Wireless Smart Battery Management System

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New topologies, systems and control schemes // Wireless Smart Battery Management System

Battery management systems (BMSs) play a critical role to ensure the safe and reliable operation of Lithium-Ion batteries. Traditional BMSs suffer from poor scalability, lack of fault-tolerant operation, and high weight and maintenance of wire harness.

Wireless smart battery management systems (WSBMSs) are a potential future trend for BMS technology due to their high flexibility, scalability and fault tolerance. In this concept, the battery systems are built by series inter-connecting smart cells, which are the integrated cell modules. Each smart cell has its own controller that integrates voltage and current sensors, ambiance or temperature monitors, cloud communication (IoT) gateway, and the balancing circuit based on bypass devices (Fig. 1). Superior balancing can be achieved with minimum loss and no need for high-frequency switching dc-dc converters, as shown in [1].

The smart cell can estimate the state-of-charge (SOC) and the state-of-health (SOH) as well as predict the remaining useful lifetime (RUL) of the battery using cloud computing. Due to the »controlled« connection between cells using individual bypass devices, high-performance active balancing is possible in both charging and discharging battery operation, as well as a high degree of flexibility is possible by using cells with higher tolerance in capacity in the package along with the faulty cell isolation feature. Moreover, wireless communication allows faster configuration of packages, remote maintenance and reduced weight [2].

Recently, pulsed-charging has demonstrated battery life extension at the extra cost of the pulse generator. The bypass device in WSBMS can be also used for pulsing the cell current in both charging and discharging operation, with no impact on load current, as very few cells are bypassed at the same time. Aalborg University built a prototype of a WSBMS, as shown in Fig. 2. The master controller is a Zedboard with an additional Wi-Fi module, and the slave controller is CC3220SF Simplelink Wi-Fi wireless microcontroller unit (MCU). A possible application of WSBMS is EVs with a relatively high number and size of battery cells where the additional cost/kWh can be minimized and outbalanced by the new features and performance.

> » Wireless smart battery management systems are a potential future trend «

[1] B. Majmunovic, R. Sarda, R. Teodorescu, C. Lascu, and M. Ricco, »Highly Efficient Smart Battery Pack for EV Drivetrains,« 2017 IEEE Vehicle Power and Propulsion Conference (VPPC), Belfort, 2017, pp. 1-5.

[2] M. Ricco, J. Meng, T. Gherman, G. Grandi, R. Teodorescu, »Smart Battery Pack for Electric Vehicles Based on Active Balancing with Wireless Communication Feedback,« Energies 2019, 12, 3862.

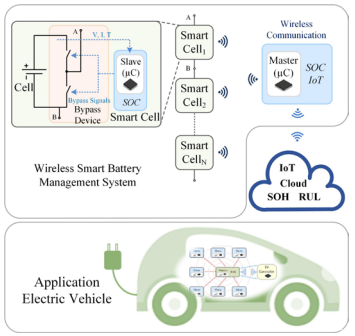

Fig. 1: WSBMS concept at Aalborg University

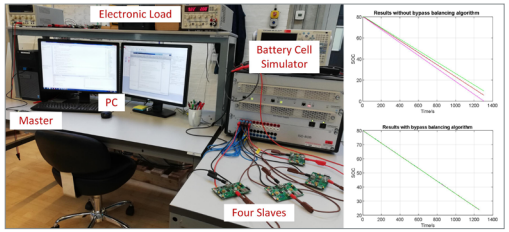

Fig. 2: WSBMS prototype at Aalborg University

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