Research on Efficiency Analysis of Automotive Electrical Mechanical Brake

Kai Liu[1, a, *], Jiani Song[1, b]
[1]*Jilin Technology College of Electronic Information, Jilin 132021, China*

Keywords: Automobile; Electromechanical brake; Efficiency.

Abstract: With the continuous development of science and information technology and the continuous development and improvement of the national economy, remarkable technological progress has been made in the technological development and application of electronic machinery and hydraulic brakes in the automotive industry. To greatly improve the quality and efficiency of automotive electronic machinery and hydraulic braking, strengthen the research and analysis of automotive electronic machinery and hydraulic braking, it would be helpful to establish the mathematical model of automobile electronic machinery and hydraulic braking system and the theoretical model of mechanical dynamics system. The effectiveness of mechanical hydraulic braking is better than that of traditional automobile hydraulic mechanical braking, which provides a solid basis for promoting the study of the effectiveness of electronic machinery and hydraulic braking and the development of their application in the modern automobile industry. its effectiveness is analyzed experimentally in this paper.

1 INTRODUCTION

With the rapid progress and development of the automobile electronic braking industry, the technology of vehicle electronic mechanical braking is also rising. The electro-mechanical braking technology for vehicles is an important technical prerequisite for consumers to ensure vehicle driving and traffic safety. The driving safety performance of automobiles also makes automobile consumers have higher and higher technical requirements for automobile electro-mechanical brake anti-skid systems. The exquisite braking system for the performance of automotive electro-mechanical braking, the technology of the automotive industry is no longer limited to the traditional hydraulic electromechanical brake. Therefore, professionals have made many developments in advanced automotive electro-mechanical braking technology as well as electromechanical and hydraulic brakes. With this more efficient technology, electronic machinery and hydraulic brakes can better meet the requirements of automobile consumers for driving and driving safety, and make the automobile development technology get better development and progress. The performance of vehicle electromechanical brake has always been an important technical key to vehicle driving safety, and people have been paying great attention to the maintenance and improvement of the anti-skid performance of automobile electromechanical brake. (He Ren, Hu Qingxun, 2005)

Automotive electronic machinery and hydraulic braking to better meet the requirements of this technology, so that the development of vehicle braking technology is more rapid. In the 1990s, some large international manufacturers and automobile manufacturers of auto parts in Europe and America began to study the EMB system, among which Bosch, Siemens, and Tevez in mainland Germany conducted in-depth research on the EMB system. Tevez in mainland Germany and Darmstadt University of Technology in Germany cooperated to discuss the EMB braking model and control system model, and the key technologies of the EMB system were studied in many universities in China.

Liu, K. and Song, J.
Research on Efficiency Analysis of Automotive Electrical Mechanical Brake.
DOI: 10.5220/0010020500420045
In *Proceedings of the International Symposium on Frontiers of Intelligent Transport System (FITS 2020)*, pages 42-45
ISBN: 978-989-758-465-7

2 BRIEF INTRODUCTION OF AUTOMOBILE ELECTRO-MECHANICAL BRAKE

When the vehicle is driving, the signal is transmitted to the central control unit of the engine in real-time through the current and displacement angular velocity sensor in the electric brake pedal sensor. Through the analysis of the schematic diagram of the optimal braking force of the vehicle driver by the central control, the pedal displacement information can be analyzed, the optimal braking force for the target vehicle can be calculated, and a control signal is sent to the four simulators and EMB drivers respectively. After the EMB brake regulator receives the signal about the brake motor, the control signal is transmitted to the engine. In order to automatically control the current and angular speed of the engine according to the signals and instructions sent by the driver to the engine. At the same time, according to the actual situation of driving vehicles, roads, braking equipment and systems, the brake simulator in the electronic brake pedal sensor sends back\ "road sense\" to the vehicle driver in the following ways. The sensor collects feedback information about the current and speed of the brake motor and the clamping force of the brake motor and sends it to four EMB brake regulators to control the operation of the whole engine. The process consists of a three-layer closed control circuit and a simulator to ensure the best braking speed and performance. (Xiong Jian, Hu Yongping, 1995)

3 VEHICLE DYNAMIC ANALYSIS MODEL

3.1 Carries on the Force Analysis to the State of Vehicle Braking

When the electro-mechanical brake on the automobile road is working on the road, the force analysis of vehicle braking has always been a focus of design and discussion in the theoretical model of automobile electro-mechanical dynamics. When designing and analyzing the braking force, it is assumed that when driving at high speed on a horizontal road, the main factors such as rolling resistance, air resistance, tire deformation, and vehicle suspension are ignored, and the consequences are likely to be unimaginable. The force analysis of the influence of direct high-speed driving on the performance of the vehicle is carried out, including the main contents of force analysis, including the control of the quality of the vehicle, the braking force of the front and rear of the vehicle, the prevention of vehicle skidding and the increase of speed. the wheelbase of the front wheel and the wheelbase of the rear wheel. Then through the analysis of the quality and force of the braking force, it can help to analyze the braking effect of the vehicle. (Peng Xiaoyan, et.al, 2010)

3.2 Tire Force Analysis Model

In the dynamic vehicle model, the analysis of the tire force model can effectively improve braking performance. This paper analyzes the tire force model in the EMB brake. When braking the vehicle, the tire characteristics have a more important impact on-road braking performance. The determination of the tire force model is mainly related to tire radius, vehicle braking torque, tire rotation angular velocity, and ground adhesion coefficient. A suitable mathematical model is used to analyze the braking force of the vehicle tire. The braking force of different tires is also different, and the results of force analysis of the same car may also be different, which needs to be analyzed many times to get accurate results.

