Equalization Algorithm of Lithium Battery Management System Based on Outlier Detection

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Abstract: in the Process of Battery Identification, the Equalization Algorithm of Lithium Battery Management System Based on Outlier Detection is Proposed. Z-Score Standardization Method is Used for Battery Properties. Value, the Abnormal Value of All Battery Components in the Battery Box. in Order to Get the Pre-Processing, the Battery Type and Abnormal Normal Battery Type in the Battery Group. According to the Dynamic Clustering, the Execution of Abnormal Battery Type and Normal Battery Type Problems is Analyzed by Information Characteristics, as Well as Equalization. Equivalent Equivalent Circuit, Green on Control Pole. Finally, through the Test of Simulation Platform, the Algorithm Can Identify the Abnormal Battery More Accurately and Reach the Equilibrium State Faster.

1. Introduction

With Regard to Environmental Pollution, Energy Crisis and Energy Security, Major Global Automobile Manufacturers Have Stepped Up the Pace of Research and Development of Electric Vehicles. Compared with Traditional Vehicles, Electric Vehicles Have Double Benefits of Environmental Protection, Energy Saving and Special Pure Electricity. Automobile Has Significant Advantages in Energy Conversion Efficiency and Exhaust Emission, Which is the Direction of Automobile Development in the Future. the Development of New Energy Vehicles, Represented by Electric Vehicles, is an Urgent Condition for the Realization of Sustainable Development, and Also a Technology for China's Automobile Industry to Catch Up with the World. to Achieve a High Level and Perfect Opportunity Curve. Battery Technology, Motor Technology and Electronic Control Technology Are the Three Core Technologies of Electric Vehicle Industrialization. among Them, the Battery Technology is Realized by the Power Battery System Including Power Battery and Battery Management. Two Components of the System (Bms) [1]. Battery Packaging Equalization Technology is One of the Main Topics of Battery Management System. It is a Difficult Problem to Detect the Battery Components of the Battery Pack That Must Be Balanced Correctly. Traditional Vehicle Manufacturers At Home and Abroad Use Voltage Based Equalization Algorithm to Balance Battery Packaging. That Effect is Not Ideal. Outlier Detection is One of the Hotspots of Data Mining. Analysis of Information Characteristics to Find Abnormal and Isolated Data. the Mechanism Can Be Applied to the Problem of Unbalanced Identification of Multiple Batteries. At Present, the Internal and External Anomaly Detection Method is Used, and the Identification of the Balance State of the Battery System is Studied. in This Study, the Outlier Detection Method is Applied to Several Battery Banknotes. the Imbalance of the Body Can Effectively Identify the Equalization Strategy and the Equalization Control Circuit According to the Battery of the Battery Pack [2]. in Order to Balance, Reduce the Gap between the Battery Units, Prevent over Charging and over Discharging, Increase the Available Capacity and Prolong the Service Life. Reduce Costs and Promote the Wide Use of Electric Vehicles.

2. Overall Scheme Design

First, as the basis of balance judgment, the physical characteristics of lithium battery pack

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(current, battery voltage, total voltage, battery temperature, ambient temperature, etc.) are used. Secondly, by using the outlier method, we can get the outliers of each cell of the battery pack. In addition, the threshold value of outliers is calculated, and the outliers are classified by threshold comparison [3]. Finally, the equalization control mode and equalization circuit are used to balance the battery pack.

