Identification and analysis of vehicle traces in traffic accidents

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Abstract: this article in view of the different types of traffic accidents of vehicle trace difference analysis, including motor vehicle accidents, accident of motor vehicles and non-motor vehicles, motor vehicles and solid content etc., combining with the factors influencing the accuracy of the vehicle trace identification results, by studying the vehicle trace identification in judging whether had collision with other vehicle, clearing the accident vehicle type, vehicle crash site, determining vehicle relative direction, clearing the specific application of hit-and-run vehicle. Its purpose is to improve the level of vehicle trace identification and to speed up the handling of traffic accidents.

1. Introduction
Identification of vehicle traces refers to the inspection method of determining the specific type of traffic accident and the type of vehicle involved according to the traces left by the vehicle and the special traces left by the personnel after the occurrence of a traffic accident. Under the background of increasing traffic flow and pedestrian volume, the rate of traffic accidents is increasing. In some sections without monitoring aids, after the traffic accident, traces on the vehicle identification are needed to obtain valid information. Through the analysis of the correlation content of vehicle trace identification process, not only can speed up the work of advancing speed, but also can provide reliable data support for the accident to judge and to speed up the processing efficiency of the problem.

2. Differences in the traces of different types of traffic accident vehicles

2.1 Motor vehicle accidents
The number of motor vehicles in road traffic is on the rise, so does the number of motor vehicle accidents. According to relevant statistics, motor vehicle accidents account for more than 60% of the total accidents in China. When judging the traces of such accidents, the following parts can be used to judge: (1) The speed of driving. In general, the active car driving speed faster with the passive car driving speed slow had a collision. The part of the collision occurs is active cars’ front convex, so at this point the vehicle traces left in there will be many deposits, it can preliminary judge the active and passive models and clear responsibility division. As shown in Figure 1, the red car will continue to move at the red light, and then the normal driving will collide with the red car. Combined with the traffic light information, it can be judged that the red car is mainly responsible. (2) The direction of the motion of the vehicle. The vehicle which in a state of parallel driving, basically won't appear the traffic accident, but some car position deviation will make the two cars produce angle, when the speed of the vehicle is similar or the offset vehicle is moving at a high speed, and appears vehicles friction, leading to depression. According to the direction of vehicle sag, the direction of impact can be judged, so active vehicle and passive vehicle can be determined. (3) Relative position. After the formation of motor vehicle collision accident, some collision debris will also be generated on the scene. The
distribution and relative position of the debris can also reflect the specific location of the traffic accident, and the accident occurrence can be calculated with the help of this content. As shown in Figure 2, according to the deformation of the vehicle and the debris scattered on the front, it can be inferred that the cause of the accident is the collision between the vehicle and the original road vehicle when the lane change occurred, and the specific responsibility needs to be further determined in combination with other information.

2.2 Motor vehicle and non-motor vehicle accidents
The analysis of collision marks between motor vehicles and non-motor vehicles can be divided into the following situations: First, the distance between non-motor vehicle drivers and non-motor vehicles after a collision accident occurs. Under normal circumstances, the displacement distance of non-motor vehicles will be shorter after collision, and the displacement of non-motor vehicles will also occur in the event of collision, which is also one of the contents to be paid attention to in the evaluation stage. Second, the steering of the non-motor vehicle seat, which is relatively weak compared with the volume of motor vehicles, so the steering of the non-motor vehicle seat is easy to occur after an impact accident. In most cases, the steering will be consistent with the direction of the motor vehicle. Third, it is important to judge the injuries of non-motor vehicle drivers, which is also one of the important references to assess the severity of accident conditions. In the event of a collision, the driver will leave
the non-motor vehicle under the impact of the motor vehicle, and the traces such as the last landing place, the injured part and the direction of the fall will also reflect the accident status, which is also helpful for the application and judgment of some accident problems. As shown in Figure 3, the accident is a collision between a motor vehicle and a non-motor vehicle when it forks into a road. Trace identification can be used to determine the main party responsible for the accident [1].

