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Analysis of anti-slip control system and dynamic performance of mechanical engineering drive based on improved social engineering algorithm

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Abstract

INTRODUCTION: The field of mechanical engineering technology is an emerging technology field with many research directions, and there are many directions of intersection with other disciplines, among which the field of mechanical engineering has outstanding research advantages. With the continuous development of mechanical engineering technology, the research direction of mechanical engineering applied to the field of mechanical engineering is also continuously enriched and developed. Mechanical engineering research focuses on realizing the monitoring and control of the dynamic performance of mechanical systems, as well as realizing the integration of design and system control.
OBJECTIVES: In order to improve the disassembly efficiency, reduce the disassembly cost and disassembly energy consumption, it is optimized using social engineering methods to achieve better results and reduce the disassembly cost and energy consumption.
METHODS: Aiming at the drive and anti-skid control strategy of four-wheel hub motor, it was simulated using improved social engineering algorithms, and based on this, three road recognition algorithms were selected for low, medium, and high adhesion road verification.
RESULTS: Through the study of automobile anti-skid control system, the basic structure of automobile anti-skid control system is summarized and some solution measures are proposed. A new type of drive anti-skid control system is proposed for the problems of high vibration and noise of automobile brake. The drive anti-slip control system is characterized by simple structure, easy maintenance, simple control and reliable operation, and high operation efficiency.
CONCLUSION: This study shows that the system not only has excellent drive anti-slip effect, but also has good control performance. In addition, this drive anti-slip system is able to ensure the safe and reliable operation of mechanical brakes in various harsh environments. This new drive anti-slip control system is a new type of drive device that can be widely used for driving force on various mechanical brakes and drive wheels, and the study of this device is of great significance.

Keywords: disassembly line equalization, social engineering algorithm, green design, green production.

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1. Introduction

The anti-skid system is a dynamic mechanical system with high self-healing property, which can realize the control of the anti-skid process according to the response to external factors such as load, direction and speed. For the control

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process of anti-slip system, it can be divided into three steps: motion prediction, pressure distribution. Among them, pressure prediction is to use the relationship between pressure distribution and driving force to calculate the friction and slip rate in the anti-skid process and then realize the control of driving force. The pressure distribution of the anti-skid control process can be used to represent the distance between pressure distribution and sliding direction; pressure distribution can be used to represent the relationship between driving force to slip rate. The pressure distribution can be used to indicate whether the drive system of the drive reaches the set anti-slip state; the pressure distribution can be used to indicate the correctness and stability of the drive working to the maximum slip rate and the position of the motion trajectory. The pressure distribution can employ one or more piezoelectric sensors and one or more inductors to provide pressure measurement and feedback on the load. The pressure transducer is used to collect information about the load state and perform signal analysis and processing; the displacement transducer is mainly used to monitor the distance from the load to each actuator and the connection between the displacement transducers.

First: The overall structure and body stability of the four-wheel hub motor electric vehicle is studied, and the drive system, the main functions of the control system, and the stability control requirements for the vehicle are thoroughly investigated.

Second: The speed control model of the four-wheel hub electric vehicle was studied. Based on this, the speed control of the four-wheel hub electric motor was studied using simulation platforms such as Cassim and Matlab/Simulink.

Third: A road recognition-based driving and anti-skid control scheme for an electric vehicle based on a four-wheel hub motor is designed. A road identification method based on active prediction is proposed for the optimal wheel slip rate under different road conditions. Secondly, this paper proposes an anti-skid control scheme for a four-wheel hub motor electric vehicle based on road identification to maximize the road adhesion and improve the smoothness and safety of the vehicle based on the sliding problem of the four-wheel hub motor on low viscous road surfaces.

The speed control strategy and the pavement discrimination method were simulated in three cases: single pavement, docked pavement, and docked pavement, and the effectiveness of the method was verified by simulation. As a result, the method can effectively improve the driving safety performance of the car. The performance is better. In addition, it improves the power utilization of the vehicle drivetrain, reduces the energy consumption in delivering power, and lowers fuel consumption. In an automotive drivetrain, the more gears in the transmission, the closer the engine's operating curve will be, resulting in higher fuel utilization. For mechanical drivetrains, increasing the number of gears can increase their efficiency under economic conditions, thus improving the economy of the vehicle.

2. Research Background

In recent years, China's automobile industry has developed rapidly and the number of cars has been increasing. According to the China Federation of Automobile Industry, there were 776,290,000 units in 2009 and 155 million units have been accumulated by the end of 2014. Overall, China's auto industry has been developing rapidly and the number of small cars is also increasing rapidly.