3.3 Adhesion Coefficient

Wheel adhesion coefficient braking and shape coefficient ground adhesion and shape coefficient also play an important role in the complete breaking of the vehicle. When the whole tire of the vehicle is in the state of semi-complete rotation or semi-rolling, the adhesion and shape coefficient of the ground should be a value that can directly reach the maximum, that is, the stability of the lateral braking force of the vehicle is the maximum. at this time, the lateral stability of the tire is good. At this time, if the wheel is completely braking and locked without rotation or rolling, the tire will be completely attached to the whole ground, the lateral stability is almost zero, and it is easy to slip and swing the tail of the vehicle, which is easy to cause traffic accidents. The calculation and determination of vehicle adhesion and shape coefficient on expressways are of great significance and influence for the establishment and introduction of vehicle dynamic model. The brake adhesion and shape coefficient of the whole vehicle tire is mainly affected by the ratio of speed and brake slip coefficient. The accuracy of the mathematical model of the system can be determined by the calculation of the maximum wheel adhesion

coefficient, the vehicle speed, the wheel brake slip coefficient ratio, and the minimum wheel shape slip coefficient. Also, according to the brake slip coefficient ratio of different speed wheels, the adhesion and shape coefficient of the road surface is also adjusted, and the braking and road surface adhesion coefficients under different dynamic parameters are obtained.

3.4 Model of EMB Braking System

The electromechanical control connection between the automobile brake hydraulic pedal and the electronic hydraulic brake control device is disconnected through the automobile brake application line, and the control instructions of the brake pedal are directly transmitted to the applied wire harness on the electronic hydraulic brake pedal through the radio signal. At present, the automobile hydraulic braking device can be divided into two hydraulic braking systems: the new electronic hydraulic braking system (EHB) and the new electro-mechanical hydraulic braking system (EMB). The new type of electronic hydraulic brake (EHB) system is an advanced technical product specially used for electro-mechanical hydraulic brake (EMB). It is further developed on the basis of inheriting the existing traditional hydraulic electronically controlled braking system, and the traditional hydraulic electronically controlled braking system has also been slightly improved and improved. At present, it has been widely used in the international market. However, the EHB braking system has many inherent defects such as too many electronic hydraulic braking lines, complex arrangement, and installation, complex abs hydraulic electronically controlled braking system, difficult production and maintenance, and high cost. The hydraulic braking system can not adapt to the development of the automobile. With the development of torque drive technology and electronic control technology, EMB will become the main market of the automobile braking system. (Li Dinggen, et.al, 2012)

3.5 Motor Model

When studying the braking performance of the automobile, selecting the appropriate engine model can make the automobile output stable electric power. In the EMB braking model, the armature current under the model can be obtained by determining the mathematical model of armature feedback EMF, engine induced EMF, and armature loop inductance. Also, according to the EMB braking model, the simulation device of engine output torque can be determined by adding factors such as armature loop inductance to simulate engine output torque.

3.6 Planetary Gear

The planetary reducer is the most important part of the EMB braking model. The most important purpose of the reducer is to reduce the speed and increase the induced torque of the transmission to meet the requirements of the vehicle braking state, including the planetary deceleration model of the reducer, which includes the relationship between the input torque and output torque. the output torque of the planet can be obtained by determining the mathematical relationship between the input torque of the solar gear and the rotation efficiency of the planetary gear.

3.7 Model of Ball Screw Pair

In the EMB braking model, the main function of the double ball screw model is to change the direction of motion. In the screw group, the rotation input of the planetary device is converted into screw translation and then transferred to the brake block; in the twin-screw model, the rotation torque of the ball screw is read from the outlet torque of the planetary frame, and then the third rotation torque of the torque is transmitted by reading the ball screw pair. Also by expressing friction, momentum, and other system relationships. (Peng Xiaoyan, 2013)

4 SIMULATION OF VEHICLE BRAKING PERFORMANCE

4.1 Parking Braking Control Algorithm

The parking brake control algorithm of the system is mainly applied to collect the switch activation signal for parking brake sent by the system, the displacement switch activation signal of the brake pedal, and the displacement signal of the parking brake pedal. As the basic basis and condition for judging and evaluating the state of parking and exiting parking braking, the braking of parking and parking is completed. That is, according to the response of the manual parking button to the signal of the parking switch, the state of parking and parking exit, an important result of judgment is that the system has completed the actual parking braking

control algorithm. such as manual parking, automatic parking, and auxiliary control. (Song Jian, et.al, 2006)

4.2 Simulation Model of the Electro-mechanical Braking System

When studying the performance of the compact automobile electromechanical braking system, the electronic simulation braking model of the compact electronic simulation braking system is established. The EMB electronic simulation braking model system is simulated by using smurf and other electronic simulation software, and the relevant electronic simulation braking data of the braking system are obtained. Compared with other traditional hydraulic electronic simulation braking system models, the simulation performance of this simulation braking model is better to obtain the authenticity of effective braking data, which shows that the simulated braking model of electromechanical simulation braking system can have better simulation effect of the electronic braking system.

5 CONCLUSION

In the process of the continuous and rapid development of our society and economy, people and consumers have an increasing understanding and demand for and improving the driving safety of cars. To continuously improve the performance of braking, in the design and analysis of the efficiency of automobile hydraulic and electronic braking systems, the performance and efficiency of the automobile electronic braking system are simulated and simulated. to better realize the comparison of braking and hydraulic performance between automobile electro-mechanical hydraulic brake and traditional electro-mechanical hydraulic brake, we can know through the comparative analysis of braking and hydraulic performance. The duration of hydraulic braking of electro-mechanical braking is shorter than that of traditional hydraulic braking so that better electronic braking performance can be obtained in the driving of electric vehicles.

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