

Statistics Platform on Human-vehicle Contact Characteristics of Car to Pedestrian Accidents

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Abstract – The platform for statistics research of pedestrian accidents is established, including data input system, database for storage and data source for stat., the tools of data analysis and mining, which can be used in the statistics and analysis of human-vehicle-road characteristics. Based on the idea of ergonomics, the human-vehicle-road-environment information model of pedestrian accidents is put forward. By means of survey and investigation, the database of Chinese body's knee joint height parameters, Chinese shoes classification parameters, and the car's frontal figure parameters are formed respectively. Based on the database mentioned above, the analysis model of the human-vehicle's relative position during the first contact phase is constructed. Above all, through the statistics platform and relative models, car-pedestrian accidents can be surveyed and analyzed, and the main relations between body injuries and human-vehicle's type and their contact characteristics can be obtained. As an essential reference, the statistics results can be applied in the evaluation and simulation research of pedestrian injuries under China typical road traffic status.

Keywords: car-pedestrian accidents; body injuries; human-vehicle contact characteristics; Statistics and analysis

1 Introduction

Mix traffic is common in China. Car to pedestrian accidents are of great proportions in the automobile accidents. The number of pedestrians dead is about 25 percent of total numbers. This brings much economy loss and heavy burden to the society. It is necessary to pay more attention to the crash between cars and pedestrians. The basic research method is to get the principle of accidents by the statistical analysis to the mass of accidents happened. Based on the past research experiences^{[1][2]}, through the statistics platform and relative models we developed, 150 car-pedestrian accidents in Beijing from 2002 to 2005 are surveyed and analyzed. Human-vehicle contact characteristics of car to pedestrian Accidents can be investigated synthetically.

2 Platform for statistics research

The platform for statistics research of pedestrian accidents is established, which includes data input system, database for storage and data source for stat., the tools of data analysis and mining. This platform can be used in the statistics and analysis of human-vehicle-road characteristics of vehicle to pedestrian accidents.

2.1 Human-vehicle information model

Based on the idea of ergonomics, the human-vehicle information model of pedestrian accidents is put forward, as fig.1. This model can be used in the investigation of car to pedestrian accidents, which includes three aspects as following:

- 1) Basic data of human and vehicle.
- 2) Data of human-vehicle interaction.
- 3) Other data of human-vehicle-road contact.

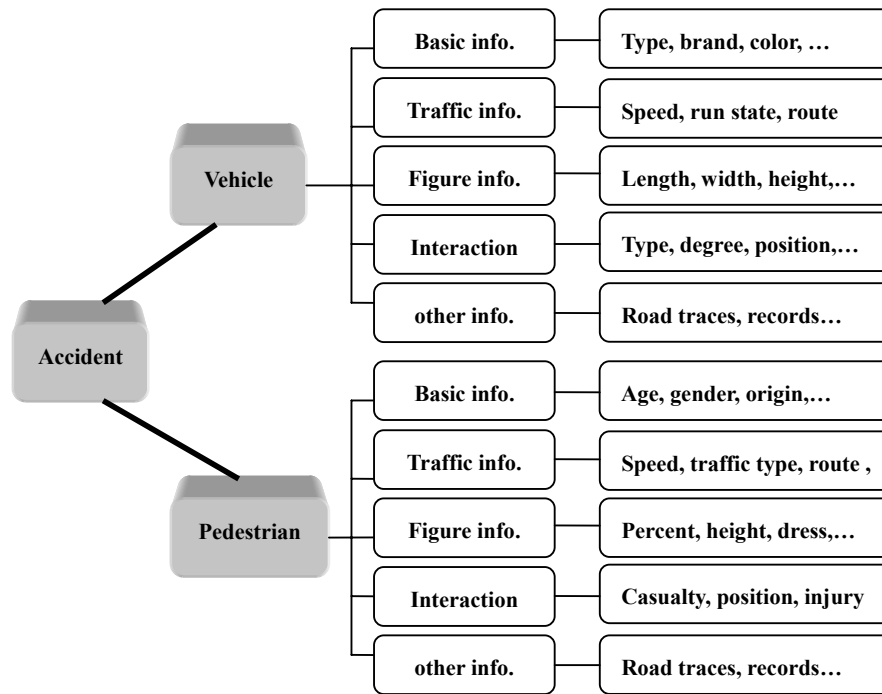


Fig. 1 The model and information of human-vehicle information

2.2 Basic characteristic information

As fig.1, the model mentioned above contains the characteristic parameters of human and vehicle, which include basic parameters, traffic characteristic parameters, figure parameters, interaction parameters and other information.

