Power simulation and performance evaluation of electric power steering system for automobiles

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Keywords: Automotive industry; Automotive electric power steering system; Matching design; Control strategy; Dynamics modeling and simulation;

Abstract: With the continuous development and progress of the automobile industry, the traditional hydraulic power steering system has been unable to meet the development needs of automobiles. Therefore, the electric power steering system has been widely used in modern automobile industry technology because it can greatly improve the performance of automobiles. Electric power steering (EPS) system can greatly improve the steering performance of automobiles, so that automobiles have excellent handling stability. In this paper, the corresponding electric power steering system will be designed according to the relevant parameters of medium-sized vehicles, and the important parts of the system will be matched. In control strategy, this paper will adopt current fault-tolerant control strategy. At the end of this paper, based on MATLAB, the dynamics model of the relevant medium-sized vehicle model will be modeled, and the characteristics will be simulated to verify the correctness of the model.

1. Introduction

With the continuous development of automobile industry technology, automobile steering system has developed from pure mechanical steering system and hydraulic power steering system to electric power steering system. Its corresponding performance is more stable and its corresponding maneuverability reflects more comfort [1-5]. Steering system is one of the most critical parts of the vehicle system. In the design process, the flexibility, safety and stability of vehicle steering should be fully considered. With the development of artificial intelligence technology and Internet of Things technology, modern automotive electric steering system tends to be intelligent. At present, electric steering system has been widely used in small cars, but its application in medium-sized buses is still blank or the related research is relatively few. Therefore, it is very important to design a reasonable and efficient electric power steering system for medium-sized buses.

Aiming at the automobile electric power steering system, a large number of scholars and research institutions have carried out research and Analysis on it [10]. The first country to apply electric steering system to automobiles was Japan, and Suzuki Corporation of Japan first used it and commercialized it; European and American [12] preferred the steering system based on brushless motor technology, which has the advantages of simple structure and no additional spark when commutating, but it has no advantages in the application of low-power motors, at the same time, it has no advantages in the application of low-power motors. The corresponding brushless motor control strategy is too complex; in the study of steering system for medium-sized bus, the relevant American company [13] has proposed pinion-assisted and rack-assisted steering system, which has certain advantages in safety and maneuverability, but its corresponding flexibility is relatively lacking, and the matching of its corresponding key parts also exists. In question.

Based on the above analysis, it can be concluded that the traditional hydraulic power steering system can not meet the development needs of automobiles. Therefore, the electric power steering system has been widely used in modern automotive industry technology because it can greatly improve the performance of automobiles. Electric power steering (EPS) system can greatly improve the steering performance of automobiles, so that automobiles have excellent handling stability. In this paper, the corresponding electric power steering system will be designed according to the relevant parameters of medium-sized vehicles, and the important parts of the system will be

  DOI: 10.25236/scmc.2019.038

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The structure of this article will be arranged as follows:

The second section of this paper will focus on the analysis of the design of electric power steering system and the matching of key components for medium-sized passenger cars, as well as the analysis of its control strategy.

In the third section of this paper, dynamic modeling and simulation analysis of medium-sized bus will be carried out based on MATLAB.

Finally, a summary of this paper is given.

2. Overall design of electric power steering system for medium bus

This section will focus on the analysis of the hardware design, control system design and matching design of the key parts of the electric power steering system for medium-sized buses. The corresponding overall design system framework is shown in Figure 1. The modules included are mainly motor, torque sensor, speed sensor, electronic control module and current sensor.

