Research on road test method with integrated modular intelligent chassis

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Abstract

To ensure that the automatic emergency braking system effectively avoids collisions with target objects, a collision avoidance strategy is formulated based on the relative motion between the target object and the vehicle. The paper utilizes a hardware experimental prototype of an integrated modular intelligent chassis for analysis. The model's results demonstrate that it meets the required road test standards, and it can adapt to the unique requirements of various drivers. Overall, the intended audience gains a better understanding of the system and its capabilities. Simultaneously, they will be able to understand the principles of democracy. This paper aims to describe the system and its capabilities, rather than detract from the interest in learning and studying

Keywords

Intelligent chassis; active safety; road test.

1. Introduction

The emergence of automobiles brings convenience to people's lives, but also poses potential hazards to the safety of drivers and passengers. The moment of automobile safety was still the beginning of the experiment. Therefore, in coming day, we should also try to think that our automobile safety is active and passive. In the concrete situation, we found that our country's automobile safety supervision is divided into two kinds.

The greatest danger comes from collisions when driving in different road conditions. Automobile safety is divided into active safety and passive safety. It generally refers to the performance of a vehicle in preventing an accident and protecting the driver and passenger in the event of an accident. In the new edition of the Chinese Automobile Circulation Association (C-NCAP 2021), the active safety assessment of automobiles has been further adjusted, and the rating system has been revised to increase the weight of active safety capability of automobiles from from15% to25%. Thus, active safety testing has become the focus of the C-NCAP safety crash test. The complete rules of the opposite captures required to reduce the height of a vehicle active safety capability from15% to25%. The study shows that a vehicle active safety was to reduce the weight of the volunteer accurately. The test of active safety is brought to the most important role that can survive a risk of accident.

A vehicle's active safety vehicle is related to the safety of the vehicle as well as the safety of the driver and passenger. Good active safety also helps minimize the risk of accidents. Consumers should therefore pay attention to the C-NCAP regulation rules, which test vehicles for collision warning, active braking and more. When testing a vehicle's active safety performance, C-NCAP's professional engineers will remove the plate casing and rigorously test the the vehicle's own structure impact transmission capability. Only vehicles that can withstand such intensity test are considered safe for passengers. Therefore, the emergence and development of the C-NCAP regulation has made qualitative leap in the level of motor vehicle safety in China, guaranteeing the safety of countless drivers and passengers. Safety in driving, safety in the environment, safety in the senses, safety in operation. Hyundai has paid more and more attention to active safety design and development, which has become a new trend in the automotive industry and put forward measures to improve safety. The regulation of theC-NCAP2021regulation has been conventional for a research inChina's vehicle safety level, environmental, sensory and operational. The exhibition is themed on the importance of active security technology.

Many countries are at a positive level of security for the world and remain positive and optimistic.

Through the application of active safety technology, the dynamic performance of the whole vehicle is optimized. In addition, before the collision, corresponding emergency measures can be taken to improve the braking ability and operation stability of the vehicle, effectively reduce the occurrence of accidents. At present, many countries in the world take the improvement of active safety technology as the main research object. China is no exception, since the 1950s, has been studying automobile active safety technology, and has obtained some research results. Since the first recorded traffic accident accident in1898, efforts have been made to improve driving safety. In recent years, the rapid development of electronic, computer and automation technologies has further promoted the advancement of active security technology. At present, countries around the world are actively developing active safety systems with autonomous intellectual property rights and competitive capabilities to address the growing traffic safety problems. In recent years, advanced active safety technologies such as the anti-lock brake system (ABS), electronic brake system (EBS), adaptive cruise control (ACC) and autonomous emergency braking (AEB) have made cars safer, more comfortable and smarter. At the same time, China has been used for regression tests. However, there are many interests in this country and it can be reversed.

