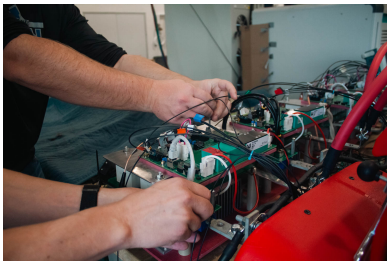
Multi-mode Control of Hybrid Battery Packs

03/20/2025



Multi-mode Control of Hybrid Battery Packs

Electrical & Computer Engineering

Abstract

This technology improves electric vehicle battery life and efficiency by improving balancing methods between separate power cells. By using a low-power energy transfer unit (ETU) integrated within the composite hybrid energy storage system (CHESS) architecture, this approach provides a cost-effective way of balancing individual cell modules and battery packs while supplying power to auxiliary loads.

Problem

Battery capacity, power, lifetime, cost, and sustainability pose significant challenges to realizing equitable electric mobility in electric vehicles, and efficiency in second life uses.

Solution

Through an advanced multi-mode control method and a low power energy transfer unit (ETU), efficiency is maximized for use in various situations, even under dynamic loads from the vehicle and connected devices.

Value Proposition

By improving battery efficiency, size and weight can easily be varied while maintaining a similar power output. This allows improvements in battery size, weight, cost, lifespan, simplicity, and sustainability.

Benefit

Electric vehicle batteries are generally heavy, expensive, short-lived, and non-renewable. Several non-conventional uses of these batteries to power non-vehicular devices, such as powering household appliances as seen in the latest EV innovations, diminish the life of ineffectively balanced batteries.

By providing a balancing circuit through a low-power ETU, the technology allows existing batteries to be used more efficiently to maximize life and performance. The technology uses a multi-mode system to balance power output from each source in the system, maximizing efficiency in all situations including EV use and powering external devices.

By improving battery efficiency, other battery characteristics such as size and weight can be varied while maintaining a similar power output. The technology allows for improvements in battery size, weight, cost, lifespan, simplicity, and sustainability.

Market Application

This technology is applicable in the electric vehicle market. It is capable of maintaining efficiency while various connected loads are attached.

Inventors

Regan A Zane

Hongjie Wang

Marium Rasheed

USU Department: **ASPIRE (Advancing Sustainability through Powered Infrastructure for Roadway Electrification),**
Electrical & Computer Engineering

Funding

This invention was made with government support under EEC1941524 awarded by the National Science Foundation. The government has certain rights in the invention.

USU Reference No. C24015

Publications

- Rasheed, Marium, "Architectural Design of Hybrid Battery Energy Storage Systems With Integrated Active Balancing and Reconditioning Control" (2023), Utah State University, All Graduate Theses and Dissertations, Spring 1920 to Summer 2023. 8865.

Intellectual Property

Pending U.S. Non-Provisional Patent Application filed August 2024