

Construct Defensive Driving Scene Based on 3DS Max

Ting Pan^{1*}, Rende Yu¹ and Bing Liu¹

(1. School of Transportation and Vehicle Engineering, Shandong University of Technology, Zibo 255049, China)

*Corresponding author email id: panting3721@163.com

Date of publication (dd/mm/yyyy): 11/06/2017

Abstract — According to the study about traffic accidents, most of traffic accidents are often directly related with human negligence. This also explains that most of them can be prevented. The defensive driving, which means drivers take an initiative way to prevent the occurrence of traffic accidents, is one of the important ways to solve the traffic safety problem. In this paper, 3ds max was used to build a three-dimensional model of the road and a three-dimensional model of the vehicle, building a defensive driving scene. Long line sight of defensive driving scenarios and wide-field of defensive driving scenarios were built under different speeds, show the advantages and importance of defensive driving.

Keywords — Defensive Driving, Scenario Building, 3ds Max, Road Safety.

I. INTRODUCTION

According to the analysis of the data about road traffic accidents around the world, as shown in figure 1, we can see that more than 80% of road traffic accidents occurred because of unsafe acts. These unsafe behaviors include poor driving skills, poor strain capacity, take the wrong operation, violation of traffic regulations, etc.^[1]. Understand and learn the skill of defensive driving techniques, can not only reduce the unsafe acts of the driver, avoid initiative traffic accidents, but also can avoid the situation that passive involved in traffic accidents because of the other traffic participants' violations of the traffic participants or negligence ^[2]. It can protect the safety of themselves and property. In addition, defensive driving can reduce driving anxiety and fatigue, reduce insurance claims and premiums, reduce the costs of fuel consumption and vehicle daily maintenance, and improve work efficiency and vehicle utilization and road capacity ^[3].

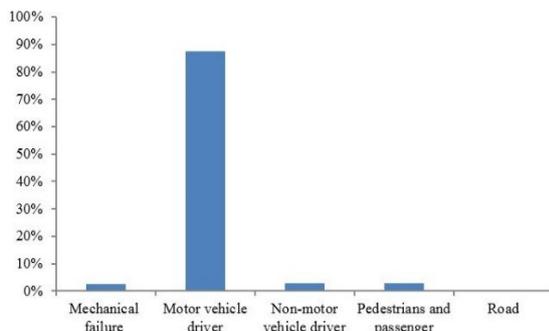


Fig. 1: Main cause distribution of road traffic accidents

Because of the powerful 3ds Max and good visual effect, the use of 3ds Max technology which can be constructed with the reality is very close to the three-dimensional space visual scene ^[4]. According to the learner's learning habits, learner is more liable to recognize the content in the real

situation ^[5]. Therefore, we can use the 3ds Max to build defensive driving scene. Building various scenarios of defensive driving can make drivers understand the effects of defensive driving and advantages of defensive driving easier.

II. CONCEPT OF DEFENSIVE DRIVING

Defensive driving technology systematically summarized relevant driving skills and habits, formed a set of simple and scientific safe driving system [6-7]. It can help the driver to understand human "physiological defects" more clearly, observe and understand the driving environment more comprehensively, predict uncertain potential risk factors more accurately, and take precautions to avoid traffic accidents timelier [8-9]. Defensive driving is anticipating problems and responding ahead of time so that you can protect yourself and others from dangerous and unexpected driving situations.

III. FIVE PRINCIPLES OF DEFENSIVE DRIVING

Through the systematic analysis, induction and summary of defensive driving, we can divide defensive driving principles into five main aspects. These five aspects, called the five principles of defensive driving, these complement integrate with each other. They can help driver choose a wide field for their own actively and provide more reaction time for an emergency. They can reduce the number of traffic accidents and the maintenance fees of the car damaged by traffic accident, reduce parking waiting time because of unexpected circumstances, and reduce the fuel consumption, the anxiety and the fatigue at the same time. It makes the road more clearly and the environmental problems have some extend of improvement.

A. Look Far Away

In the road traffic accident, lots of traffic accidents are due to the driver did not look forward and foresight. According to the study, most of the drivers only can ensure the wait-and-see distance for only 3s to 6s at present. But 3s to 6s is not enough. When the driver increases the wait-and-see distance to 6s to 15s, the various problems caused by the short wait-and-see distance will be improved, but the degree of improvement is limited.

However, when the driver's wait-and-see distance can reach more than 15 seconds, the problems mentioned above due to the short wait-and-see distance will be improved greatly. When the driver driving on the city road in the urban area, if you can guarantee the wait and see distance of 15s, then the driver can quickly see the front of the next intersection of road traffic when through an intersection, increased security through intersections. When driving at

night, the eyes should observe outside the area of the vehicle headlamps exposure as much as possible.