However, today, with the rapid development of our automotive industry, our country is facing increasingly serious environmental problems, as well as energy conservation and emission reduction. Electric vehicles are an effective environmental protection measure that is attracting increasing attention.

Compared to conventional engine vehicles, electric vehicles offer significant control advantages in terms of high energy efficiency and environmental friendliness. Conventional vehicles typically respond to torque in the range of 100-500 ms because the engine is engine-powered and has mechanical devices such as clutches. Electric vehicles, on the other hand, use electric motors, which produce torque usually in a few microseconds. Thus, the response time is faster compared to a normal engine engine. In addition, for electric vehicles, the current of the motor can be controlled to obtain the corresponding transmission torque and braking torque for active safety purposes. Motor torque is easy to determine. The power characteristics of a conventional engine motor make the output torque of the motor difficult to be measured. In an electric vehicle, the output torque of the motor is determined by the motor current. Therefore, using the motor speed and torque conditions, the driving torque and braking torque between the wheels and the ground can be estimated, laying the foundation for the implementation of control strategies for road recognition.

Separate drive unit. Electric motors in electric vehicles have their own unique advantages, such as: the small size of the wheel motor and the high power density, so that the motor can be integrated into the wheel, thus helping to create a separate transmission system. This greatly facilitates the implementation of anti-lock brakes, anti-skid driving, and electronic vehicle stabilizers (ESP). However, the large size and high cost of the engine makes it difficult to establish an autonomous transmission system in conventional vehicles. If the method of feedback or without sensor is used for motor control, it will bring more economy to the motion controller system where safety, reliability and accuracy are required. In order to control the whole control, it is generally achieved by state feedback control, traction control and adaptive control. Since the theory and simulation experiments of individual control methods are better, several control schemes are used jointly, for example, pulse control, intermittent control, adaptive control, etc..

3. Materials and methods

3.1. Status of development of four-wheel hub motor electric vehicles at home and abroad

Four-wheel hub motor is a new type of power electric vehicle, which eliminates the mechanical structure such as drive shaft, and assembles the wheel motor directly on the wheel hub, which facilitates the integration of the moving device and the body parts, and not only increases the structural arrangement of the vehicle bureau, but also reduces the loss and mechanical loss in the power process. In addition, the four-wheel hub motor technology integrates the power, transmission, and braking functions into the wheels, making its power characteristics significantly improved. For example, the torque response speed of an electric vehicle equipped with a hub motor is within time about seconds, while a conventional hair transmission machine vehicle is through for 300 ms. A combined arrangement of four-wheel hub motor electric vehicle speed control strategies is shown in Figure 1.

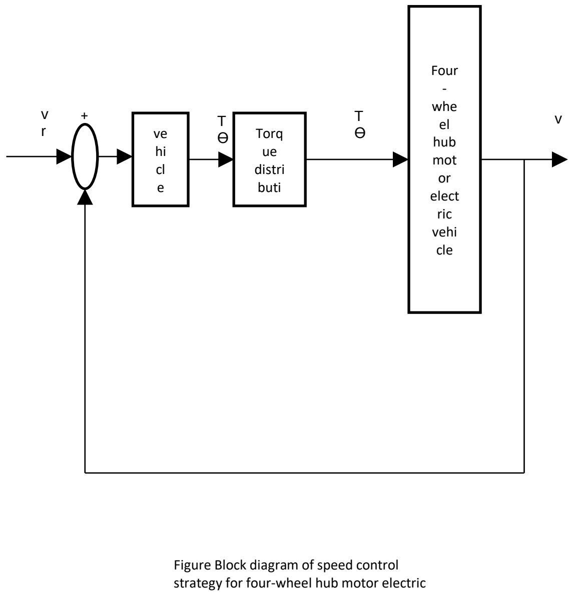


Figure 1. Block diagram of four-wheel hub motor electric vehicle speed control strategy

