

Microcosmic Study on Road Safety

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Abstract: Based on the analysis of the current situation and existing problems of road safety research, this paper proposes a new direction of road safety research based on the theory of system control. Combined with research in recent years in the driving simulation model, driving track and special conditions of vehicle running safety analysis and road alignment design safety evaluation of research results, showing the based on driving simulation of road safety micro research overview and application value. In the end, the development prospect of the research on the future work and the safety of road is expounded.

Keywords: Road safety; Driving simulation; Microscopic

1. Introduction

According to WHO statistics, every year there are more than 1 million 100 thousand people died in traffic accidents, and the number is about 100 thousand in China, the relevant scholars predict 2020 traffic accidents will be the cause of the death of third people. Traffic accidents have caused great loss of life and property, and more and more attention has been attached to the research of road safety.

2. Current Research Situation of Road Safety

Because the road safety system is a system composed of people, vehicles and roads, any problem will bring bad influence to the whole system. Therefore, the research of the system needs more professional knowledge. For this global problem, launched a very fruitful study of the relevant departments and experts in various aspects of road safety: medical workers from the epidemiological analysis of the driver's point of view, and according to different qualities and characteristics of drivers to distinguish a susceptible population, and put forward the prevention measures; to study the effects of driving behavior of workers from the car accident analysis the data of vehicle performance and safety, the driver of the traffic safety, so as to provide the necessary support to improve the safety of the vehicle; road traffic management is the identification and remediation of accident prone sections, in order to reduce the accident rate and reduce the loss of life and property; and researchers from the road design and road operation safety perspective on road safety research, in order to achieve by improving the road traffic facilities to reduce the accident rate and loss Purpose. It can be seen that, with the deepening of the study, the mutual penetration of various disciplines, the field of experts to participate in the study of the trend will become more and more obvious.

At present, our country road workers to road safety research generally include the following aspects:

Accident black spot identification [1]. General by the principles and methods of mathematical statistics on a road a few years of accident data analysis, find out accident prone position, so as to provide a basis for the traffic regulation and transformation of black spots. Road safety audit [2]. From the point of view of road facilities and traffic safety, this paper analyzes the road safety condition of the planning, design, construction and operation, and puts forward the reasons and suggestions for improvement.

Road safety evaluation [3]. Through the direct or indirect relationship between the accident data and the road alignment to evaluate the safety of a road, and puts forward some suggestions for improvement. Research on road safety of special sections. Analysis of traffic safety accidents caused by high accident rate of high accident rate, such as long and steep slope, tunnel entrance and exit, and put forward suggestions for improvement.

Although, in these areas has made substantial progress in the study, but still difficult to specific sections were road safety quantitative evaluation, difficult to a specific accident do accident analysis and reappearance, and the more and becomes the research focus.

3. The Study of the Microscopic Nature of the Proposed

In the past, statistical analysis and regression methods were used to establish the relationship between the factors of road safety and road safety[4]. This research method is called macro research. Research on qualitative research and quantitative research is more effective, such as intersection model, two lane model, etc.. But macro model, in fact, is not the interaction between the various elements effectively build up, cannot effectively reveal the essence, object of study it is often various elements mixed together, so the conclusion is also a classification

and general concept. The advantage of macro research is that it not only contains all the elements, but also highlights the research focus ". However, this is also the cause of its shortcomings, that is, it is difficult to accurately separate the elements, can not effectively analyze how the factors affect the driving safety, and thus the specific location of the analysis is relatively weak. Macro research on road safety preliminary audit is more effective, can quickly through the road design indicators to make a preliminary judgment, to lay a good foundation for further research.

With the in-depth study, people tend to want to get more accurate results, then macro research is often unable to obtain satisfactory results, and the need to people to analyze in depth the road safety system of the internal structure and operation mechanism, realize the system observability and controllability, which is a microscopic study of the category. Road safety micro study is quantitative analysis of the interaction between the various elements of the road safety system, establishing the micro model, from the point of view of the system control and analysis of the elements of the system safety.

On the basis of system theory and control theory, the research on road safety is based on the system theory and control theory. Including physiological and psychological characteristics of people; the dynamic characteristics of the vehicle[5]; characteristics of the road itself; driver and vehicle control running characteristics; dynamic response of vehicle on different road; drivers to the road alignment and environment recognition and response; the road safety system framework and simulation.

Microscopic study is road safety research deeply and concretely, the reasonable location required the use of road engineering, traffic engineering, automotive engineering, automatic control theory, theoretical mechanics, psychological and physiological science, computer simulation technology, and other related disciplines of knowledge. In fact, the microscopic research includes two aspects: theoretical research and experimental research. In recent years, the author has made a superficial attempt on some aspects of micro research, and obtained some valuable knowledge. Here is a brief introduction of the one or two.

4. Preliminary Study on the Microscopic Study

4.1 Driving simulation model

Microcosmic study on road safety usually performance for driving simulation research, it can be said that the driving simulation is the microcosmic research foundation, according to the practical application, the complexity of the model is also inconsistent, but basically includes three parts: driver model, vehicle dynamics model and road model.

