generate three-dimensional path.This case again after building the scene of the accident can see figure 2. The scene of the accident reconstruction, the accident now the content can be directly on the relationship between Pc - Crash were measured in. Such as accident vehicle final location for the north side of the right rear wheel base of shoulder 3.5 m vehicles, car about 8 ° northeast bias. Pedestrians final location for pedestrians from north shoulder 8.5 m.
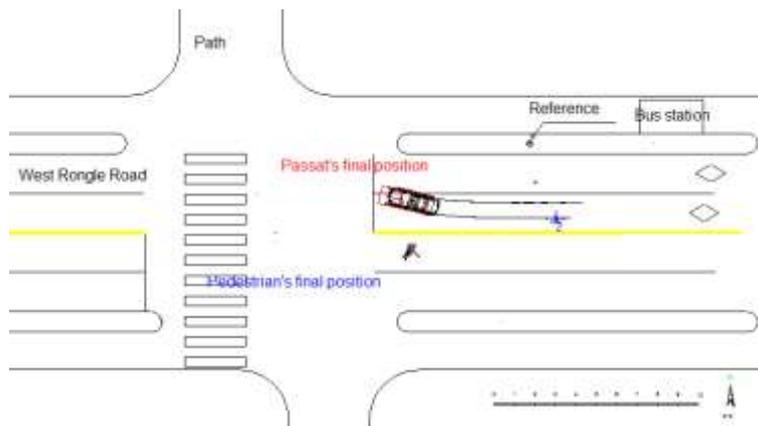
Fig.2 The reconstruction accident scene

3.2 Vehicle and body modle

In general, through Pc-Crash within the vehicle database can be obtained have a lot of information of the vehicle accident, such as the aspect of higher, but the vehicle's feet it is hard to get[8] . And shape parameters in vehicle information is very sensitive parameter , so should get figure as accurately as possible 1 The parameters of the values, especially the front part of the value of the parameter; The values of these parameters can generally be pictures of the car through Pc-the Rect Software obtained after processing, or straight connect to the vehicle side elevation input Pc-Crash canon of appropriate software release and measurement, in this case the accident vehicle silhouette parameters as shown in figure 3.The other parameters for the software inside the VW-Passat 1.8T - M01 The default parameters .
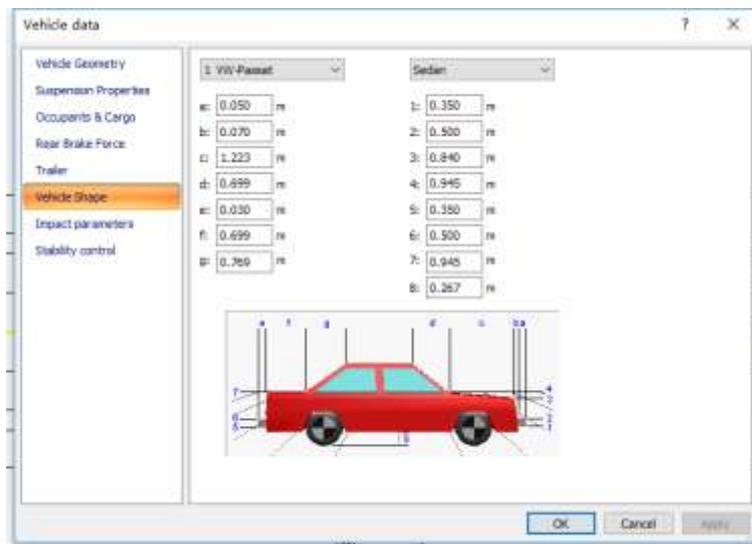

