Parameter Matching and Simulation Optimization Analysis of Electric Vehicle Power System

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Abstract: With the development of new energy electric vehicle technology, its application is more and more popular, not only in the field of passenger cars, but also in the field of commercial vehicles. Based on this, this paper first analyzes the matching of electric vehicle dynamics and electric drive system, secondly, carries out the matching and design of electric vehicle power system parameters, and finally optimizes and simulates the power system.

1. Introduction
As one of the main sources of greenhouse gas emissions, the exhaust emissions of traditional fossil fuel vehicles not only pollute the atmosphere, but also consume a lot of fossil energy. With the innovation of battery electronics and other technologies, new energy vehicles are gradually coming to the market, and become a research hotspot in recent years. However, there are still many deficiencies in new energy vehicles, especially the performance of the power battery of electric vehicles have become the main factor restricting its further development. Therefore, it is of great practical significance to study the rationality and selection of new energy EV power system parameters matching.

2. Electric vehicle dynamics and electric drive system matching

2.1 Performance analysis of electric vehicle
The performance of electric vehicle includes power and economy. Among them, the economy of electric vehicles refers to the maximum continuous mileage under full power. Specifically, it includes three indicators as shown in Figure 1. The detailed description of the three indicators is shown in Table 1.

![Figure 1. Performance indicators of electric vehicle](image-url)
2.2 Key points of electric vehicle power system parameter design

The design elements of driving motor for electric vehicle mainly include several aspects as shown in Figure 2. Among them, the core parameters of the drive motor mainly include power, torque and speed. The parameters of the motor are very critical, too low or too high parameter setting will lead to serious problems, affecting the comprehensive benefits of the motor. As the energy source of the electric vehicle, the performance parameters of the power battery will have an important impact on the vehicle performance. Therefore, it needs to pay attention to the matching of battery parameters, including the number of batteries, battery voltage, battery energy and so on.

![Figure 2. Design elements of driving motor for electric vehicle](image)

2.3 Factors affecting the performance of electric vehicle

In the parameter matching of electric vehicle power system, in addition to the influence of battery itself, other key parameters, such as vehicle mass, system efficiency, roll resistance, windward area, etc., also need to be considered as a whole to further clarify the direction of matching design and power system performance optimization. Based on the typical electric vehicle model, according to the calculation results from the key parameters of the whole vehicle under NEDC condition, the changes of the whole vehicle mass and system efficiency have the greatest impact on the vehicle energy consumption. Therefore, in the process of parameter matching, dynamic system parameter matching design should be carried out based on these two factors.

3. Parameter matching and design of electric vehicle power system

3.1 Driving motor

The drive motor system of electric vehicles is stricter than the technical specifications of general industrial motors. It needs to achieve high efficiency, low speed and large torque characteristics and constant power characteristics in a wide range under the condition of minimum volume and weight. In addition, electric vehicles have higher requirements for the reliability and price of their motor system.
3.2 Power battery
As mentioned before, the performance of the power battery is directly affected by the amount of energy storage, while its capacity storage is directly related to the endurance performance of the electric vehicle. Therefore, the application of the power battery of the electric vehicle should comprehensively consider the performance index requirements of the whole vehicle, such as economy, mileage, maintainability, adaptability and reliability. In addition, the energy storage of electric vehicle power battery pack should be as large as possible, and the thermal management system should be equipped to maintain and track the battery status.

3.3 Power battery
At present, the power transmission system layout of electric vehicles mainly includes motor central drive and electric wheel drive, as shown in Figure 4 below. The central drive mode of motor is easy to operate, but its efficiency is low. The electric wheel drive is of low quality and high efficiency, but its technology is complex.

4. Power system optimization and simulation analysis
Due to the good speed regulation of the motor itself, electric vehicles generally use gearboxes with no more than three gears. Too many gears not only increase the weight of the system, but also reduce the transmission efficiency and affect the vehicle economy. Three speed transmission is selected for optimal matching to ensure the stability of motor output power and gear connection. The interval optimization method is applied to the transmission ratio of gears to ensure smooth connection during gear shifting. The energy consumption curve of NEDC before and after optimization is shown in Figure 4. It can be seen that the energy required after the optimization of a cycle under the same working condition is significantly lower than that after the optimization.
5. Conclusions

In this paper, the parameter matching of electric vehicle power system is analyzed. Based on the existing research, the idea of overall optimization is established. After analyzing the structure and power-train components of the whole vehicle, the matching factors that affect the performance of the whole vehicle are analyzed. Then, based on the performance requirements of the whole vehicle, the parameter matching scheme is carried out. Finally, through the simulation platform of the whole vehicle, the rationality of the optimization matching is analyzed and verified. The results show that the overall performance of the vehicle can be effectively improved.

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