Simple driving simulation model is suitable for low speed driving without considering the dynamic response of the vehicle, so the driver of the steering wheel is also simple. Simple driving simulation model can be used as the single point preview optimal acceleration model proposed by academician Guo Konghui as the driver model. Inputs to the model system dynamics model is the driver's steering wheel angle, and the output is the coordinates and orientation of the center of gravity of the vehicle; road model input is the vehicle coordinate and direction angle, and the output is the pile number, lateral displacement and the direction of the wheel angle. The simple driving simulation model shows good track tracking performance. The dynamic response of the vehicle is generally considered in the complex driving simulation model, considering the strategy of the driver's speed control, steering wheel control and gear position control, and even the influence of the road environment.

4.2. Travel path research

When the vehicle is running on a curve with a smaller radius, the running track of the vehicle has a large deviation from the ideal track, which has a great influence on the safety of the driving. On a curve, offset the trajectory of the following rules: when a vehicle enters a curve, the trajectory always first toward the inner side, the general in the corrosion dot near the maximum, when the vehicle is about to exit curve, the vehicle trajectory toward the lateral and in slow straight near the point reached the maximum value.

Under the same radius circular curve, the longer the transition curve, the smaller the lateral offset, however, after more than a certain length, the offset reduction effect is gradually less obvious. When the curve radius increases, the length of the corresponding transition curve increases, the curvature change rate decreases rapidly, and the lateral displacement is also significantly reduced. Therefore, the lateral displacement of the curve can not be considered for a larger radius.

4.3. Vehicle operation safety research under special conditions

Assume that a vehicle traveling at the speed of 20 m / s, while the driver to the front a 0.008 radian angle input, in 5 seconds when the driver to the vehicle a brake input, and in the 6 seconds, tire and road adhesion coefficient from 0.8 mutations of 0.45. Four wheel longitudinal force in braking on the road adhesion coefficient mutation suddenly reduced, longitudinal slip rate on the road adhesion coefficient mutation dramatically reduced to - 1. That is to say, locking phenomenon.

Vehicles from the start of the brake to stop the time required for the 4.66 s, driving distance of 44.51 m, stop when the deviation from the established track 1.39 M. And friction coefficient decreased conditions can be

found in attachment coefficient of the sudden decrease of pavement are turning braking, the braking time and braking distance is taking longer than the road adhesion coefficient did not change the 102 technical research, and the vehicle is easy to appear the phenomenon of locking, and steering failure, deviate from the established track, easily lead to a traffic accident.

In large bridges, cross sea bridge or in the valley between the wind is often a large gust of wind, which will have a great impact on the high speed of the vehicle. Under normal circumstances, gusts of wind, first of all, does not take vehicle to blown over, but the tire which is caused by the lateral deviation, lead to changes in the vehicle trajectory, in the driver is not found in time and correct the vehicle to a certain angle side hit on the curbs or barriers, which can lead to rollover accidents.

At the speed of $V=100$ km/h under crosswind is 30 m/s under the condition of the vehicle driving in a straight line, consider two: when the vehicle suddenly affected by crosswind, the driver's steering wheel stays. From the simulation results, after marching 91.6 m, the vehicle lateral offset of 1 m and at 0.85 degree angle drove to the roadside; if driver in vehicle side partial after 0.5 m, vehicle trajectory deviation, and through the steering wheel control, the vehicle back to the ideal position. According to the simulation, the driver in the 58 m found that the vehicle deviates from the track, the maximum offset position in the vicinity of 100 m, the maximum offset is 0.92 M. The maximum lateral force of the vehicle is about 5200 N.

4.4 road route design safety evaluation [6]

Get the vehicle simulation driving track and by force, changes in the speed, steering wheel change index through the specific road alignment driving simulation, these indicators through certain combinations can be expressed as a comprehensive index. When the relationship between the comprehensive index and the actual accident rate is established, the index can be used as a quantitative indicator for the safety evaluation of road route design.

5. Research Prospects

The research of road safety micro can help us to study the road safety from the point of view of controllability and observability, and solve many problems which can not be solved by macro analysis. Although the above research is

still relatively shallow, but has shown its proper theoretical value and application value. In the future research, we can develop and improve it from the following aspects.

Driver characteristics in-depth study. On the driver's driving habits, psychological and physiological characteristics, the road infrastructure and traffic information processing are studied from the combination of theoretical and experimental point of view on the driver for modeling and parameter calibration.

Simulation of multi vehicle and multi system coupled traffic operation. From the research on the development of the vehicle driving simulation system, the simulation model of multi vehicle and multi system coupling traffic operation. Different from single system, multi system coupling model needs to consider the relative independence of each driving system, and to fully consider the relationship between different systems.

Research on accident reconstruction. Through the analysis of the driving simulation under the specific road traffic conditions, the whole process of a certain type of accident is reproduced, and the technical support for the identification of traffic accidents is provided. Although the microcosmic study on road safety is still in the stage of preliminary research, the development of road safety will inevitably encounter all kinds of difficulties, but its good development prospects will attract more researchers to work hard.

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