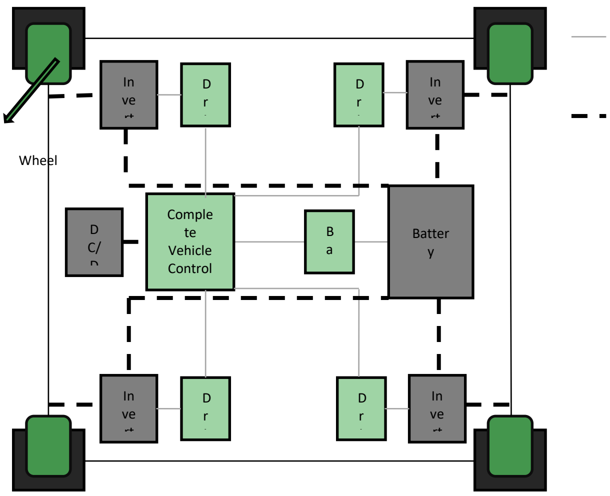
A four-wheel hub motor is a four-wheel independently driven four-wheel hub with a large wheel torque response. The traditional four-wheel drive wheel electric vehicle has better power and handling capability, so the four-wheel hub motor has attracted extensive attention from the transmissible electric vehicle industry for its unique structure and functional advantages. With the rapid development of the automotive industry, the performance and performance requirements of automotive controllers are also increasing. In addition, with the continuous development of electronic engine control systems, the time for calibration (adjustment) and development of various parameters is also increasing. Therefore, reasonable parameter matching of the dynamic characteristics of the whole vehicle as well as software modeling and simulation can greatly shorten the development cycle and reduce the research cost in the early stage of the development of electric vehicles. During the development of the electric control system, when the hardware structure and parameters of the system are basically determined, how to calibrate it to meet the engineering requirements and thus achieve the performance index of the system becomes the success or failure of the whole project. However, in many engineering problems, the dynamics model of the system is unknown, which makes many mathematical conditions difficult to achieve, and in order to analyze the performance of the system, the system identification must be carried out first.

3.2. Safety control techniques for four-wheel drive systems

Four-wheel hub motors have become a popular topic in the field of electric vehicles because of their many advantages in power, economy and active safety. Due to the development of four-wheel hub motor using four-wheel dynamic system, by the machine volume is large, high cost, making it difficult for regular vehicles to carry out four-wheel drive alone. In short, compared with conventional vehicles, four-wheel drive hub motor has more freedom and more controllability, making it easier to implement the present control. With the wheel motor technology and fuel cell-related technologies continue to four-wheel drive type electric vehicles will become dominant in the development of steam in the future.

In the same time of saving energy and reducing emissions, the driving safety of the car is also widely valued by people. The car in a certain vehicle due to a certain cause when the body of the car is unstable, safety issues, endangering the driver's life safety structure. For example, when a car is on a road such as snow or ice, the tires can slip, causing the car to become unstable and cause a rollover. Therefore, it is necessary to propose active safety management to people to ensure the stability of the vehicle in operation. Four-wheel hub motor four-wheel junction and conventional transmission has a fundamental not, four wheels are electric by the wheel horse hub movement, four wheel hub electric no mechanical coupling. Due to the various articles, the technology of conventional vehicles is only applicable to conventional transmission machine vehicles. For the characteristics of four-wheel hub motor electric vehicle knot, in order to improve stability and safety, to meet the driver's driving safety needs, based on improved social engineering algorithm of mechanical engineering drive anti-skid control system and dynamic performance analysis, need to carry out the corresponding a technology development for four-wheel hub motor .

In order to study the stability control of four-wheel hub motor electric vehicles in the driving process to meet the dynamic development direction of automotive power and electric vehicles. At present, the safety control technology of four-wheel dynamic system has become the core technical problem that urgently needs to be solved by four-wheel hub motor electric vehicles. This paper pin subject to road surface identification based on the four-wheel motor of the four electric motor driving anti-slip problem data acquisition analysis, as shown in Figure 2.



Four-wheel hub motor

Figure 2. Anti-slip control system data collection and analysis chart

3.3.Overview of the development of pavement identification technology

However, due to the constraints of the technical level, the existing vehicle operation and anti-skid control technologies do not adequately reflect the optimal slip rate of the wheels, wheel or body speed, angular acceleration and other performance indicators, so most of the automobile manufacturers set the predetermined slip rate as the optimal slip rate of the wheels when designing, and set it as the optimal slip rate of the wheels, so as to judge whether the slip rate of the wheels is in the slip rate stability zone or unstable zone. For the anti-slip control of a four-wheeled autonomous vehicle, the selection of its control strategy and algorithm is directly related to its performance, but many existing control means are not good enough to achieve real-time, real-time vehicle driving and anti-slip, so a real-time, reliable real-time monitoring device needs to be developed to determine the optimal wheel slip rate in real time according to real-time traffic conditions to improve the operational efficiency of the vehicle. As shown in Figure 3.