B. Expand Field of View

The road traffic system is complex and changeable, and affected by a number of factors. These factors are related each other and influence each other. The driver drives a motor vehicle on the road, not only to observe the front side of the vehicle, the left side, the right side, behind the motor vehicle, non-motor vehicles and pedestrians, but also to observe a variety of traffic signs and road conditions below the road.

Through observation, the driver has a comprehensive understanding of the vehicle driving conditions. This provides reliable information for the driver to make the right decisions and take effective measures. Drivers want to observe such a wide range need an effective observation skill. The skill is to keep more than 15s wait-and-see distance and to observe the rearview mirror every 5s to 8s.

C. Keep Your Line of Sight Flexible

The road traffic environment is constantly changing. There is no consistent road traffic condition in real life. The driver must be observed at all times and the direction of sight is constantly changing. According to the study, the driver's sight is changed every 1s or 2s to avoid staring. Staring at an object for a longer time will cause the driver to ignore the observation of the other direction and will led to traffic accidents.

In the course of driving, the driver needs to be vigilant. The driver's lines of sight need to change frequently in the process of driving in order to avoid staring and daze. In the process of sight transformation must avoid staring at the same object for more than 2s.

D. Leave Room

A lot of vehicles, non-motor vehicles and pedestrians travel on the same road, especially on urban roads. The driver must observe carefully, forecast the possible risk all the time, and set aside enough time and space, in response to the potential risks. During driving a vehicle, at least one safety direction must be left in the four directions around the vehicle, that is, there is at least one direction without motor vehicles, non-motor vehicles and pedestrians, and we can dodge when the front is dangerous.

To achieve the estimated risk and leave room have skills, such as two seconds rule. The two seconds rule means that the driver must be keep a safe distance of more than two seconds with other vehicles in the same direction and the same lane of the vehicle. It is very necessary to keep the safe distance of at least 2 seconds. It can reduce the happening of the accident effectively.

E. Catch the Attention

It is necessary for the driver to communicate with other road traffic participants when drive the vehicle on the road. Other vehicles and pedestrians should be noticed while driving the vehicle, and other vehicles and pedestrians should be taken care of themselves. When the driver wants to change the way, at least 3s ahead of time to turn on left light. So that the rear vehicle will notice that you will change. If the driver wants to overtake, a at least 3s ahead of time turn left turn signal, so that the front of the vehicle and the rear of the vehicle are aware of their driving

vehicles will be changed. When in the night or driving at night without light intersection, the driver should to flash light, in order to warn other traffic participants. When the vehicle is running on the corners or arriving at the top of the slope, it is necessary to whistle to prevent the front vehicle from stopping or the other vehicle crossed the line.

IV. CONSTRUCT DEFENSIVE DRIVING SCENE BASED ON 3DS MAX

According to the five principles of defensive driving research, the following will be some defensive scenes to build.

A. Building the Defensive Driving Scene of Look Far Away

The speed of the vehicle is different, the vision is different. The general driver can only guarantee 3-6 seconds' wait-and-see distance, so we take 5 seconds wait-and-see distance scene construction.

The relationship between speed and wait-and-see distance is shown in table 1. Next, we will build the defensive driving scene at different speeds.

Table 1: The relationship between travel speed and wait-and-see distance

Speed (km/h)	5 seconds of wait-and-see distance (m)	55 seconds of wait-and-see distance (m)
30	42	126
50	69	207
65	90	270

1) When the driving speed is 30km/h, the construction of the defensive driving scene as shown in figure 2:



Fig. 2: Construction of the defensive driving scene at the speed of 30km/h

In figure 2, we take the red car as the research object, and construct defensive driving scene of the red car in the speed of 30 km/h. The horizontal distance of the red car from the vertical red plane is 42m, the horizontal distance from the vertical blue plane is 126m. This means that the red car driver can see the vertical red plane at the speed of 30km/h at 5 seconds wait-and-see distance, and can see the vertical blue plane at the speed of 30km/h at 15 seconds wait-and-see distance.

2) When the speed is 50km/h, the construction of the defensive driving scene as shown in figure 3:

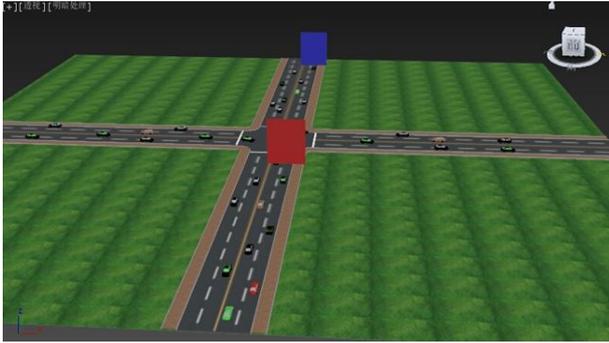


Fig.3: Construction of the defensive driving scene at 50km/h

In figure 3, we take the red car as the research object, and construct defensive driving scene of the red car in the speed of 50 km/h. The horizontal distance of the red car from the vertical red plane is 69m, the horizontal distance from the vertical blue plane is 207m. This means that the red car driver can see the vertical red plane at the speed of 50km/h at 5 seconds wait-and-see distance, and can see the vertical blue plane at the speed of 50km/h at 15 seconds wait-and-see distance.