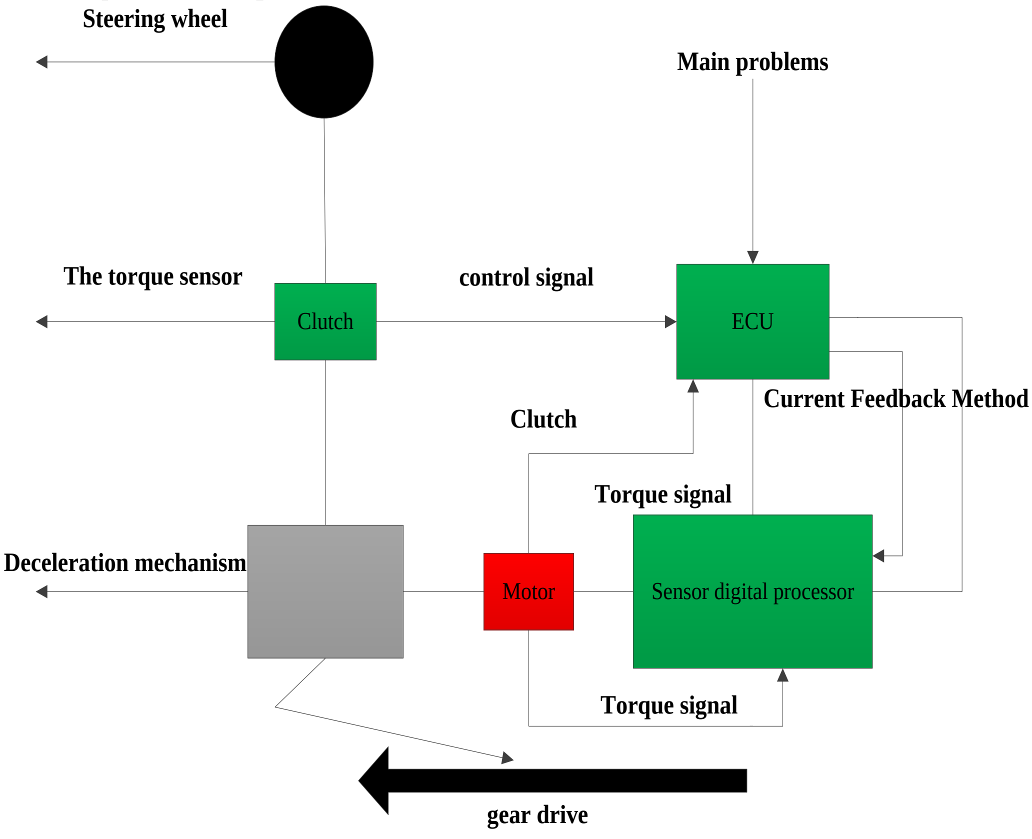

Figure 1 Overall frame diagram of electric power steering system for medium bus

A Hardware Design and Key Device Matching

In the part of hardware design, the main devices are all kinds of sensor circuits, including signal input circuit, MCU operation control circuit, motor drive circuit and relay protection circuit. The corresponding hardware schematic diagram is shown in Figure 2.