Figure 3. System functional module diagram

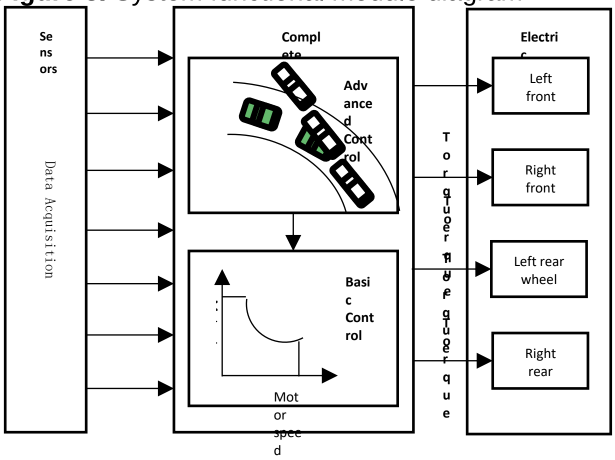


Figure Structure of the whole vehicle controller

3.4.Development of ASR pavement recognition system

The vehicle's road surface recognition technology is one of the key technologies to achieve safe vehicle operation safety. The classification and discrimination of vehicle operating conditions is a new road condition detection technology that has emerged in recent years, which mainly detects the noise and images on the road, and then uses various methods to analyze and process them in order to obtain the characteristics of road conditions. The problems faced by this method mainly focus on image recognition and classification, which traditional machine learning algorithms are often able to handle effectively. Among these algorithms, there are two common ones: experimental and image-based digital correction. The first type extracts a path from a straight line and then uses it to perform spatial similarity extraction. The second one uses a clustering algorithm to extract information about the road, which classifies the road by combining its geometric features with the similarity of the road surface. Both algorithms first perform preprocessing and feature extraction, then training and modeling, and finally classify and categorize the objects to be recognized. In terms of target detection, the use of convolutional neural nets for target detection allows accurate target location based on the features of the target by means of regression of edges, etc.

(1) is generally set up in front of the vehicle, which can predict road conditions in advance and in real time, facilitating adaptive vehicle adjustment and rapid response. Some scholars have adopted the method of laser irradiation to detect the adhesion state of the road surface and use light beams to detect the adhesion condition of the road surface with high sensitivity and good discriminative ability. In addition, the gray threshold points on the pavement are detected by using light sensors. According to the same theory, various methods such as ultrasonic, radar wave and

millimeter wave can be used to effectively detect the road adhesion coefficient.

When the constructed highway is similar to the built highway, the use of optical, acoustic, microwave and other sensing technologies to identify the pavement can achieve good recognition results, but if the distance between the pavement and the built highway is large, the desired recognition effect cannot be achieved. In addition, it has many drawbacks when analyzed from the point of view of current technological and social development. For example, the method requires a lot of additional equipment and is therefore very costly; secondly, after the installation of the sensor, many experiments are needed to obtain relevant data to provide a basis for future recognition, but the accuracy is not high and there are large deviations, and the recognition of roads that are not understood is difficult; in addition, the biggest drawback of this sensor is that it does not require the sensors required by the vehicle itself, such as wheel speed sensors, acceleration sensors, and therefore cannot achieve the integration of the control system of the vehicle itself, see the attached Figure 4.

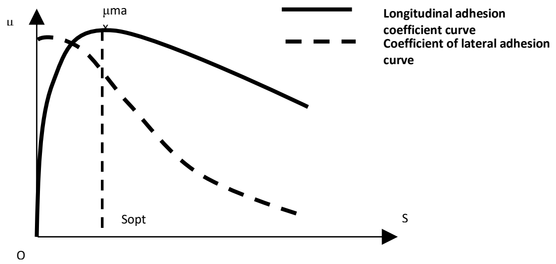


Figure 4. Coefficient of adhesion curve analysis diagram

In response to the above disadvantages, many scholars believe that the use of vehicle dynamic identification technology can reduce the complexity of the vehicle, reduce the cost of assembly and facilitate vehicle integration by using some sensors in the safety equipment of the vehicle itself.

(2) Use of vehicle dynamic characteristics to evaluate and forecast road conditions

Foreign researchers consider the dynamic characteristics of the vehicle as a method to evaluate and predict road conditions, called effect base. American Moore invented a road identification method based on ABS in 1994, mainly based on factors such as vehicle wheelbase and braking pressure of wheel cylinders, inputting the information into the ABS fuzzy control system, and then getting the current stickiness coefficient of the road according to the pre-set rules and algorithms. Gustav Sen Fredrik (Gustav) Sen Fredrik (Gustav), Sweden, and WookugHwang (WookugHwang), Korea, et al. obtained the correspondence between the tangential force on the road surface and the sliding rate of the axle by assuming a linear link between the tire load and the longitudinal driving power, which led to the wheel slip ratio and the adhesion factor between The theory of gradient variation. It was demonstrated that the scheme can achieve good results at large slip rates.

