Energy Management on Compound Storage System in Electric Vehicle with Longitudinal Dynamics

Dawei Meng, Yu Zhang, Meilan Zhou, Xiaochen Tian
Department of Electrical Engineering, Harbin University Of Science And Technology, Harbin 150080
zhangyu8419@163.com

Abstract. Aiming at short endurance mileage for electric vehicle, effected vehicle life because of battery excessive charging and discharging, the control method is put forward making use of super-capacitor to recovery regenerative braking energy, Hafei Saibao electric vehicle is as example, the required energy of front wheel is detected to develop control strategy. On the basis of experimental data, co-simulation is achieved in the vehicle special simulation software, the experimental results show endurance mileage of improved car has increased, and the full load characteristics are optimized.

Keywords: Compound storage system Energy flow longitudinal dynamics pure electric vehicle

1 Introduction

The huge energy consumption and serious pollution of the environment is the inevitable problems in our country, automotive manufacturers relying solely on technological progress of traditional vehicle cannot meet the emission limitation, and must depend on technical innovation and development of electric vehicle, and battery electrical vehicle arises at the historic moment[1-2].

2 Basic parameter matching for vehicle

Parameter matching is on the basis of Hafei Saibao electric vehicle as the original models, the basic parameters of the vehicle are shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tbody>
<tr>
<td>full load vehicle quality (kg)</td>
<td>1580</td>
</tr>
<tr>
<td>maximum speed (km/h)</td>
<td>120</td>
</tr>
<tr>
<td>full load centric height (mm)</td>
<td>500</td>
</tr>
<tr>
<td>the centric to the rear axle (mm)</td>
<td>1200</td>
</tr>
<tr>
<td>the centric to the front axle (mm)</td>
<td>1470</td>
</tr>
<tr>
<td>frontal area (m²)</td>
<td>1.97</td>
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</table>

Table 1. The main simulation parameters

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<tr>
<th>lithium battery capacity (Ah)</th>
<th>rolling resistance coefficient</th>
<th>wheel radius(mm)</th>
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<tbody>
<tr>
<td>100</td>
<td>0.009</td>
<td>289</td>
</tr>
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</table>

The main energy storage system is the CENS lithium battery CBP2450. The 13 section is connected in series to a group [3-4], the 2 groups in parallel; the super-capacitor is American MAXWELL BMOD0165.

3 Model combined with longitudinal dynamics characteristics

According to the running equation of automobile is given by

\[
\frac{T_w l}{r} = G f + \frac{C_p A u^2}{21.15} + G \sin \alpha + \delta m \frac{du}{dt}
\]  

(1)

Take isolated body from the various parts of the car, and take the driven wheel, the driving wheel and the rest of the car to force analysis [5].

According to the relationship of the wheel force and needed power as well as the characteristics of the main parts of reverse building the electric vehicle model [6], as shown in Figure 3. Vehicle model construction based on the analysis of longitudinal dynamics is shown in Figure 1.

According to the control strategy of figure 3, to reestablished “eBrake & mBrake Unit” in CRUISE, and super capacitors and batteries for data bus connection, “Switch” logic gate settings, as shown in black module of figure 2.

Fig.1. Model Construction  
Fig.2. The vehicle mode after the strategy established
4 The simulation results analysis

Simulation study based on the construction of models and control strategies, figure 4 and figure 5 is a single NEDC conditions of motor power distribution curve and battery SOC change from the initial value of 95%.

Fig.4. Motor power and battery SOC changes on NEDC road cycle

Fig.5. In view of the Figure.7 SOC of partial enlargement
In this paper, the design of composite energy management system can guarantee the power demand of the vehicle effectively, the actual speed and the working condition of reference velocity error is controlled within 5%, ensure the power output of the vehicle and achieve the expect requires of control strategies.

5 Conclusion

Taking Hafei Saibao electric vehicle as a research object, this paper is added the super capacitor as energy storage. On the basis of the experimental data, we use the Cruise-MATLAB simulation and determine the reasonable configuration scheme of power system. This method for other forms of composite energy combination analysis of pure electric vehicles provided the effective basis and methods, and also in order to solve electric vehicle energy problems such as limit on-board energy and short endurance mileage.

References