Fig.3 Parameters of vehicle shapes

The pedestrian model can be input Pc-Crash bring in dummy model to gain . After model input software interface, should change its height , weight etc,the parameter value . In this case, the height for pedestrians 162cm , the weight 55kg , it is the default.
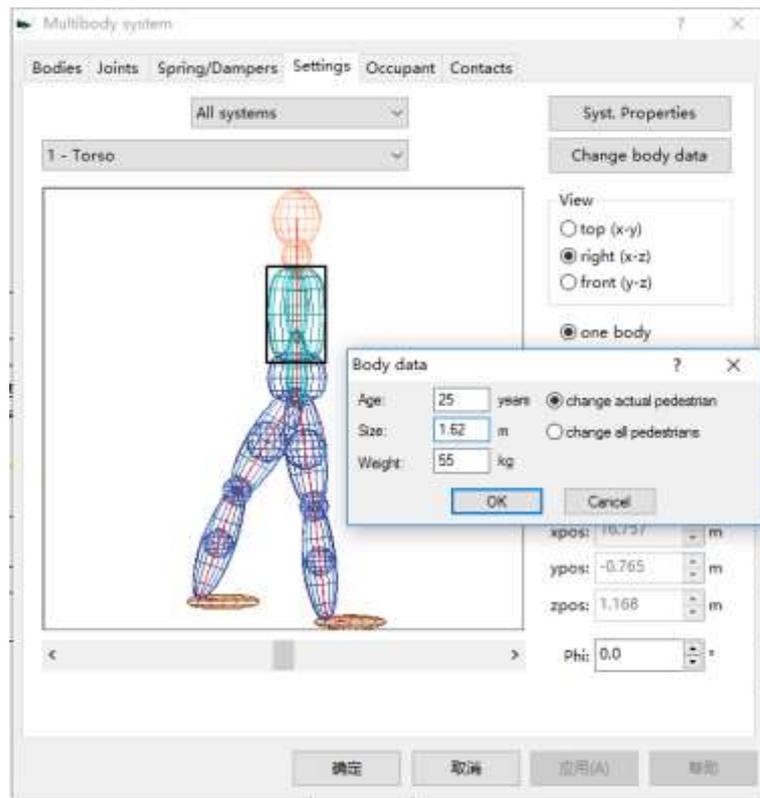
Fig.4 Parameters of Pedestrian

3.3 The simulation analysis and result

The aforementioned 2 steps are successfully implemented, the simulation analysis can be realized . Through repeated adjustment of vehicle initial relative position, the speed of the vehicle and pedestrian walking speed , attitude and people-car , people-the friction coefficient between road to participate the number, to make people-the car collision in conformity with the accident information to contact position and pedestrians eventually stop position and the scene of the accident stop position a as much as possible to.When best match degree, argues that the parameters of the corresponding value of the optimal value[9-11] .

Through the repeated simulation found that when the vehicle speed 60 km/h and pedestrians Walking speed 4.68km/h , the car-the coefficient of friction between the road 0. 8 The vehicle brake time to coordinate 0. 2 s , people-the coefficient of friction between the road 0. 6 , people-the workshop friction factor 0. 2 when the simulation information in accordance with the accident information most . figure 5 to figure 8 gives the simulation process, the different time people relatively position; figure 9 pedestrians are given finally stop position, the figure for the vehicle Legal parked on the side of the road . figure 10 given in the pedestrian head acceleration curve.
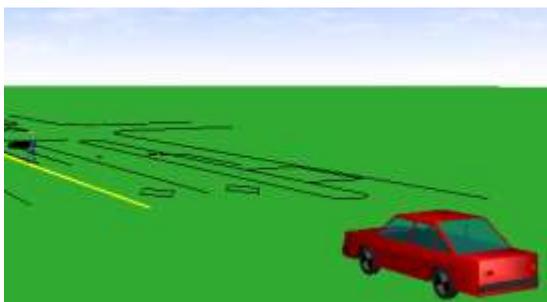

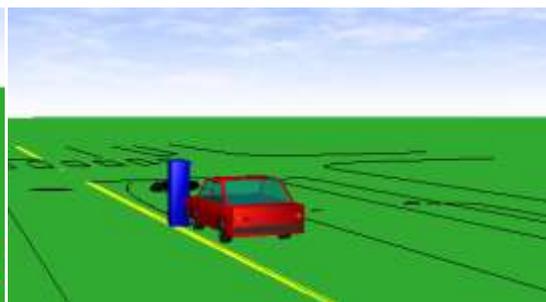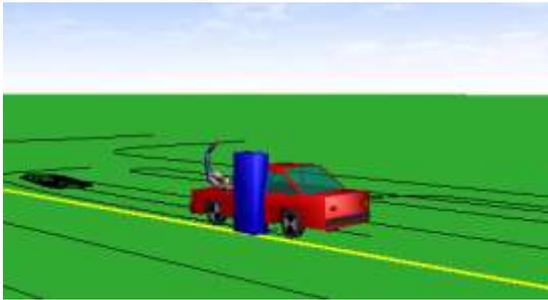Fig.5 When t=0s in simulation   Fig.6 When t=0.025s in simulation
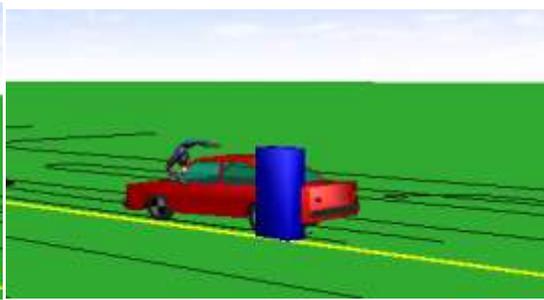
Fig.7 When t=0.155s in simulation   Fig.8 When t=0.275s in simulation
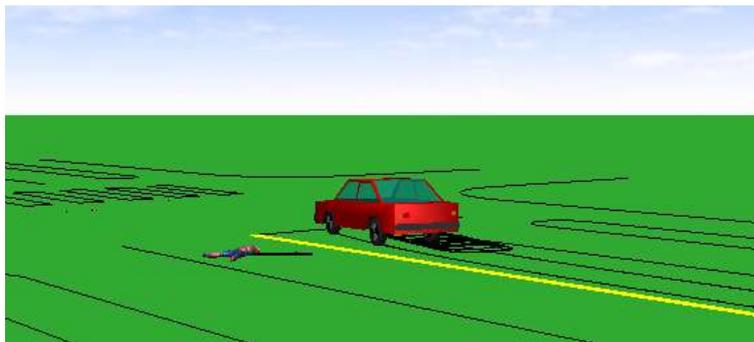