Researchers such as Yukio Yamada and Saburo Matsui at the University of Tokyo have observed the variation of adhesion and slip rate over the interval of all-wheel slip rate and evaluated the adhesion condition of the pavement. However, the results of the actual measurements showed that the bonding ability of asphalt concrete was tested when large slip ratios, i.e., large slips or slides, were produced.

3.5.Analysis of factors influencing the stability performance of the vehicle

When a four-wheel hub motor electric vehicle is driven on a low adhesion road and the accelerator pedal given by the driver is opened too much, it will cause the drive force output by the motor to be too high, and at this time, due to the low adhesion coefficient of the ground, the adhesion force provided by the road is less than the drive force of the wheels, resulting in the phenomenon that the wheel speed of the wheels rises sharply, and at the same time, the speed of the vehicle cannot keep up with the rising speed of the wheels, and the wheels slip. From the vehicle stability and safety considerations, when the wheel slip occurs, the vehicle driving process is prone to side deviation phenomenon, and in serious cases may even produce the vehicle rollover phenomenon, threatening the safety of the driver and passengers. In the actual vehicle driving process, due to the uncoordinated speed and deflection angle, it may lead to the vehicle in the process of driving due to overshoot and produce violent shaking, thus seriously affecting the safety and stability of the vehicle . When the car is designed to ensure the stability of the driving direction, the vehicle will generally move the center of gravity forward, but when the vehicle is overcrowded, the rear weight will increase and the center of gravity will move backward, thus affecting the stability of the vehicle; and when the vehicle is traveling faster, it is easy to skid or rollover when turning. As the higher the vehicle speed, the greater the braking distance, the greater the centrifugal force during steering, and the worse the handling stability .

Wheel slip rate is an important factor affecting vehicle stability, and the wheel slip rate is defined as shown in equation 1.

$$S=\frac{\omega r-\upsilon}{\omega r} \qquad (1)$$

Based on the mechanical engineering driven anti-skid control system with improved social engineering algorithm and dynamic performance analysis, the classification function can finally be obtained as shown in equation 2.

$$\sum m=1Mtm\cdot xmn\leqslant Tbn=1,2,\cdots N \qquad (2)$$

The drive axle is mainly composed of the drive axle, reduction axle, drive axle, etc. . The structure of the drive axle includes two main components: the drive axle and the drive rod. From the basic theory of vehicle transmission, the drive axle is used to drive the wheel and rotate the wheel when it is in contact with the wheel. The structural optimization of the drive axle should be carried out from the following two perspectives: first, whether there is a relative displacement of the two drive wheels in the drive axle, that is to say, there is a relative position change between the drive axle and the drive shaft; second, the transmission mechanism between the two active wheels, that is to say, whether the two active wheels can be rotated on the drive axle. In addition, it is important to note the presence or absence of gears between the active wheels and the wheels.

Generally speaking, we can dig out the relevant data from these data and introduce them into the input and output parameters of the system to get a more realistic mathematical model reflecting the target. With the rapid development of modern control engineering technology, the impact of system failure is becoming more and more significant, and therefore, a lot of research has been conducted to ensure the operational reliability of the project. At present, the fault-tolerant control technology used has become a proven means, mainly including passive and active, to maintain the progressive stability of the system even in the event of failure. As shown in Figure 5, distance protection, overcurrent protection, etc. are designed to quickly and reliably remove the failed component from the system, while protecting both the failed component and the impact of the failed component on the system.

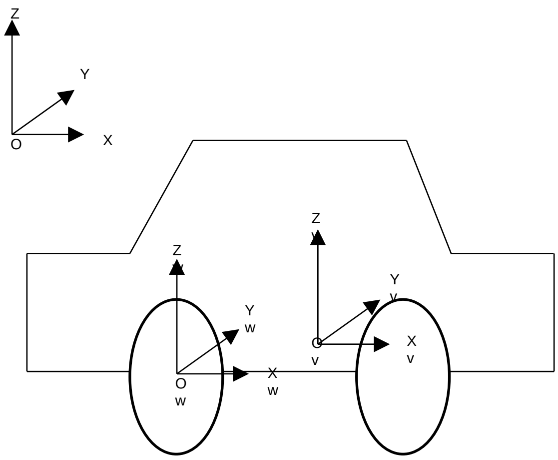


Figure 5. Vehicle coordinate system

As can be seen from Figure 3, when the wheel sliding rate is lower than the optimal sliding rate, the longitudinal attachment factor of the road increases with the increase of the wheel slip ratio; on this basis, when the rolling speed is greater than the optimal sliding rate, its vertical attachment factor decreases with the increase of the wheel sliding rate. Meanwhile, when the wheel sliding rate increases, the lateral adhesion factor of the road also decreases; and, in the case of larger sliding, if the slip ratio is around 1, its lateral bonding factor is almost zero, while if a small disturbance occurs, it will cause the car to slide sideways and make it lose balance . Usually, the wheel can be considered as being in the steady state range for 0 to the optimal sliding rate sopt; when the sliding rate of the wheel is larger than the optimal sliding rate sopt, it can be considered as being unstable.