2.3 The platform for statistics

Based on the model mentioned above, the platform for statistics research is developed. The input platform and the data inquire of database are shown as fig. 2 and fig. 3 respectively.

事故编号	行人ID	车型	车速	碰撞部位	方位	角度	人车接触方位
00001	00001	MiniCooper	40	dsE	斜	45	头上
001	234	2134	23	2314	正	44	膝上
002	234	2134	23	2314	正	44	膝上
005			0		斜	0	头上
234	004		0		斜	0	头上
sg050194	1	夏利	43	右膝下部与	侧	85	膝下

Fig. 2 The input platform of database

事故编号: sg050194

车速: 43 km/h

车型: 夏利

碰撞部位: 右膝下部与

碰撞方位: 侧

碰撞角度: 85

人车接触方位: 膝下

备注: 1,77017

Fig.3 The data inquire of database

3 Basic data bases

By means of survey and investigation, the database of Chinese knee joint height parameters, Chinese shoes classification parameters, and familiar cars frontal figure parameters are formed respectively. Through the basic database, the analysis model of the human-vehicle's relative position during the first contact phase can be constructed.

3.1 Chinese stature parameters

According to GB10000—88 and GB/T 17245—2004, we can obtained the stature, tibia point height (tph), centroid height of Chinese body.

(1) parameters of standing man (mm)

percent	18~60 year							18~25 year						
	1	5	10	50	90	95	99	1	5	10	50	90	95	99
stature	1543	1583	1604	1678	1754	1775	1814	1554	1591	1611	1686	1764	1789	1830
tph	394	409	417	444	472	481	498	397	411	419	446	475	485	500
percent	26~35 year							36~60 year						
	1	5	10	50	90	95	99	1	5	10	50	90	95	99
stature	1545	1588	1608	1683	1755	1776	1815	1533	1576	1596	1667	1739	1761	1798
tph	394	409	417	444	473	481	498	392	407	415	441	469	478	493

(2) parameters of standing women (mm)

percent	18~55 year							18~25 year						
	1	5	10	50	90	95	99	1	5	10	50	90	95	99
stature	1449	1484	1503	1570	1640	1659	1697	1457	1494	1512	1580	1647	1667	1709
tph	363	377	384	410	437	444	459	366	379	387	412	439	446	463
percent	26~35 year							36~55 year						
	1	5	10	50	90	95	99	1	5	10	50	90	95	99
stature	1449	1486	1504	1572	1642	1661	1698	1445	1477	1494	1560	1627	1646	1683
tph	362	376	384	410	438	445	460	363	375	382	407	433	441	456

3.2 Average data of Chinese shoe height (mm)

	Shoe leather	Tour shoe	Slipper	High-heel-shoe
Male	30	25	20	
Female		30	25	70

3.3 Frontal parameter of car

(1) Frontal figure parameters of car

Classification	Vehicle	Bumper	Engine hood	Wind screen
Type, brand	Length, Width	Length, Width,	Length, Width,	Length, Width,
Grade	Height	Height	Height, Angle	Height, Angle

(2) data source of car

type	Mini	Economical	Medium	Luxury
Main	Auto, Xiali, QQ,	Santana, Jetta, Fukang,	Bora, Buick, Passat,	Audi, Benz,
brand	palio, mini-Cooper	Polo, Cherry, Sail,	Mazda, Honda, Camry,	BMW,
.....		Golf,	Nissan,	Lotus.....

4 Information Stat. of Human-Vehicle Contact Characteristics

Through the statistics platform and relative models, 150 car-pedestrian accidents in Beijing from 2002 to 2005 are surveyed and analyzed, and the main relations between body injuries and human-vehicle's type and their contact characteristics can be obtained. The Information to represent contact characteristics and the items of application research are presented as following.

4.1 Information of contact characteristics

(1) Pedestrian parameters

1) basic parameters

Age (<5, 6~10, 11~15, 16~20, 21~25, 26~30, 31~35, 36~40, 41~45, 46~50, 51~55, 56~60, 61~65, 66~70, 71~75, 76~80, >81), gender (Male, Female), origin (Beijing, Others--north, northeast, northwest, southwest, middle, south, Southwest), etc.

2) traffic parameters

Traffic characteristic (across the road, walk roadside, stand), casualty (injured, dead), etc.

3) body height parameter

Stature (<0.8, 0.8~1.5, 1.5~1.6, 1.6~1.7, 1.7~1.8, >1.8), weight, percent (5, 25, 50, 75, 95), centroid height, etc.

4) lower limb height parameter

Tibia point height (tph), shoe-height, tibia point height with shoe, etc.