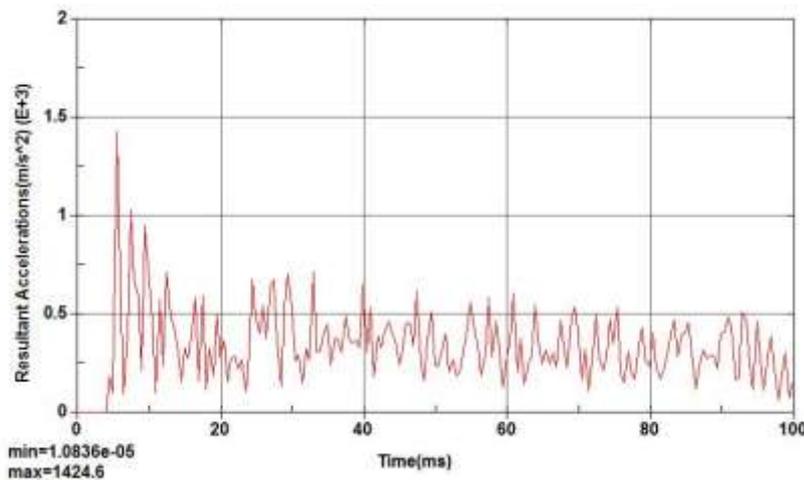Fig.9 The rest position of the pedestrian

Fig.10 The Acceleration of the pedestrians' head in simulation

3.4 Verification of Simulation Results

Using Pc – Crash the biggest advantage of realize simulation of accident reappearance is that can make full use of various effective information of the scene of the accident, validation the rationality of the results, so as to make the analysis result more objective , more persuasive[12] . In step 3.3 the use of evidence mainly includes the car-the car collision contact position. The information such as people stop position, but the pedestrian damage is not able to take advantage of, and the deformation of the vehicles information and the information in and it's valuable accident reappearance analysis, based on the multiple rigid body car-digital reconstruction of collision, the deformation characteristics of body structure can't very well, but the collision response of pedestrians are available.To pedestrians collision response after combining the pedestrian injury biomechanics knowledge can be determine the damage . Then the simulation and the injury of pedestrians medical reports, to verify the foregoing steps.

In this case, the pedestrian AIS 6 The harm such as this information in step a sudden 3. 3. Have not been in

use, below and simulation based on this information fruit and injury biomechanics knowledge to verify the simulation results is reasonable sex. Each part of the pedestrian injury and simulation analysis AIS Grading and See table 1.

Table1 Grading standards of AIS

AIS	degree of injury
0	unhurt
1	minor injury
2	moderate injury
3	Seriously injured, but not life threatening
4	Severe injury, have life risk
5	Severe injury, not sure whether can live
6	The biggest injury, that cannot be cured, death

From the table 1 you can see, the pedestrian is indeed AIS 6 Such injury harm, and can learn information consistent. To this, the basic can be determined when the accident happened, accident vehicle speed for driver described about 60 km/h.

V. Conclusion

In this paper,Pc – Crash as the simulation platform, make full use of the accident information   and evaluate the results of the reconstruction of uncertainty. Based on the actual accident case analysis shows that, in accordance with the steps of this method, can be satisfied reproduce the results of the analysis of accident information, which makes the results more objective and more persuasive. And can learn that represent the results of distribution, can get accident represent the result value within a certain range of probability, the identification for accident provide more effective information.

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