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The Driving Control of Pure Electric Vehicle

Zhang Guirong , Zhang Henghai , Li Houyu

Shandong Jiaotong University，250023 Jinan, China

Abstract

Pure electric vehicle has become the representative of new energy source auto because of its low level of environmental pollution, noise, high efficiency, availability of multiple energy resources, and ability of energy feedback. Pure electric vehicle is driven by motor, with no reduction gears in the scope of fixed torque and fixed power. It can also generate torque in the low speed scope, and can work under the way of fixed power using field-weakening control in the high speed scope. This paper analyzes the advantages and disadvantages of traditional drive mode, motor-driving axle combined drive mode, motor-driving axle integrated drive mode, and wheel-hub motor drive mode. The electric wheel driving vehicle gradually becomes a new direction of pure electric vehicle relying on its great advantage in the 4 driving modes.

Keywords: Pure electric vehicle; driving control; driving motor

1 Introduction

Automobile industry is the fundamental industry of national economy, it is closely related to peoples' life, and it has become an essential factor of modern society.

However, Although providing us fast and comfortable vehicles, traditional automobile industry consuming petroleum has already caused the economy's deep dependent on fossil energy resource and has made the conflict between energy production and consumption even worse.

24% of the world's total energy resource consumption is the vehicle energy resource consumption.

As the vehicle holding is still increasing, the energy resource problem becomes more and more obvious and threatening.

Moreover, the air pollution and global warming caused by CO2 has made a great influence on the environment in which we human beings are living.

In the circumstance of energy and environment crisis, increasing the efficiency of energy consumption and reducing the discharge of harmful waste are highly required.

However, it is very difficult to deal with this problem only by improving the performance of the engine. Developing new energy vehicles becomes the very direction of the development of automobile industry in the future.

Developing EV is one of the effective ways of solving this problem.

2 The Advantages of EV

Compared with ordinary engine driving vehicles, EV has the following advantages.

(1) High level of efficiency: the engine efficiency of modern vehicles is about 38%, while the ultimate efficiency is

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only 12% because of frequent braking, low speed driving and signal waiting. But EV suffers no lost of idles, and 80% of the e-power can transfer from motor into vehicle motion. Besides, it can retrieve power when braking.

(2)Low level of environmental pollution: Powered by batteries and super capacitors, pure electric vehicle discharges no waste gas.

(3)Low rate of noise: The noise and vibration of the automobile depends on the engine and the driving condition. Compared to engines, EV has much fewer vibration sources, no burning procedure, no mechanical motions, only has noises from air compressor, cooling fan and transmission mechanism. Thus its noise level is much lower than engine vehicles.

(4) Multiple energy resources available:

Not restrained by petroleum resource, EV can acquire e-power from public power grid. Thus any method to acquire e-power can apply to EV, such as hydro power, nuclear power, thermo power, wind power, subterranean heat and solar power.

(5) Energy feedback

According to the energy resource combination mechanism, we can easily retrieve the braking energy or potential energy when declining. Thus the continual mileage and the stability are going to increase. All the new EV developed in recent years have energy retrieving system, which can increase the continual mileage by 10%-15%.

3 The driving character of pure EV

3.1 The basic requirements of EV to Driving Control System

In an EV, motor is driven by the motor controller, the motor transfers the e-power into mechanical power to drive the vehicle.

The basic requirements of the EV to the driving control system are as follows,

(1)High specific power. To account in maximum power, usually reaches (1～1.25)kw/kg.

(2)Large range of motor speeding, usually in 25%-100% maximum speed, the motor may have a performance of small torque, permanent power, which can fulfill the requirement of the maximum speed and highway patrol of the EV.

(3)Sufficient starting torque to qualify the demand of fast starting, accelerating, climbing and frequent start/stop.

Usually the overload factor of the motor reaches 3-4.

(4)Fast torque response, the driving system can control the driving torque and braking torque quickly and mildly in all kinds of speed ranges; in multiple motor system, the motors should have high controllability, good steady state precision and dynamic characteristics.

(5)Good environmental adaptability, can do reliable work in harsh environments.

(6)High rate of energy retrieve in regenerative braking.

(7)Have good characteristics of efficiency, can acquire optimum efficiency in a wider speed/ torque range, increase the continual driving distance after charging 1 time, usually should acquire 85%-93% efficiency in typical circuit driving zone.

3.2 The dynamic characteristics of the motor

As to the traditional engine vehicle, the function of its engine is to transfer the heat energy into the rotating mechanical energy, which is transmitted to the wheels through gearing, differential and clutch. As the engine's maximum output torque changes with the speed change, the vehicle's speed should correspond with the switch of the reducer. In this way, the engine can keep working with a maximum power. However, pure EV are driven by the motors, which can generate torque in low speed range without switch the reduce gears, as shown in Figure 1. Besides, the motor can operate in permanent power in small torque by using the weakening control method. Thus pure EV can adopt these characteristics flexibly in different kinds of driving resources.

For example, to make the motor smaller and lighter, it is appropriate to put high speed motor and reducer together.