Research on Integrated Control Strategy of Automobile Chassis Based on Active Safety

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Abstract: With the advancement of electronic technology, sensor technology and vehicle network technology, the electronic control system of automobile chassis represented by electronic stability control has been developed at a high speed, and the loading rate is also increasing, whether it is for the driving safety of the car or Ride comfort has been significantly improved. At present, most of these chassis electronic control systems are designed and developed by individual component manufacturers to improve a certain performance index, without considering the mutual influence and coupling with other electronic control systems. They are simply superimposed and not fully reflected. To achieve their respective performance, it will reduce the overall performance of the vehicle, so integrated control has become the future development direction of automotive active safety technology. Chassis integrated control can fully consider the mutual influence and coupling between the various subsystems, optimize the control objectives or control actions in hardware or software, fundamentally resolve the conflicts between the various subsystems, and achieve the best overall vehicle performance. excellent.

1. Introduction

There are different classification standards in the technical aspects of improving vehicle safety, one of which is active safety and passive safety. Passive safety refers to a technology and measure to protect the occupants of the car after an accident, while active safety is a technology and measure to prevent car accidents. Therefore, active safety is preventive, compared with passive safety It is more meaningful and important, and the research on active safety is therefore more important. The active safety system of automobile chassis has gradually developed under the promotion of electronic, sensor, network and other technologies, and has formed three major types of systems: longitudinal control, lateral control and vertical control. Driven by technology, the loading rate of automobile chassis control systems is increasing day by day, and the technical improvements in various performances are also being researched and applied, but the overall performance improvement is not obvious, and sometimes it is even affected by the coupling between technologies. The impact of the role cannot play a more effective role in the overall security. Therefore, in order to control the conflicts between the technologies in the integrated system, the coupling role is rationally used, so that the functions in the system are more effectively strengthened, and it is oriented toward active safety. The integrated control of automobile chassis also needs to conduct strategic scientific research to make scientific guidance for improving the overall safety performance.

2. The Need for Integrated Chassis Control

At present, with people’s pursuit of perfect car performance, the loading rate of chassis control systems is getting higher and higher. Both the driving safety and ride comfort of the car have been significantly improved, but these electronic control systems are mostly focused on improving A certain performance index is independently designed and developed by each component manufacturer without considering the interaction and coupling with other electronic control systems. For example, the vertical control represented by ASS improves the car's performance by changing the vertical force of the tires. Ride comfort and handling stability. The lateral control represented by

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AFS improves the handling and stability of the car by changing the lateral force of the tire. The longitudinal control represented by ESC improves the car's handling by changing the longitudinal force of the tire. Handling stability and driving safety, according to the tire friction circle theory, the change of vertical force will affect the control potential of lateral force and longitudinal force, and the change of lateral force and longitudinal force will also affect each other's control. Therefore, the simple superposition of these electronic control systems cannot fully reflect their respective performances, but will reduce the overall performance of the vehicle.

The conflicts between control systems can be divided into the following three categories: 1) Different control systems have different control goals. For example, ASS mainly improves car ride comfort and comfort, while ESC mainly improves car handling stability and driving safety. When the two are integrated, there will be conflicts due to different control objectives; 2) Different control systems have the same control objectives, such as AFS, ARS and ESC, which can improve the handling stability and driving safety of the car. Conflicts will occur; 3) Different control systems have the same actuator, such as ABS, TCS and ESP will all control the brake, and the conflict between them also needs to be considered. Therefore, how to avoid conflicts between control systems and make reasonable use of the coupling relationship between tire forces, so as to give full play to the advantages of each system and achieve the optimal overall performance of the vehicle, has become an urgent need to solve in the field of automotive chassis control today. One of the key issues.

Integrated Chassis Control (ICC) is an effective means to solve the above problems. The current definition is not very clear. First of all, two or more chassis control subsystems need to be integrated and controlled. This integration is not multiple sub-systems. Simple combination or superposition between systems, but needs to fully consider the impact and coupling between the various subsystems, optimize the control objectives or control actions in hardware or software, fundamentally solve the conflicts between the subsystems, and realize the whole vehicle the best overall performance. The advantages of integrated control of automobile chassis are summarized as follows: 1) Eliminate conflicts between systems. For example, 4WS can change the lateral movement of the car, and ESC can also change the lateral movement of the car. Realize that the two systems each act in the same direction with an appropriate amplitude to eliminate possible conflicts; 2) Improve the overall performance of the car, such as the integrated control of ABS and 4WS can make full use of the road adhesion coefficient, shorten the braking distance, and can Ensure vehicle handling and stability; 3) Realize information sharing and reduce costs. Many control systems require the same sensor signals. Signal sharing can be achieved through integration and the number of sensors can be reduced; 4) The complexity of the system is reduced. The continuous increase in the number of control systems has greatly increased the number of controllers, sensors and actuators, resulting in complex electronic circuits, chaotic layouts, increased costs, and difficulties in overhaul and maintenance. Integrated control can integrate existing systems from the perspective of system engineering. The controller simplifies the system structure and greatly reduces the complexity of the system. As the future development direction of automobile active safety system, the integrated control of automobile chassis has just started domestic research. my country must closely follow the development trend of automobile technology in order to improve its ability to compete with developed countries, so as to realize the transformation from a major automobile country to a powerful automobile country at an early date.