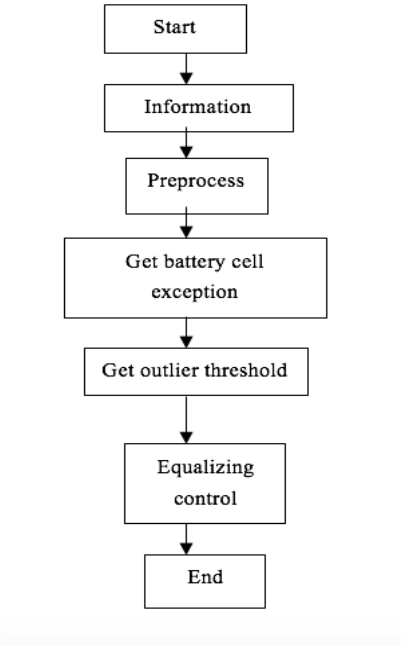

Fig.1 Basic Flow of Equalization Algorithm Based on Outlier Detection

2.1 Basic Process of Equalization Algorithm

In this paper, the real-time and accurate identification of battery cells must be balanced in the battery box, so the battery components must be balanced in the battery pack, in order to identify the new battery pack equalization technology will be used. Please improve the consistency of the battery pack, and then increase the available capacity of the battery pack [4]. The basic processing method of detecting abnormal points of battery pack is composed of six parts: obtaining information, preprocessing, obtaining battery abnormality, obtaining battery abnormality threshold, equalizing battery and equalizing control.

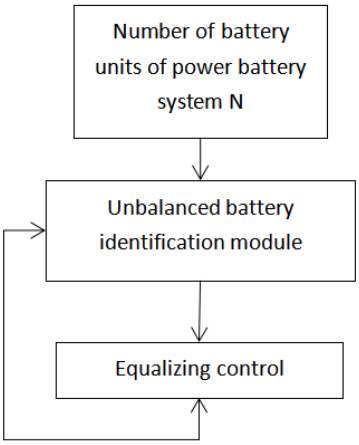

Fig.2 Initial Design Frame Ofbatteryequalization Algorithm

2.2 Frame Design

Based on the shortcomings of the current battery pack equalization technology, combined with the abnormal battery characteristics which deviate from the conventional battery, the abnormal

point detection method is used to determine the balance battery in the battery pack. Design parameter adaptive outlier detection method [5]. It is necessary to maintain the balance of the battery pack components of the battery pack components in real-time identification. An initial design block diagram of a power lithium battery pack equalization algorithm is shown.

3. Algorithm Implementation

3.1 Identification Method of Unbalanced Cell in Battery Pack

Fig. 3 shows the process of the unbalanced battery identification module. The main contents of cell identification module of unbalanced battery are as follows: the characteristic parameters (voltage, SOC, etc.) of single battery are used as the basis to judge whether the battery needs to be balanced. Then, the characteristic of the cell is the cell pretreated by Z - fractional specification. The abnormal value of each cell is the Euclidean distance between the monomer and all other monomers in the battery pack [6]. Then, at the initial stage of the battery pack, it is easy to get the center. All the monomers are sorted according to the abnormality degree of each battery cell. The difference between adjacent cells is abnormal. Then, the error two minutes reconciliation is taken as the standard. At the initial stage, the two largest centers are easy to get two differences. All cells of the battery pack are dynamically clustered. After all monomers are classified, the number of monomers in each classification is calculated, and the number of monomers is the least. The number of classes is classified as abnormal, the larger number is classified as normal, the abnormal class and the normal class are judged again, the unit to be balanced is output, and the unit to be balanced is discharged through resistance [7].

Fig. 4 shows the characteristic parameters of a lithium battery input and output parameters of a lithium battery. The input parameters of the lithium battery model used are the battery current I and the ambient temperature t0. The output parameters are battery terminal voltage V, battery temperature T and SOC. Each unit includes physical parameters (voltage, temperature, current, etc.) and mathematical characteristic parameter SOC. The cell sets the characteristic parameter, i.e. cell 1, to cell 1 (v 1, temp 1, SOC 1, I). 1) power lithium battery pack consists of battery 1, battery 2 The battery n is composed of N battery lithium battery cells connected in series.

According to the definition of distance based outlier detection method, the outliers of battery cells are calculated. The outliers of each battery cell in the power lithium battery pack are the sum of the distances between the battery cells and the battery cells in the battery pack. The outlier of the battery pack is a battery cell whose value is greater than the outlier detection threshold [theta]. The method of outlier detection is different in the process of identifying the equilibrium state of battery pack, because the parameter K and the threshold value θ are set differently in outlier detection. In order to get better results, users need to modify the parameters repeatedly in the initial stage, and get information according to the real valuable abnormal points in the database [8]. The equalization algorithm based on outlier detection can't correctly identify the cell which must balance the battery pack. The difference of the parameters (component voltage, monomer temperature, etc.) of the battery components in the lithium battery pack is due to the continuous change in use. Fixed abnormal threshold can not detect abnormal cell of lithium battery pack correctly.