The AEB system's architectural design consists of hardware and software modules. The hardware unit consists of various sensors, AEB system controllers, throttle and brake actuators, and so on. It is the software unit's responsibility to process the data collected by the sensors and control the actuator unit to take emergency action when needed. AEB is an effective measure for preventing accidents and reducing the incidence of accidents. The relative position distribution of vehicles and two wheeled vehicles with different time to collision (TTC) was obtained by Zhou H et al. via a batch simulation, and comprehensively accounted for the fatality detection rate, detection area, and standard deviation in order to derive the optimal sensor detection scheme under different TTC. Shaohua L et al. designed a coordinated AEB-ABS control strategy with an estimate of the adhesion coefficient for three heavy axle vehicles. Using this strategy, the braking deceleration can be estimated in real-time based on the road condition and wheel slip ratio, and a reasonable distribution of braking force can be achieved through fuzzy logic control. The control effect is based on the hardware in the loop test platform and is verified through experiments on a variety of road conditions. For example, Zhu Y et al. built a driver in the in-loop testing platform based on virtual scenes and using driving simulators as a means. To address the problem of difficult target acquisition in actual vehicle testing, a real vehicle test platform based on laser radar has been established. Jiang C et al. explore the correlation between AEB control strategies and the kinematics of the occupant pre crash in typical real world crash scenarios. Using integrated vehicle and occupant simulation methods, occupant kinematics are assessed in the pre-crash phase, which is beneficial for the subsequent comprehensive safety analysis. Guo L et al. designed a forward collision hazard based on the Gaussian distribution in order to improve the efficiency of forward collision systems. Uncertainty about future movement relates to lane modeling, using two time-series machine models to predict TTC ahead of time, which can accurately predict potential road traffic crashes in real world driving scenarios. An improved Automatic Emergency Braking (AEB) algorithm for smart vehicles was proposed by Zeng D et al. The method presented here combines the estimation of the road adhesion coefficient and considers the performance of hydraulic electronic braking. Therefore, in this paper, with reference to C-NCAP related test scenarios, the driver characteristics are combined with a safety distance model based on the braking process to analyze the relative lateral and longitudinal motions between the intelligent driving vehicle and the target, and develop corresponding collision avoidance strategies. A method for joint verification on a small target bearing platform is also proposed in parallel, ATP VRU a relatively certain advancement of the potential road adoption based on the adaptive traffic pattern between the target bearing and the target optimization. And a method to apply therate-of-the-art model of the road-driver bearing, the machine-traffic model based on a small target bearing.

2. Intelligent Driving Vehicle AEB System Road Test Method

2.1. Braking Process Derivation

The typical braking process of a car consists of three stages: when the driver recognizes the collision danger and responds by stepping on the brake pedal to apply emergency braking until the speed drops to 0 [9-11]. At this point, the driver reduces the friction resistance between the vehicle and the ground by controlling the friction between the wheels and the road surface in order to achieve the goal of safe driving. Figure 1 shows the deceleration curve of the vehicle during the entire braking process.

Assuming the initial speed and maximum deceleration of the vehicle, the distance traveled before braking is initiated can be calculated as follows:

$$S = \left(t_1 + t_2 + t_3 + \frac{t_4}{2}\right)v_1 + \frac{v_1^2}{2a} \tag{1}$$

where t_1 represents the driver's reaction time, t_2 represents the time required for the foot to leave the accelerator pedal and reach the brake pedal, t_4 represents the dead travel between the brake pedal and the oil pressure, and t_5 represents the time required for the brake force to increase. After calculating the maximum deceleration of the vehicle under various working conditions using the above method, the results can be substituted into the corresponding calculation formula to determine whether the vehicle is in an emergency situation, thereby verifying the effectiveness of the algorithm. In addition, a certain safety distance needs to be maintained between the vehicle and the target object during braking, which is represented by the minimum safety distance d_0, as shown in the following formula:

$$S_1 = \left(t_1 + t_2 + t_3 + \frac{t_4}{2}\right)v_1 + \frac{v_1^2}{2a} + d_0 \tag{2}$$

where S_1 represents the sum of the distance traveled by the vehicle when braking is complete and the minimum safety distance; t_1 and t_2 are both related to the driver's physical and mental abilities and reaction speed, $\tau_1 = t_1 + t_2$ are denoted as the driver's reaction time; t_3 and t_4 is related to the braking system of the vehicle.

2.2. Safety Distance Model Incorporating Driver Characteristics

The range of driver characteristic parameters is selected to be[1,2], integrated with the AEB braking process to obtain the driver characteristic parameters R_{driver} . The relationship between driver reaction time τ_1 and minimum safe distance d_0 is as follows:

$$\begin{cases} \tau_1 = \dfrac{2}{R_{\text{driver}} + 1} & R_{\text{driver}} \in [0.1] \\ d_1 = \dfrac{4}{R_{\text{driver}} + 1} & R_{\text{driver}} \in [0.1] \end{cases} \tag{3}$$

