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Vehicle Accident Reconstruction Based on Pc-crash

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ABSTRACT: Accident reconstruction software Pc-crash was used in this paper to analyze and set characteristic parameters. Pc-crash was taken as the simulation platform to construct the multi-rigid-body model of people, two-wheel vehicle and four-wheel vehicle in the accident scene. Simulation of the cause, process and the final location of the accident were conducted, which reconstruct the whole accident process to the most degree. To illustrate the rationality of the process, a four-wheel vehicle two-wheel vehicle accident happened in Shanghai was selected as an example to conduct the simulation and analysis. In this accident case, rational utilization of the scene, valid data were collected for traffic accident identification to provide more effective information.

Keywords: Accident Reconstruction,Collision, Pc-crash,Simulation

I. INTRODUCTION

The continuous growth of car ownership is undoubtedly the important indication of improvement of national living standards. However, the increasing number of vehicles has brought unprecedented pressure on transportation environment. In China, for example, various kinds of accidents happen almost every day, which have brought immeasurable losses. In the term of death toll, in 2014, the national road traffic accident death toll is at 2.22 per 100 thousand vehicles. To be exactly, the death toll is 34292.34 persons, which has increased 8.5% compared with the death toll in 2013. In 2015, the death toll is at 2.1 per 100 thousand vehicles. To be exactly, the death toll is 36178.8 persons, which has increased 5.5% compared with the death toll in 2014. From the death toll in 2014, 2013 and 2012, we can see that there is a trend of small range rising in the number of the road traffic accident death toll in our country year by year.

Disputes caused by traffic accidents are even more common. In order to provide accurate and effective accident identification information and do traffic accident responsibility definition, it is extremely necessary to use professional software Pc - crash to conduct accident simulation.

II. THE ACCIDENT CASE INTRODUCTION

One morning in 2015, rainy, in the location of 50 meters north of a crossroad in Shanghai, a four-wheel vehicle Santana and a two-wheel vehicle electric bicycle collided. In this accident, the headstock of Santana was damaged slightly but the tailstock of electric bicycle was severely damaged. The pilot on the Santana was not injured but the person on the electric bicycle was died on the spot. According to the accident process, a 2D CAD file that describes the motion trail was drew to make preparation for the subsequent simulation.

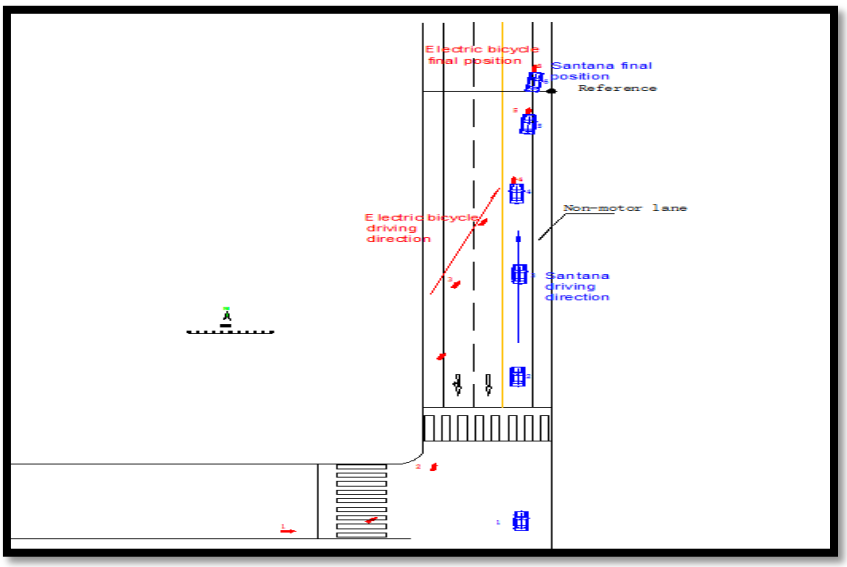


Fig. 1 CAD file of accident process

Fig. 2 The overall damage of Santana

Specific damage of parts on Santana: (1) the middle part of front windshield was burst;(2) front engine hatch cover was hunched;(3) the left side of the air-inlet grille was damaged;(4) the left headlamp was damaged;(5) the left side of the front bumper was damaged;(6) front bumper skin is fell off.The damaged part of the whole vehicle is the headstock.The main force bearing point position is the left front.Force direction is 11 o 'clock direction and it is because the electric bicycle hit the left side of the car.