First, obtain the characteristic data of all batteries of the battery pack collected by the normal battery type and abnormal battery type. Value, the exception of each cell is the sum of Euclidean distances of cells in the cell and all other cells. Cells are sorted and obtained according to the exception of all cells. The difference of outliers between adjacent cells is the initial ease of use of the largest difference between the two components as the center, and finally, the sum of squared errors standard, according to the dynamic clustering of all components in the battery pack, all of the singletons are waiting after being classified. Count the number of monomers of each category, classify a small number of categories as abnormal category and classify the number of categories as normal category. Fig. 5 shows a process for obtaining a battery exception class and a normal class.

After obtaining the battery components to be discharged and balanced, they are divided into abnormal battery and normal battery [9]. The flow chart of obtaining the battery to be discharged

and balanced is shown in Figure 6.

3.2 Equalizing Circuit Control

The equalization circuit selects the energy consumption circuit. Fig. 7 shows the structure. The power lithium battery pack is a series of N batteries (battery 1, battery 2 It consists of battery n). Each unit is equivalent to an equalizer circuit. The equalizer circuit consists of a resistor and a series of switches. Each equalizer circuit is connected in parallel with the battery unit. S 1, s 2 and s are switches of the equalization circuit, and the unbalanced cell identification module outputs switch control signals. On / off of the switch that controls the equalization circuit. R 1, R 2,… N is the discharge resistance of the equalizer circuit. When a battery in the battery pack needs to be balanced by resistance discharge, the battery unit is equivalent to the equalizing circuit, the switch is on, and the battery unit is balanced by resistance discharge. The unbalanced cell identification module identifies the cells in the battery pack that need to be discharged in time, and balances the cells that need to be discharged and balanced. Discharge equalization of circuit and resistor.

4. Simulation and Analysis

The simulation model of equalization algorithm is built by Matlab / Simulink. The simulation platform of equalization algorithm based on MATLAB / Simulink can quickly realize the establishment of control strategy and the simulation, simulation, fast algorithm verification and problem discovery of various working condition data. Under the same test conditions, three different equalization algorithms are used for battery pack, constant current charging and discharging mode and battery management battery pack, and three different equalization algorithms (equalization algorithm, based on voltage equalization algorithm and equalization standard detection sub equalization algorithm) are used. In the simulation test, the simulation results of different equalization algorithms are compared and analyzed. The initial state of the three battery packs (battery 1, battery pack 2, battery pack 3) is the same, and battery pack 1 uses balance based on outlier detection. Battery pack 2 uses voltage based equalization algorithm, while battery pack 3 does not use equalization algorithm. Three battery packs were charged and discharged for 10 times with constant current. After the test, they were charged and charged with constant current. In this case, the battery pack does not use the equalization algorithm. Cut off the charge and compare the SOC of each battery unit of the three battery packs. Fig. 8. A comparison of the battery voltage of one battery pack is shown in Fig. 9. Discharge the battery pack with constant current. In the discharge process, the battery pack does not use the equalization algorithm. The discharge is cut off, and each cell of the three battery packs is cut off. Figure 10 shows the SOC comparison. Figure 11 shows the voltage comparison of each battery cell of the three battery packs. Unbalanced battery and package components accuracy reduces the mismatch of battery and package components.

5. Conclusion

The analysis of the information characteristics of the battery components in the battery box, the real-time acquisition of the abnormal detection battery of the lithium battery pack, the effective equalization strategy of the equalization algorithm based on the equalization and the equalization control circuit reduce the performance gap between the batteries by improving the consistency of the battery pack, so as to prevent the overcharge and excessive discharge of the battery from starting, and increase the available capacity of the battery pack, The cost will be reduced by electric vehicles, which are widely used and very easy.

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