3) When the driving speed is 65km/h, the construction of the defensive driving scene as shown in figure 4:

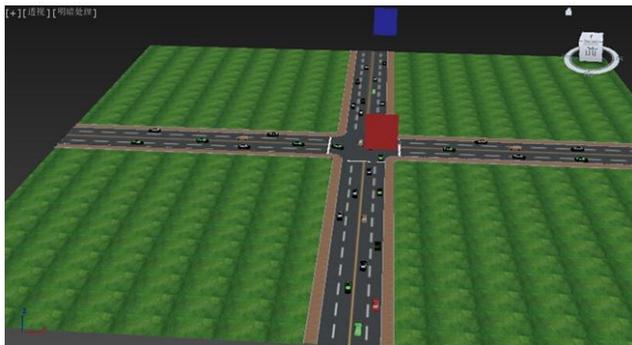


Fig.4: Construction of the defensive driving scene at 65km/h

In figure 4, we take the red car as the research object, and construct defensive driving scene of the red car in the speed of 65km/h. The horizontal distance of the red car from the vertical red plane is 90m, the horizontal distance from the vertical blue plane is 270m. This means that the red car driver can see the vertical red plane at the speed of 65km/h at 5 seconds wait-and-see distance, and can see the vertical blue plane at the speed of 65km/h at 15 seconds wait-and-see distance.

4) Analysis of defensive driving scenes at different speeds

By contrasting the defensive driving scene at different speeds, we can clearly see that the wait-and-see distance required for the driver increases with the increase of driving speed. When the red car driver's wait-and-see distance is 5 seconds, the driver's line of sight will generally not exceed the intersection. But when the driver's wait-and-see distance reach 15 seconds, the driver's line of sight can

easily cross the intersection. Generally speaking, the driver's vision is farther, the longer range of observation, the more beneficial to traffic safety.

B. Construct Defensive Driving Scene of Expands Field of View

A comprehensive observation of the car body around is one of the important elements of defensive driving, defensive driving scene as shown in figure 5:



Fig.5: Construction of the defensive driving scene of expand field of view

In figure 5, we take the red car as the research object, and assume that there is no signal at this intersection, red car traveling from south to north. Because there is no signal at this intersection, the traffic situation is very complex. In the process of vehicle passing through the intersection, the driver need to observe the left turn vehicles from north to east from, the straight vehicles from west to east, the left turn vehicles from west to north, the left turn vehicles from east to west, the straight vehicles from east to west, the right turn vehicles from east to north, all of these vehicle have the conflict with the direction of the red car. Therefore, it is necessary to observe around the vehicle with a full range. If you arrive at a no traffic light intersection, there are lots of cars, the situation is complicated, Then stop and waiting at the intersection as far as possible ,across when the vehicle is reduced, always put safety first.

V. CONCLUSION

Both in our country and in other countries, the casualties and property loss caused by the traffic accident is not a small number each year. The traffic accident has become the world's "first harm". How to reduce or even prevent the occurrence of traffic accidents, has become a common concern around the world.

Defensive driving is an important way to reduce the incidence of traffic accidents and it has been widely concerned. By building look far away under different speeds of defensive driving scenarios, expand field of view of defensive driving scenarios and leave room of defensive driving scenarios, shows the advantages and importance of defensive driving. Based on a 3ds max defensive driving scene, the driver is more able to grasp the defensive driving. When the driver really understands the concept of defensive driving, then put into action, the driver can't take the initiative to cause traffic accidents. And the driver not passively involved in traffic accidents. When all traffic

participants can grasp the concept of defensive driving, the traffic accident will happen rarely. To protect people's travel, improve the road capacity, and promote social harmony.

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AUTHORS' PROFILES



Ting Pan,

she was born on April, 1990 in Shandong province, China. She is a graduate student at Shandong University of Technology, and major in transportation engineering. Her research direction is the education of traffic safety.



Rende Yu,

he was born on June, 1966 in Shandong province, China. He is an associate professor at Shandong University of Technology. His main research direction is traffic planning, management and safety.



Bing Liu,

she was born on February, 1993 in Heilongjiang province, China. She is a graduate student at Shandong University of Technology, and major in transportation engineering. Her research direction is the traffic planning and management.