Charging characteristics of battery pack during equalization

What is the goal of battery equalization?

The goal of equalization is to increase the battery pack's consistency as well as the battery pack's real capacity. The higher the equalization efficiency,the shorter the battery equalization time. The balancing goal can be formulated as: where represents the SOC of the ith battery,the battery pack has 2 n batteries in total,.

Does battery equalization increase pack capacity?

Finally,the results of simulation and experiment both show that the equalization strategy not only maximizes pack capacity,but also adapts to different consistency scenarios. Pack capacity and consistency in the fresh or aged state are significantly improved after battery equalization.

What is equalization time in a battery pack?

Equalization is defined as the least square sum of the battery pack's SOC and its average SOC being less than 0.01,and the equalization time is defined as the time from start to end of equalization. The specific simulation parameters are shown in Table 3 and Table 4. Figure 3. External current for the battery pack. Table 3.

Why are battery pack equalization variables difficult to measure?

Measuring and estimating battery pack equalization variables have many problems,such as accuracy and computational complexity. It is difficult to ensure the accuracy and reliability of battery voltage,temperature,and current measurements due to multi-physical field interferencein the operating environments of EMSs.

What is the maximum capacity of battery pack without equalization?

Limited by the "weakest cell",the maximum available capacity of battery pack without equalization in Case 1 and Case 2 are only about 642mAhand 588mAh,respectively. With the designed equalization strategy,the maximum available capacity of battery pack in those two cases can be further improved 10.29% and 10.25%,respectively.

What is layered battery equalization method?

A layered battery equalization method is proposed,which reduces the calculation difficulty of the equalization currentby layered equalization of the batteries in the group and calculates the equalization current in real-time according to the state of the batteries in the group.

Aiming at the energy inconsistency of each battery during the use of lithium-ion batteries (LIBs), a bidirectional active equalization topology of lithium battery packs based on energy transfer was constructed, and a bivariate equalization control strategy of adjacent SOC difference and voltage is proposed according to the corresponding relation...

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Throughout this section, we consider a general charging scenario in which a battery pack can be charged using a variety of power sources, such as the a photovoltaic ...

In [], a hard constraint of the terminal state vector (x(N)=x_s(N)) is used to make the cells" SOCs at the end of the charging process equal to their target value.However, the user settings may not be accomplished in practice; for example, even if we persistently charge the battery with the maximum allowed charging current, the battery pack cannot be fully charged ...

Schematic of a series battery pack during charging and discharging, and the definitions of capacity. 1.3. EMS frameworks. An EMS monitors the external characteristics of a battery pack in use, estimates and identifies its internal states and parameters, and measures inter-cell inconsistency via internal and external features. When an inconsistency is detected, ...

During the charging period, the converter is in buck mode, and its output is controlled by constant current/voltage; during the discharging period, the converter is in boost mode, and its output is controlled by constant voltage.

Three for the active equalization circuit board, mainly used for the unbalanced state of the single battery equalization charging and discharging control; 4 for the battery pack module, by four 18,650-type, rated voltage of 3.7 V, the battery capacity of 3,000 mAh lithium iron phosphate batteries connected in series, as shown in Figure 11(b) is the active equalization of ...

This typically involves increasing the voltage to about 2.5V per cell, approximately 10% higher than the normal charging voltage. Begin Charging: Initiate the charging process and monitor closely. Monitoring the Process. During the equalization charge, it"s vital to: Monitor Specific Gravity: Check the specific gravity readings every hour ...

A battery usually consists of a pack of cells connected in series. Manufacturing processes lead to imperfections in cells, as a result of which, all the cells in a pack are not identical. Electrical imbalances occur during charging and ...

Pack capacity and consistency in the fresh or aged state are significantly improved after battery equalization. In the real battery module experiment, the maximum absolute errors of open circuit voltage (OCV) and state of charge (SOC) are 21.9 mV and 1.86%, and the capacity is improved by 13.03%.

To our knowledge, this is the first work to achieve series-connected battery pack active equalization by fusion of data-driven residual capacity online estimation and global optimization-based equalization current calculation. Our work clearly demonstrates the conveniences and great potential of data-driven residual capacity online estimation ...

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During the charging period, the converter is in buck mode, and its output is controlled by constant current/voltage; during the discharging period, the converter is in boost ...

This solution is based on treating and filtering a time series in real-time software, using the battery pack characteristic discharge curve and time series statistical features. The time series is ...

During the equalization process, there are differences in the equalization principle when the highest voltage cell and the lowest power cell have different position relationships. The equalization principles in each of the two different cases are analyzed. When the highest and lowest voltage cells are in the same series battery pack P x, assuming that B xi has the ...

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The main purpose of Li-ion battery pack equalization is to improve the consistency between battery cells, to achieve the same or close characteristics of power and voltage between each cell, and to reach the ...

When a cell in the battery pack is fully charged/discharged, the connection to the external power source/load must be discontinued to prevent overcharge/over-discharge of the Li-ion battery. Otherwise, the remaining cells in the battery pack that are not being fully charged/discharged lower the battery pack"s real capacity [14, 15].

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