(2) Vehicle parameters

1) basic parameters

Type (mini, economic, middle, luxury), brand (Xiali, Santana, Fukang, Jetta, Bora.....), price, grade, mass, etc. The 4 main brands are Xiali, Jetta, Fukang, Santana, which take up 58% or so, as fig. 4. Other brands proportion is dispersive, including 27 different kinds of cars.

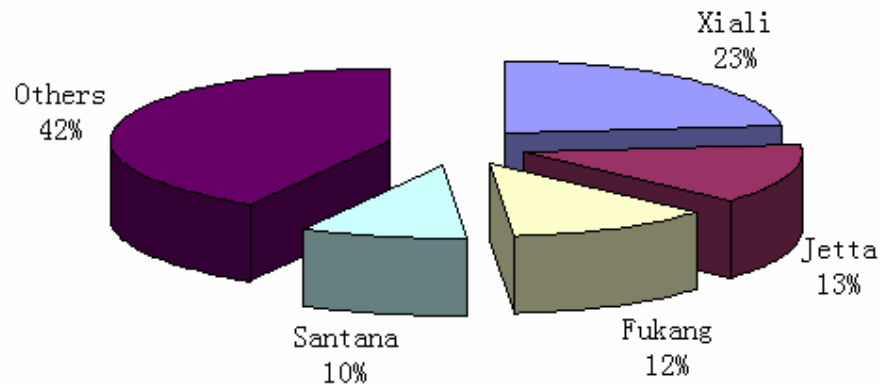


Fig. 4 Distribution of the brands of cars

2) traffic parameters

Running characteristics (straight, swerve, back), collision speed (<20, 21~30, 31~40, 41~50, 51~60, 61~70, 71~80, >80), etc. The distribution of collision speed is shown as fig.5.

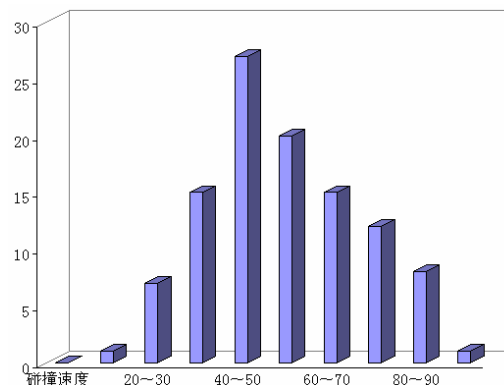


Fig.5 Distribution of collision speed

3) Frontal character parameters of car

Whole-vehicle, bumper, engine hood, windscreen (Length, width, height) , etc.

(3) Human-vehicle interaction parameters

1) human injury

Fatal injury, lower limb injury, head injury, fracture, AIS (MAX) , ISS, etc.

2) vehicle damage

Degree, affection part, bumper, windscreen, engine hood, etc.

3) contact part characteristic

Contact type (front to side, front to front, front to rear, side scratch) , contact angle, contact area, the relative position between tibia point height and bumper, etc.

(4) Environment parameters

1) natural environment

Date, time, place, climate, weather, etc.

2) road environment

Road state, road surface point, etc.

(5) others

1) driver parameters, etc.

2) road surface parameters: vehicle trace, human trace, etc.

4.2 Items of application research

As an essential reference, the statistics results can be applied in the evaluation and simulation research of pedestrian injuries under China typical road traffic status. As following, some research contents will be carried out in the near future.

(1) Recent research contents

1) Data mining of pedestrian accident information.

2) Human-vehicle-road characteristics analysis of car to pedestrian.

3) The relativity between vehicle frontal parameters and pedestrian injury.

4) The collision speed analysis based on the pedestrian injury.

(2) Future research contents

5) The classification on pedestrian accidents.

6) The accident prevention based on the pedestrian injury.

7) The protection methods of pedestrian under mix traffic.

8) The prediction of pedestrian injuries.

5 Conclusions

This project is to classify the cases from the Traffic Accident Reconstruction Laboratory have done and make the data standardization and systematization by building a statistical platform to investigate the contact characteristics between pedestrian and vehicle. Through the analysis to the stat. results we can summarize the universal rule in the car to pedestrian accidents taking advantage of the injury features of the pedestrian.

Based on the database platform we developed, the human-vehicle's relative position during the first contact phase can be analyzed. Through the stat. of 150 car-pedestrian accidents, the main relations between human injuries and human-vehicle's type and their contact characteristics are obtained. This project is of important application value to reduce the injury of pedestrian, which can provide basic analysis to the establishment of future pedestrian protection methods.

6 References

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