Fig. 3 The overall damage of electric bicycle**Fig.4** The overall damage of electric bicycle

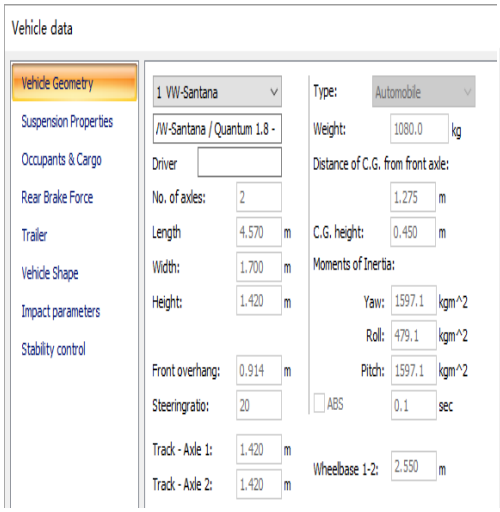
Specific damage of parts on electric bicycle: (1) the front guide plate was fell off;(2) the rear car stand was buckling forward, and there was orange print on the surface;(3) the rear toolkit was missing;(4) the rear suspension was buckling forward;(5) the rear fender was missing;(6) the tail lamp was broken off;(7) the rear plaque was broken.The damaged part of the whole vehicle is the tailstock. The main force bearing point position is the tailstock. Force direction is 6 o 'clock direction and it is because the rear part of electric bicycle hit the Santana.To speculate the collision position based on the vehicle damage condition, the left side of headstock of Santana was collided with the tail of electric bicycle, which belong to rear-end collision between four-wheel vehicle and two-wheel vehicle. Parameters were acquired based on the previous case analysis, and it was used to conduct the simulation of accident process.

III. SIMULATION OF ACCIDENT CASE

3.1 Parameter settings

The parameters need to be set in Pc-crash can generally be divided into three categories. The first is deterministic parameter that contained in the software database or gained by searching through the Internet. This kind of parameter usually can easily be acquired and with high accuracy, such as the length, width and height of vehicles. The second is measured parameter that acquired by measure at the accident scene. This kind of parameter has a high requirement of measurers, such as road conditions, seat angles, etc. The third is experience parameter that deduced from equations or experience. Some of them have default value in Pc-crash. This kind of parameter has the bigger error, such as friction coefficient, etc.

3.1.1 Basic information of vehicles



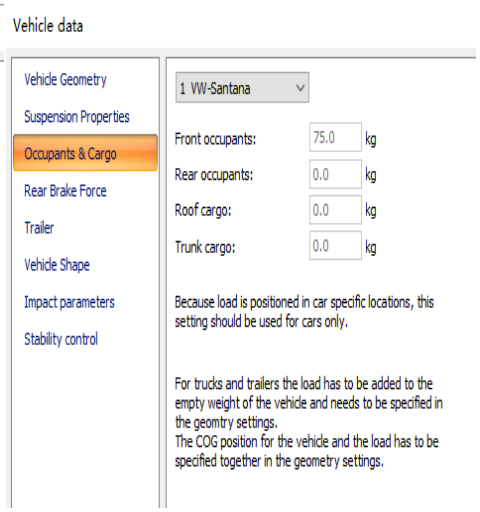
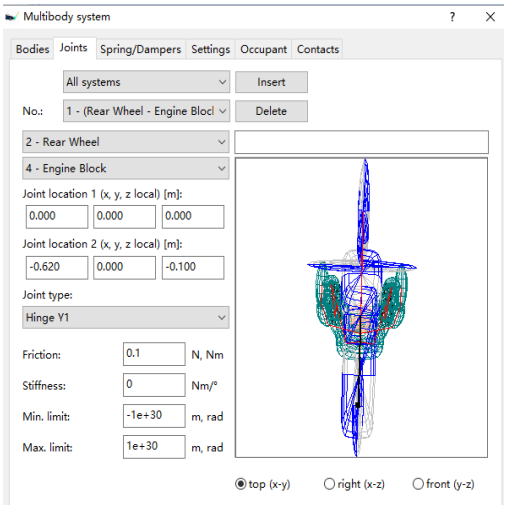


Fig. 5 Basic information of four-wheel vehicle**Fig. 6** Basic information of four-wheel vehicle



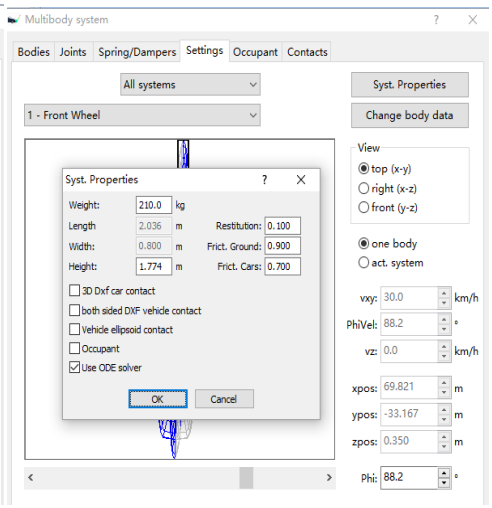
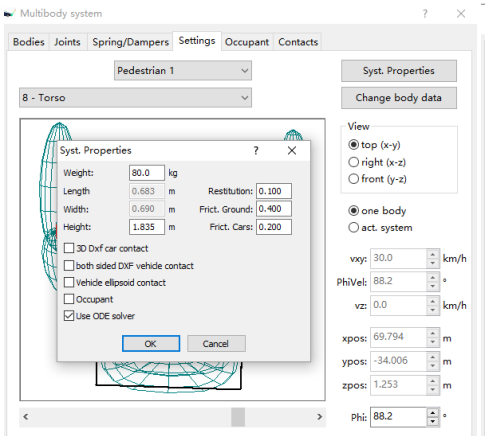