In the case of vehicle maneuvering, if lateral maneuvering is dominant, for example, the wheels are best maneuvered when the road side adhesion factor is at its maximum; the car has the lowest vertical adhesion factor and the tires have the weakest acceleration. If the control of the car is mainly vertical, then the longitudinal force on the wheels is at its highest when the road longitudinal adhesion factor is at its maximum and the acceleration of the car is better; at the same time, the car has some lateral stability due to the high side adhesion factor of the road.

The transmission and anti-skid control of the car is centered on the degree of wheel slip. In particular, the drive and anti-slip control objective of the system is to ensure the stability and safety of the vehicle by adjusting the drive torque of the motor and controlling the wheel speed to keep the wheel slip ratio within a stable range in case of sliding phenomena.

This thesis focuses on the control of acceleration driving with a four-wheel hub motor electric vehicle as the core. Therefore, this thesis uses the longitudinal direction of the car as the main control means, and the rolling speed as the main control object in the control of the car's driving and skid prevention.

Social engineering is generated from the principle of social engineering. Social engineering is the use of certain technical means to obtain the personal data of others in order to guide or force them to fulfill their desired social needs. On the basis of this, a new network-based approach is proposed - exchange and exchange order.

It is assumed that the decomposition order of mechanical components is S = (ai), i = 1, 2, ... , n. Make aj and ak a two-step decomposition in S and include OS (aj, ak) as swappers to show pairs of separated swapping operations aj and ak. One is included in the order of multiple exchangers. Use SS = (OS1, OS2, ... , OSl) to express the swap order consisting of l exchangers. In the decomposition order, all the exchangers in the swap order are decomposed in order. In this paper, 3 operators are given to enable SEO to solve the problem.

1) Summation operator. If SS1 and SS2 are both a switch with n lengths, then the operation of this operator is to combine the two data strings of the two switches, expressed as SS1SS2. The length of SS is 2 n.

2) The operator of sequence confusion. Suppose SS is a switch with n lengths, and β[0,1] is an input parameter of SEO. Assuming μ= ceil [n xU (0,1)] and σ= ceil [n xsin (α)], the specific operation of the chaotic operator is to order the decomposition order from the gth bit to the μ+vth bit, and if μ+v is greater than n, it will be adjusted from the μ bit to the last bit to SS'= SS [U (0,1) xsin (β)]. In particular, SS'= SS'= SS'[1+ U (0,1) xsin (β)] is used for decomposition operations other than the μth-μ+vth in the decomposition order.

(3) The averaging operator. Assume that SS1 and SS2 are both exchangers with length n and that each SS1 and SS2 is randomly selected with equal chance as a new order of exchangers for SS1 or SS2. SS has a length of n, as can be seen in Figure 6.