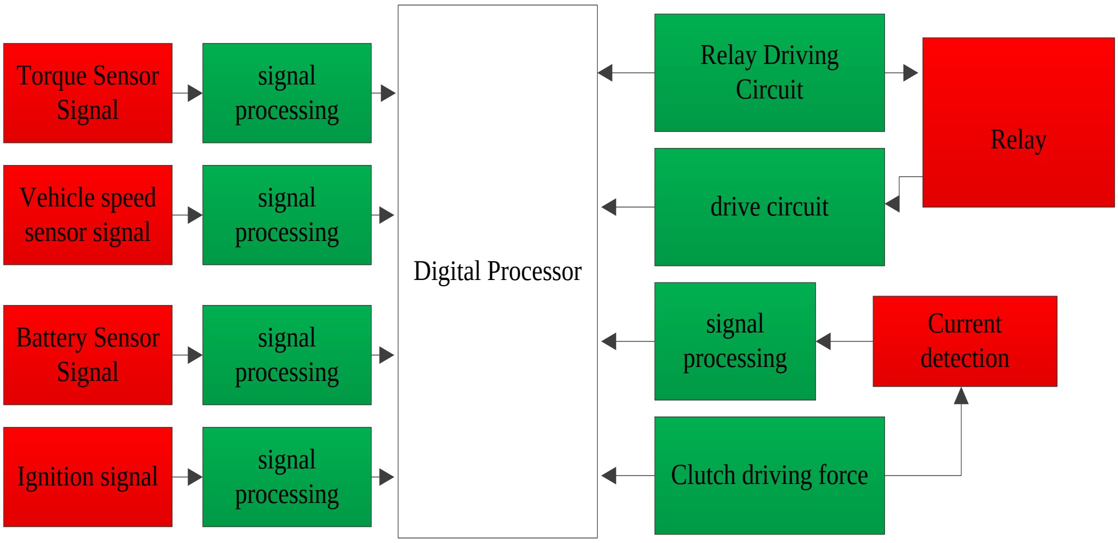

Figure 2 Hardware block diagram of electric power steering system for medium bus

In the MCU operation control circuit, the Texas Instrument microprocessor TMS320LF2407A is selected as the digital processor. The A / D chip sends the torque signal of the torque sensor and the vehicle speed related signal from the CAN bus to the digital processor, and calculates the target current of the related medium-sized bus motor based on this. At the same time, the actual current of the motor is fed back to the digital processor through the current sensor, and finally compensated by the related algorithm. In the hardware design of power supply circuit, TPS7333Q of Texas Instrument is used as power supply chip, which realizes the conversion of voltage from 5V to 3.3V. At the same time, the chip has current limitation and overheating protection mechanism.

In the selection of current sensor, this paper chooses LA25-NP Hall current sensor, which is based on Hall magnetic balance to detect current.

In the selection of motor, this paper mainly uses permanent magnet DC motor as motor. Its work flow is as follows: the input signal is filtered, then converted by A/D and input to the digital processor for processing. Finally, the PWM wave is output and transmitted to the motor for control and drive.

In this paper, a potentiometer type torque sensor is used on the torque sensor, which is mainly composed of torsion bar spring, angle-displacement converter and potentiometer.

B Control System Design

At the level of software design, the control mainly involves the collection of sensor-related data and the processing and analysis of relevant data by digital processor. In motor control, the main concern is the detection and analysis of current. At the same time, we need to focus on the PID control based on current detection and the related output control signals. The flow chart of the algorithm at the corresponding software level is shown in Figure 3.

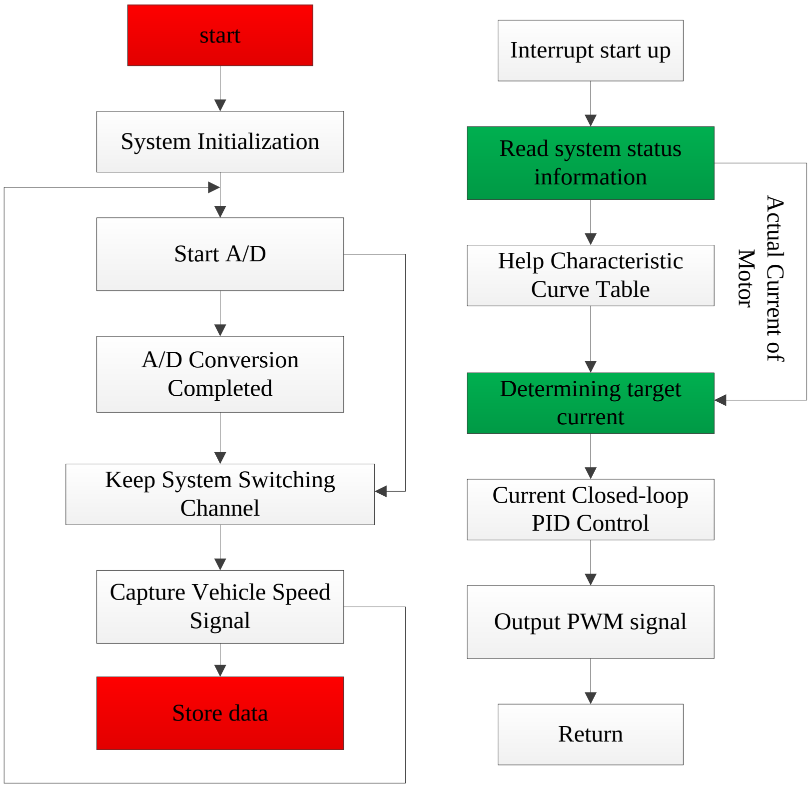

Figure 3 Software flow chart of electric power steering system for medium bus

3 Simulation and Analysis of Electric Power Steering System for Medium Bus

The simulation model of the whole control system based on MATLAB is shown in Figure 4, in which the input module corresponding to the simulation model has three parts, respectively, the armature voltage of the motor, the torque of the steering wheel and the resistance torque applied to the steering wheel.