Fig. 7 Parameters of two-wheel vehicle**Fig. 8** Parameters of two-wheel vehicle



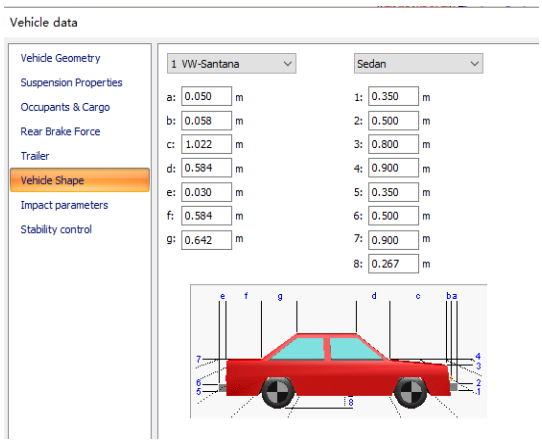


Fig.9 Parameters of pilot on the two-wheel vehicle**Fig. 10** Boundary dimension of Santana

3.1.2 Adjustment of vehicle body parameter

Boundary dimension of vehicle was set according to the actual value of Santana to match the boundary dimension of vehicle in the accident and to minimize error.

3.2Reconstruction of accident scene

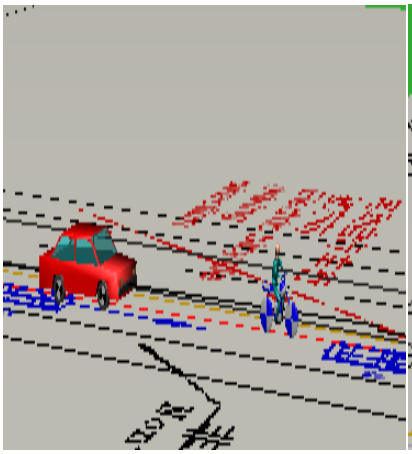


Fig. 11 Run before the accident

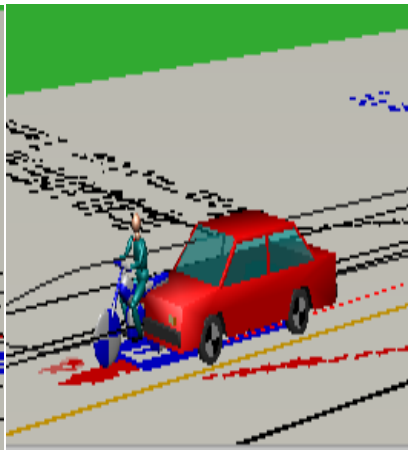


Fig. 12 Moment of collision

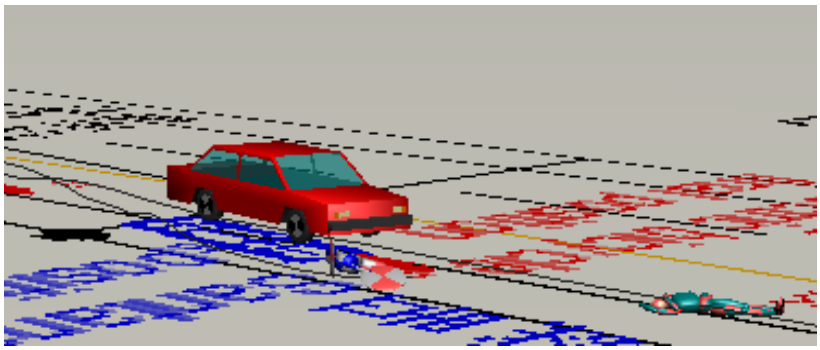


Fig. 13 Final position after the collision

3.2Results and Analysis of Accident Reconstruction

Take the headstock and tailstock of four-wheel vehicle as two feature points, and take one space point in the monitor video data as point A. It takes 6 frames for the headstock pass through point A to the tailstock, and the length of the vehicle is 4.546 meters. Take interframe spacing in the surveillance video as t, so t' = 1/25 = 0.04 seconds. And it takes n frames for the headstock pass through point A to the tailstock, so the pass time t = n * t',

V = S/T = 4.546 / (0.14 x 6) = 68.2 km/h

The speed gained from Pc video method basically matches speed gained from the software, which is 65km/h. The final position and damage condition matched as well. So, the Pc - crash software simulation results are basically accurate.

IV. CONCLUSION

Pc-crash was taken as the simulation platform in this paper and the accident scene information was fully utilized. The measured data and the police to provide data to represent the simulation of accident, mainly impact parameter Settings, make it as far as possible the reduction of accident process, make the results more objective, more persuasive, it can provide more effective information for the accident identification.

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