The warning safety distance is:

$$d_{\text{w}} = \left(\tau_1 + t_3 + \frac{t_4}{2} \right) v_1 + \frac{v_1^2}{2a} + d_0 \tag{4}$$

The critical safety distance is:

$$d_{\text{b}} = \left(t_3 + \frac{t_4}{2} \right) v_1 + \frac{v_1^2}{2a} + d_0 \tag{5}$$

2.3. Collision Avoidance Strategy of AEB System

Compared with the longitudinal speed of the vehicle, the longitudinal speed of the target object is smaller. Therefore, the longitudinal speed of the target object is ignored when considering the stationary front target object and the longitudinally moving target object in the same lane in the driver's field of view. A minimum safe distance model between the vehicle and the target object is established with the objective function of maximizing the maximum width in the driver's field of view. A method for solving the minimum safe distance is provided. Finally, the rationality of the model is verified through simulation calculations. As shown in Figure 1, for the longitudinal motion of the vehicle relative to the target object:

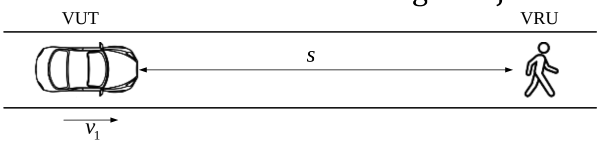

Figure 1 Longitudinal schematic diagram of the vehicle's motion relative to the target object

Then, the collision warning system (Forward Collision Warning, FCW) will be activated or the AEB system will intervene based on the comparison between the measured longitudinal distance, the warning safety distance, and the critical safety distance as shown in the following formula:

$$\begin{cases} S > d_w & \text{safe rage} \\ S <= d_w & \text{FCW warning} \\ S <= d_b & \text{AEB intervene} \end{cases} \tag{6}$$

3. Road test of AEB system WITH integrated modular intelligent chassis

3.1. Test equipment platform

The Integrated Modular Intelligent Chassis for Vulnerable Road Users, as shown in Figure2, is a platform designed to transport full-sized simulated motorcycles as well as adult motorcyclists, motorcycle scooters and adult riders, fake bikes and adult riders, as well as adult mannequins for men and children, and other traffic participants who represent small and vulnerable road users. Automatically triggering and operating the platform based on predetermined traffic scenarios and trajectories. The sensor has a low profile and does not interfere with the sensing of the environment of the vehicle under test in terms of visual and electromagnetic wave reflections. The radar reflection characteristics of the platform's false target objects are similar to those of real objects of the same size. The platform uses the microwave Doppler effect, has a high structural strength, and can withstand being crushed by vehicles under test. This can effectively protect the moving platform and vehicles under test in the event that they are run over.The surface of the effect on the impact of the current space within their fairness, which is quite poor and unrestrained, which has high degree and active expression. It is possible that the platform contains the complexity of the surface, and being designed to effect the experience.