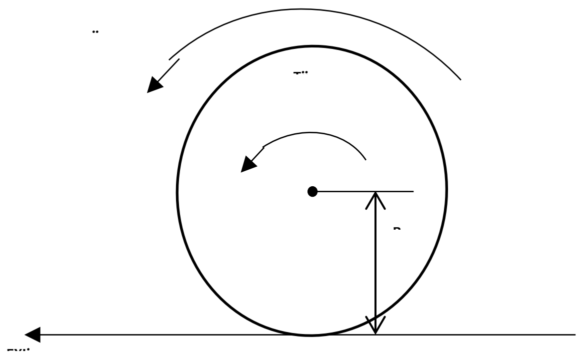


Figure 4. Coefficient of adhesion curve analysis diagram

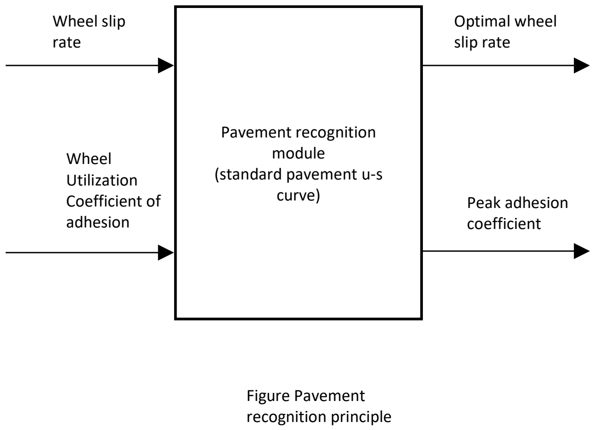


Figure 7. Principle of road surface identification

4. Results and Discussion

4.1. Improved social engineering algorithm

The stability of the four-wheel hub motor drive system has been investigated to ensure that its stability in driving is consistent with the needs of vehicle dynamics and the development of electric vehicles. Lane keeping and autonomous driving technology for automobiles has become a popular topic in the rapid development of autonomous driving and electronic control technology for automobiles. The automotive control system is composed of relays, programmable controllers, switching elements, etc., which provide precise control of motor amplitude, angle and speed through microprocessors, sensors, motor control and other technologies. With the rapid development of computer technology, microprocessor, power electronics and other technologies, the control technology of inverter is gradually developing in the direction of digitalization and intelligence, and gradually becoming a current research hotspot. Currently, the active safety control technology of the four-wheel hub motor has become a technical problem that needs to be solved, but the accuracy of the technology is not high under uneven road conditions, and further research is needed. Finally, the effectiveness of the method is demonstrated by comparison with experimental data. In the future work, we will continue to improve the computational efficiency and compare it quantitatively with the existing results. Finally, in this paper, the proposed algorithm is analyzed for security, including key analysis, sensitivity analysis, and statistical analysis. In future work, we will improve these algorithms and further justify the related theorems to derive more meaningful algorithms and verify them through a large number of experiments. Please refer to the attached Figure 7.

4.2. Improved social engineering approach for mechanical engineering driven anti-skid control

To implement the comparative experiments, we used the Improved Social Engineering Approach to Mechanical Engineering Drive Anti-Skid Control system, the model was used and used as a validation of the previous training set, as shown in Figure 8.

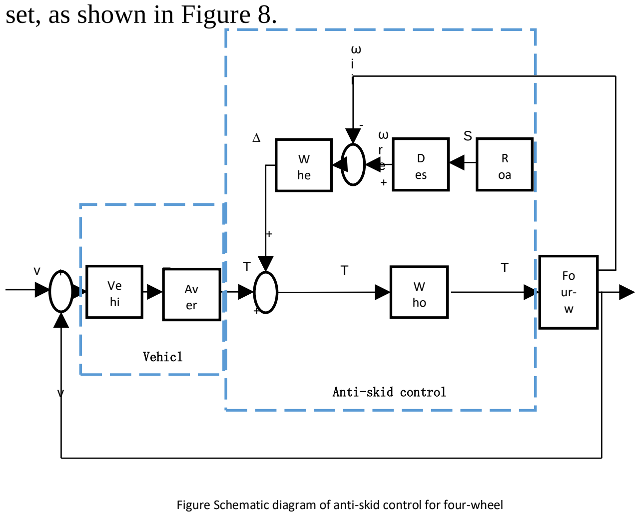


Figure 8. Schematic diagram of four-wheel hub motor electric vehicle drive anti-skid control based on road surface identification

As shown in Figure 8, the vehicle speed control strategy was unable to control the vehicle speed under the docked pavement, while the vehicle speed increased from 5 km/h to 60 km/h under the drive-anti-skid control strategy, with a vehicle speed response time of 18 seconds and a speed overshoot of 0% during the control period. In the vehicle speed control strategy, during the period of 4 to 18 seconds, the vehicle acceleration is 0.6 m/s during the acceleration process and the final vehicle acceleration cannot be converged; while in the vehicle driving and anti-skid control, during the period of 4 to 18 seconds, the vehicle will enter the acceleration state and the acceleration will be maintained at 0.8 m/s, and after 20 seconds, when the vehicle speed reaches the expected speed, the acceleration will gradually decrease to 0 m /second. Under the speed control strategy, the sliding speed of the four wheels while driving will increase rapidly to 0.8, which means that the wheels are much faster than the car speed and sliding occurs; while with the active anti-slip control scheme, the sliding rate of the left and right front and rear wheels are controlled to be close to the optimal sliding ratio of about 0.05 during the acceleration of the car in 4 to 18 seconds, and at the same time, because the left and right front and rear road is a highly bonded road, so the wheel slip rate rate is close to 0 and the wheels are in normal condition. In the speed control strategy, the car's trajectory deviates from the desired track, while in the drive-skid control, its motion trajectory is largely consistent with the desired trajectory. While driving, under the speed control strategy, the vehicle was unable to reach the desired speed and experienced severe roll, resulting in a complete loss of vehicle stability. In contrast, under drive and anti-skid control, the vehicle speed can be quickly converged to the desired speed without overshooting and without skidding and keeps the vehicle on the intended trajectory.