2.3 Motor vehicles and solid objects
Under the influence of human operation factors, motor vehicles sometimes collide with solid objects in the process of driving, such as guardrail, telegraph pole, kerb, green plants, etc. As shown in Figure 4, this is the type of accident in which a motor vehicle collides with a solid object. In this kind of question carries on the trace analysis, first, the height difference between the motor vehicle and the solid object is counted so as to judge the correlation between the damage of the motor vehicle and the solid object. At the same time, the damaged parts and damaged direction of the solid are evaluated to determine the driving direction and collision direction of the damaged vehicle [2]. Second, collect trace physical evidence left on solid objects by motor vehicles, and judge relevant parameters involved in this accident according to trace physical evidence. In the specific implementation link, the data to be collected include vehicle paint, vehicle residual debris, peeling off of vehicle skin paint or items, and the basic characteristics of the detached objects, etc., with the help of these contents, the type of accident can be calculated and the reliability of accident judgment results can be improved.

3 Factors that affect the accuracy of vehicle trace identification results

3.1 Vehicle loading weight
Highway project provides a lot of convenience for people's travel life and urban economic communication, and the increase of vehicles on the highway also increases the probability of traffic...
accident analysis. Traffic accidents totaled more than 1.2 million and the cumulative death toll exceeded 83,000 in China, according to 2019 data, which is still on the rise. In influencing the accuracy of vehicle identification data types, the influence factors of vehicles load weight are common, a lot of traffic accident vehicles in the traffic accident, the car loaded with heavy goods, but the goods will be fast scattered after the accident, and in the exploration stage of the vehicle is in idle state, this can also cause the interference when measuring the body judgment, affect the accuracy of the judgment result [3].

3.2 Tire pressure value
Combined with the statistical data shows that more than 30% of traffic accidents in the occurrence stage, the vehicle will be accompanied by the situation of tire puncture, especially in the summer high temperature stage, the pressure in the tire will be in the external temperature, friction heat, began to increase gradually, and finally led to the emergence of the situation of tire puncture. The time between the trace identification and the accident is relatively large (it is necessary to treat the wounded first and dredge the road traffic, etc.), so that the tire pressure value will leak within this time. The number of tires may be more than one, which will also reduce the height of the vehicle and affect the final judgment result [4].

3.3 Car driving state
Car driving state refers to the changes of the vehicle driving speed, driving direction, more than 50% of the traffic accident occurred in the process of driving vehicle service road or plane intersection. For example, in the process of vehicles running parallel, a car position deviation, will make the two cars produce angle, when the speed of the vehicle is similar or the offset vehicle is moving at a high speed, and appears vehicles friction, leading to depression. [5]. However, the sag and direction are directly related to the speed and direction. If the change distance in a vehicle accident is large, it will also lead to a decrease in the matching degree of the vehicle collision trace, thus affecting the driving trace.

3.4 The strength of the collider itself
At present, the total number of motor vehicles in China is 1.5 to 2.0 times that of the national total, and the quality, hardness and elasticity of materials used by vehicles at different prices are also greatly various. When meeting the same impact force, the impact area also can appear different deformation conditions, such as higher elasticity, bigger hardness. Better body material quality meets the impact when the form variables is relatively small, but poor elasticity, small hardness, poor quality of car body materials, would appear large deformation in weak place, this has increased the complexity in the process of trace identification, which affects the accuracy of the appraisal result [6].