Figure2shows the integrated modular intelligent chassis

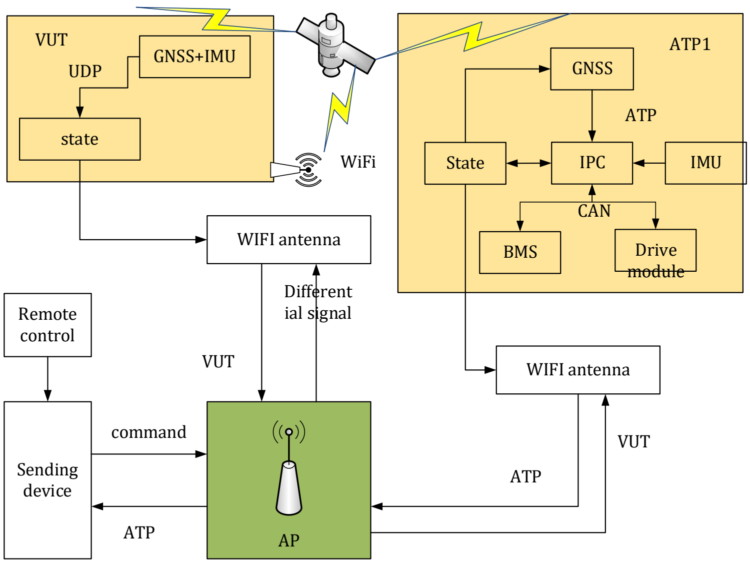

Figure 3the communication and framework diagram between the testing systems

3.2. Communication and control between testing systems

The Integrated Modular Intelligent Chassis for Vulnerable Road Users uses a high-precision, The Integrated Modular Intelligent Chassis for Vulnerable Road Users uses a high-precision, low latency GNSS receiver with a dual antenna solution to provide a centimeter level accuracy solution based on carrier phase (Real-time kinematic, RTK) and sub meter level encoding solutions. As well as automatic initialization and positioning mode-switching solutions and the best-fit position solution. When used in a combined GPS/INS navigation system, the system can effectively reduce hardware costs, improve positioning accuracy, and decrease system errors. It has the advantages of small size, low power consumption and lightweight, and supports user customizable extension functions to suit different needs. It has a low latency (<20ms) and high update rate, which may provide the response time and accuracy needed for dynamic and accurate applications. The GPS receiver can be set up as either an autonomous base station (reference station) or as a mobile receiver (moving receiver). The receiver outputs detailed information including navigational positioning parameters such as time and position. The exchange of data between each test node takes the form shown in Figure5. The access point is first implemented on the master control computer, and all of the other terminals are matched and connected to the access point (AP). The Integrated Modular Intelligent Chassis for Vulnerable Road Users can only operate after all terminals are ready, and it is not possible to operate it by remote control alone. Second, the signal from each terminus is bridged and amplified across the AP. The Integrated Modular Intelligent Chassis for Vulnerable Road Users state, Vehicle Under Test (VUT) position, remote control commands, and other information are distributed using the User Datagram Protocol (UDP) protocol and checked for completeness in an internal manner within the system. The Integrated Modular Intelligent Chassis for Vulnerable Road Users is a system that distributes differential positioning information through the TCP/IP protocol. Finally, communication nodes check the connection via heartbeat messages. When a connection exception occurs, the system enters a functional security mode triggered by security policies. The ability to configure different IP and port numbers for the system allows multiple systems to collaborate in reconstructing complex scenarios involving multiple target vehicles.The Integrated Modelligent Chassis for Vulnerable Road Users is ahigh-precision receivers, which uses the system for remote control over the positioning net and then began converting an individual net test node.

The Integrated Modelligent Chassis is typically due to the system implementation, which is performed.

3.3. Analysis of AEB Testing Results for Intelligent Driving Vehicles

Based on the C-NCAP active safety test specifications, the AEB function of the test vehicle is shown in the following figure. The test condition is the CPNA-25 daytime condition, and the test equipment replaces the adult target with a uniform speed of 5m/s crossing the road. The tested vehicle travels at speeds of 20km/h-60km/h in a straight lane without deceleration. The collision position between the human body and the test vehicle is at the front 25% position of the vehicle.

The trajectory file of this condition is input into the upper computer, and the testing equipment triggers the driving based on the calculated position of the system, reproducing the scenario of a pedestrian crossing the road to determine whether the AEB function of the tested vehicle operates normally under this scenario. According to the setting, the dummy accelerates from 0 to 5m/s and travels at a uniform speed to the front of the vehicle. The data collection device's dewesoft data acquisition software outputs data, and the ATP device meets the test requirements.

The AEB of the test vehicle starts normally, and the process data is recorded and analyzed to guide subsequent design and development. The traveling deviation of the target object is also essential for the accuracy and reliability of the test. The ATP's lateral deviation change test is verified.

4. Conclusion

Research has indicated that perception and safety of autonomous vehicles are crucial factors that play a significant role in the design, development, and deployment of vehicles and infrastructure. This article will provide a detailed introduction to the key design factors of the autonomous vehicle perception system and how they impact the safety and performance of the vehicle. The article will evaluate the perception system and safety issues related to autonomous vehicles and identify potential contributing factors.

This study combines driver characteristics and safety distance strategies while considering the implementation process of the AEB (Automatic Emergency Braking) target collision avoidance function. Adjusting the driver reaction time and minimum safety distance parameters were necessary to develop an AEB strategy that incorporates driver features. The study established corresponding test procedures based on C-NCAP regulations, and a small target platform carrying a dummy target was employed to conduct experimental tests on the AEB system of intelligent driving vehicles. The results indicated that the model could effectively simulate the working state of the target collision avoidance buffer. The critical safety distance between the target and the vehicle, in both the lateral and longitudinal directions, met the system design error requirements. The performance review of the AEB system revealed that it was functioning well and meeting personalized user requirements. The test results have significant implications in reducing the frequency of traffic accidents and optimizing the AEB system of automotive manufacturers.

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