In many literature and scholarly studies, the multi-parameter model has more advantages and more effective fitting compared to the single-parameter and two-parameter models. However, in many engineering problems, the dynamical model of the system is unknown, which leads to many mathematical conditions that are difficult to achieve, and in order to analyze the performance of the system, the identification of the system must be performed first. In complex thermal system modeling and simulation studies, we often need to make a trade-off between more accurate complex models and less accurate simple models, i.e., a certain degree of simplification of the model. Among the many mathematical models, the vapor distribution equation, the specific internal work equation and the cyclic heat absorption equation are the most basic ones, which are the basis for thermal economy analysis and consumption difference analysis.

In conclusion, in the three cases of single pavement, docked pavement and opposed pavement, the automatic driving and anti-skid control strategy based on pavement identification proposed in this paper cannot ensure that the vehicle speed reaches the expected speed quickly and without overshoot, and it can effectively avoid wheel sliding and ensure that the car runs according to the expected trajectory.

5. Conclusion

For the drive and anti-skid control strategy of the four-wheel hub motor, it was simulated using an improved social engineering algorithm, and based on this, three road identification algorithms for low, medium and high attachment were selected for road verification. This paper summarizes the basic structure of the automobile anti-skid control system and proposes some solution measures through the study of the automobile anti-skid control system. A new type of drive anti-skid control system is proposed for the problems such as high vibration and noise of automobile brakes. The drive anti-skid control system is characterized by simple structure, easy maintenance, simple control and reliable operation, and high operating efficiency. The system not only has excellent drive anti-skid effect, but also has good control performance. In addition, the drive anti-slip system can ensure that the mechanical brake works safely and reliably in various harsh environments. The research shows that this new drive anti-slip control system is a new drive device that can be widely used in various mechanical brakes and drive forces on drive wheels, and the research on this device is of great significance.

In the actual production, many factors are uncertain, such as the time of disassembly, the quality and requirements of the components, the operation level of workers, etc. Introducing IoT and intelligent technology into DLBP is a solution. This paper focuses on the combination of DSP and DLBP.

The summary of the full paper is as follows.

(1) The overall structure and body stability of a four-wheel hub motor electric vehicle are studied, and various factors affecting its stability are analyzed and evaluated.

(2) The mathematical model of the four-wheel hub motor electric vehicle is established and its speed control is investigated through the analysis of the mechanical engineering driven anti-skid control system and dynamic performance based on the improved social engineering algorithm. Based on the overall structure of the four-wheel hub motor and its simplification, the simulation model of the four-wheel hub motor with seven degrees of freedom is finally obtained. Based on this, the speed control scheme of the four-wheel hub motor is established by using the joint simulation platform of Carsim and Matlab, and its speed control strategy is verified by simulation. It is found that the vehicle speed control strategy has better results on roads with high and medium adhesion; however, the control efficiency of the vehicle speed control strategy is not high at low adhesion roads.

(3) A driving and anti-skid control scheme based on a four-wheel hub motor is proposed based on the road surface identification technology of the four-wheel hub motor. A method based on road surface identification is proposed for different optimal wheel slip rates under different road conditions, which is predicted dynamically, and based on this method, an electronic drive and anti-skid control scheme for four-wheel hub motors based on road surface identification is proposed. And a control parameter

adjustment method for the anti-skid control of vehicle drive is proposed.

(4) On the basis of Carsim and Matlab, an anti-slip control scheme driven by a four-wheel hub motor is simulated and compared with the previously proposed method to arrive at a target speed of 30 km/h, 60 km/h, and 120 km/h under three road conditions: single road surface, docked road surface, and opposed road surface, respectively.

On this basis, the method is proved to be effective in suppressing wheel sliding and ensuring the car to drive on normal roads through simulation tests under three typical road conditions of single pavement, docked pavement and opposed pavement respectively; finally, two control methods of car driving, anti-skid and speed control are compared through simulation; the simulation results show that, compared with the traditional speed control strategy, the method can ensure car speed reaches the expected speed quickly and without overshoot; meanwhile, the active anti-skid control strategy of the car can make the wheels travel in a stable range, thus improving the acceleration and stability of the car. The driving and anti-skid control of a four-wheel hub motor is investigated, and this paper proposes a new method for solving the multi-objective decomposition line equilibrium. In this paper, a new method based on the swapper and the swapping sequence is proposed and solved. Then, the operator operator of social engineering is defined based on the exchange sequence. The method is verified with a high-speed electronic snapping machine and compared with three traditional algorithms using four indices, and the results show that the method has better performance. Compared with the traditional method, the method proposed in this paper can better solve the problem of decomposition order.

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