4 Specific application of vehicle trace identification in traffic accidents

4.1 Determine whether there has been a collision with another vehicle
After a traffic accident, in some cases, the vehicle driver will choose to flee the scene in order to avoid legal liability. Then in the identification of traces on the scene, there will be only one vehicle. For example, on the night of July 16, 2018, in He Ping District, Shenyang, there was a hit-and-run case, and only the vehicle was left at the scene, as shown in Figure 5. During the forensics of its traces, the indentation was found to be 5-10 centimeters, and the rear part had been seriously deformed and parts fell off. At the same time, check whether the vehicle staying at the scene has collided with other vehicles, have an in-depth understanding of the traces left on the scene, and combined with the calculation model, make sure that the vehicle has had a collision with other vehicles, is a passive vehicle, and it is a traffic accident after rear-end escape. After local monitoring and evidence collection, the vehicle causing the accident was determined to be a medium-sized Jeep. In addition to bearing the economic losses of the crashed vehicle, it also needs to bear certain criminal responsibility, thus improving the scientific nature of the result of accident responsibility distribution [7].
4.2 Identify the type of vehicle in the accident
It has been mentioned above that after a traffic accident occurs, in some cases, the vehicle driver causing the accident will choose to flee the scene in order to avoid legal liability. Vehicles at the scene of the accident, then, may not stay, only a few lines of the vehicle, the vehicle identification of the need to inspect the vehicle tire grain, according to the grain of the related parameters, such as display case, grain width, etc., knowing the quantity of tires of the vehicle, the distance between the tires, tire size down, so as to determine the vehicle specific categories, such as cars, vans, trucks, etc., it also can reduce the accident vehicle screening, so as to improve the accuracy of the judgment [8].

4.3 Location of vehicle impact identified
In the process of vehicle running, if the rear vehicle is running too fast and the parallel vehicle suddenly changes lane, then vehicle friction will occur, which will lead to the appearance of sag. For example, in 2019, a rear-end collision occurred at a high-speed intersection in Zhengzhou. As shown in Figure 6, the rear car was directly close to the front car, while the rear car was deformed after the collision, and the personnel of the two cars were injured to varying degrees. For this reason, we can judge the impact of the vehicle by the deformation of the rear end or the front end. After the deviation of the driving routes, it can be found that it was a collision accident at the plane intersection. Although the front car did not have obvious deformation, there were large scratches at the rear and some cracks in the car. Combined with the monitoring images of other sections at that time, it can be found that the silver-white vehicles behind are speeding, which is also consistent with the relevant content of motor vehicle accidents. Finally, the identification conclusion is drawn that the silver-white vehicle should take full responsibility [9].
4.4 Determine the opposite direction of the vehicle
For some sudden large traffic accidents, for instance continuous rear-end collision, the whole process of impact is relatively complex, and sometimes the same car will be hit and rub for several times, which also increases the complexity of accident liability judgment. With the help of vehicle trace identification, the accident can occur, the sequence of vehicle impact to determine. At the same time, according to the situation of impact point, it can be classified into depression trace, collapse trace, holes trace, scratch trace, crushing trace and surface trace, etc. According to this classification requirement, the location of the first impact point and the location of the second injury were determined, so as to sort out the party responsible for the accident and bear the proportion of responsibility, and improve the accuracy of the judgment results [10].

4.5 Identify the hit and run vehicle
Combined with the experience of dealing with accidents in the past, it can be known that after a traffic accident, the display of the body shape and structure can also well show the driving process. At this time, the vehicle scratch evaluation can be used to judge the direction of the vehicle impact, based on which to judge the driving condition of the vehicle caused by the accident. For example, a traffic accident, the vehicle parts because of the impact appeared parts of tilt, then based on the tilt direction, pile height is from low to high impact accessories to the car driving direction, passive vehicle driving state, at the same time can also be clear to the whole process of impact for rapid reduction, to speed up the troubleshooting work efficiency.

Conclusion
To sum up, after the occurrence of a traffic accident, the corresponding trace identification can, on the one hand, improve the reliability of the identification results and provide reliable data support for the accident treatment. On the other hand, it can also provide reliable data support for the intelligent traffic management system and improve the effectiveness of urban traffic management.

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