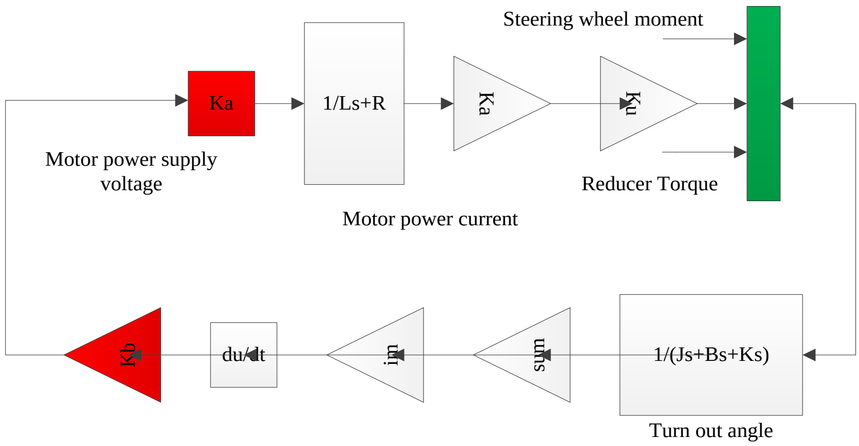

Figure 4 Simulation Model of Electric Power Steering System for Medium Bus

Based on the above simulation model, steering simulation is carried out for medium-sized passenger cars with driving speeds of 50 Km/h and 80 Km/h. The corresponding simulation results are shown in Figure 5. From the figure, it can be seen that the corresponding steering wheel torque will be reduced compared with that without the power system, and the corresponding steering portability and flexibility of the vehicle will be improved. At the same time, it can be seen from the simulation diagram that the electric steering system involved in this paper is conducive to enhancing the safety and stability of driving when the vehicle speed increases.

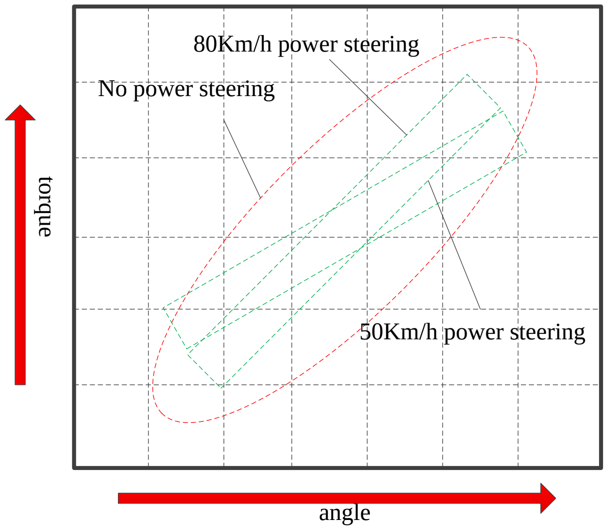

Figure 5 Simulation waveform of electric power steering system for medium bus

5. Conclusion

In this paper, the research situation of automobile power steering system in automobile industry is analyzed and discussed, and the current research situation is analyzed and discussed. The following conclusions are drawn: the traditional hydraulic power steering system can not meet the development needs of automobiles, therefore, the electric power steering system is widely used in modern automobiles because it can greatly improve the performance of automobiles. Vehicle industry technology. This paper designs the corresponding electric power steering system based on the relevant parameters of medium-sized vehicles, and matches the important parts of the system. In the control strategy, this paper adopts current fault-tolerant control strategy. At last, based on MATLAB, the dynamic model of the relevant medium-sized vehicle model is built, and the characteristics are simulated to verify the correctness of the model.

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