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The Control Strategy for 4WD Hybrid Vehicle Based on Wavelet Transform

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Abstract

In this paper, in order to avoid the frequent switching of engine operating points and improve the fuel economy during driving, this paper proposes a control strategy for the 4-wheel drive (4WD) hybrid vehicle based on wavelet transform. First of all, the system configuration and the original control strategy of the 4WD hybrid vehicle were introduced and analyzed, which summarized the shortcomings of this control strategy. Then, based on the analyze of the original control strategy, the wavelet transform was used to overcome its weaknesses. By taking advantage over the superiority of the wavelet transform method in multi signal disposition, the demand power of vehicle was decomposed into the stable drive power and the instantaneous response power, which were distributed to engine and electric motor respectively. This process was carried out under different driving modes. The proposed control strategy not only ensured the dynamic property, but avoided the frequent switching of engine operating points by making the most of the fast-transient response of electric motor. Last but not least, in MATLAB/Simulink environment, the vehicle model and the control strategy model were built. Compared with the original control strategy, the simulation results showed that the proposed control strategy could reduce the range of engine operating points and make them more concentrated, which could effectively improve the working condition of engine. As a result, the proposed strategy improved the fuel economy, which verified the effectiveness of the control strategy based on wavelet transform.

Keywords

4-wheel drive hybrid vehicle, energy management strategy, wavelet transform, power distribution

Introduction

With environmental and energy problems increasingly serious, new-energy technology is the inevitable choice for the development of automobile industry [1]. As one core of new-energy technology, hybrid power technology is equipped with a relatively mature, efficient and reliable system that can effectively avoid the anxiety of driving range brought by pure electric technology, so it is favored by automobile companies. The four-wheel drive(4WD) hybrid system not only has the advantages of hybrid power technology in terms of fuel economy, but also can obtain excellent comprehensive performance such as dynamic performance, pass ability and handling stability, which has attracted widespread attention in the market [2]. The 4WD hybrid vehicle is composed of several power components and has a high degree of freedom, resulting in complex driving modes of the power system. Therefore, the research on control strategies is the key part of 4WD hybrid technology. This study focuses on the energy management strategies to achieve good fuel economy.

At present, the research on energy management strategies of hybrid power systems at home and abroad is mainly divided into two categories: rule-based and optimization-based control strategies. The rule-based control strategy is composed of two types based on deterministic rules and fuzzy rules [3]. The control strategy based on deterministic rules realizes

5. Conclusions

Based on the deficiencies of the original control strategy, this paper proposes a 4WD hybrid vehicle control strategy based on wavelet theory. Compared with the original rule-based control strategy, the method proposed in this research can effectively avoid frequent switching of the engine and shrink its working range, resulting in the improvement of the fuel economy. It provides a new idea for the study of energy management strategies. In future work, the control strategy based on wavelet theory will be further studied. The wavelet theory will be applied to the hybrid vehicles with more complicated configurations. The characteristics of the components such as motor and battery will be taken into consideration in detail in the future. And the future study will carry out the test and verification of the bench and the actual vehicle.

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