3. Integrated Control Strategy of Automobile Chassis

In the vehicle chassis integrated control strategy, the integration of braking and steering occupies a very important position, and the integration of braking and steering has become an important technology. At present, the most common and effective way is the application of optimal control technology. The realization of this control method requires an accurate control model. The problem in practice is that the car is a complex nonlinear system. In automotive engineering, the model needs to be simplified as much as possible, which makes the accurate model impossible to guarantee. The effect is naturally not guaranteed. After the car is put into use, it is always in

dynamic operation in the running state, the driving environment, the parameters of the car itself, etc. are all changing, sometimes even difficult to grasp, the so-called optimal control cannot always maintain the optimal. In this regard, the author believes that the model predictive control (MPC) method can be used to design an integrated controller based on MPC to realize the integration of the ESC system and the AFS system. Model predictive control can overcome the influence of model errors and uncertain environmental interference, and has good online real-time performance. At present, this technical method has good applications in power, chemical, energy and other fields. One of the key technologies to be developed and promoted in the future.

In addition to the integrated control of braking and steering, active suspension control must be integrated to form an integrated vehicle chassis integrated control system. Because the aforementioned integrated braking and steering control is mainly a force that directly changes the stability of the car's handling by influencing the longitudinal force and the lateral force; the suspension control is to affect the vertical load of the wheels. A working mechanism of longitudinal force and lateral force is also a force to ensure the stability of car handling. Suspension control adjusts the vertical load of the wheel often when the longitudinal force and lateral force reach the adhesion limit. Changing the equivalent lateral stiffness of the front and rear axles is also effective at large lateral acceleration. Therefore, when the suspension control exerts its power, the car All work in the nonlinear region. The author believes that the integrated control of braking, steering and suspension with optimal distribution algorithm can be realized by designing integrated sliding mode variable structure control and tire force. Sliding Mode Variable Structure Control (SMVSC) is a nonlinear control algorithm that can overcome system parameter changes and external disturbances. It has strong robustness and is very suitable for complex systems such as automobiles. Kinetic control.

The above research on the integrated control strategy of automobile chassis is an exploration through practice summary and technical research. Whether this strategy is effective still needs to organize scientific test experiments and research to verify, but the test of such technology is often High-standard conditions are required. Here the author only introduces the construction of a test platform for the integrated control of braking and steering and suspension control: First, based on the Matlab/xPC Target technology to design and develop a hardware-in-the-loop test bed for integrated control of the automobile chassis. Including driving simulation system, real-time simulation system and ESC hydraulic braking system, it meets the needs of carrying out driver-in-the-loop braking, steering and suspension integrated control test; second, the network around the integrated control hardware-in-the-loop test bed Topological structure; third, in combination with ISO standards, select the driver's emergency double-shift working condition in the loop, and perform hardware-in-the-loop test verification on the integrated control algorithm of braking, steering and suspension. Carrying out the test of the integrated control strategy of the automobile chassis on the platform built above, the result shows that the stability control effect of the automobile is obviously improved, and the research and application of the above strategy has scientific value and significance.

4. Conclusion

With the continuous innovation and development of modern technology and the improvement of people’s living standards, automobiles have gradually moved to tens of thousands of households. As modern vehicles bring convenience and enjoyment to people, they also have safety accidents at all times. Security issues are important issues for everyone. At present, the electronic control system of automobile chassis is constantly developing, and the safety and comfort of driving are improved. However, this development is more or less a single development mode in a certain performance, and the unity of the entire system has not been considered and Improvements, and sometimes even the addition of simple technologies, can cause overall performance degradation. In response to this problem, the author mainly discusses the active safety-oriented integrated control strategy of automobile chassis, and proposes an overall strategy framework, aiming to provide overall development ideas for the improvement of automobile safety performance through the research of

this article, and promote driving Security is improved.

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