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USU College of Engineering

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UPEL students, M. Muneeb Ur Rehman and Hongjie Wang, published three research papers at COMPEL 2015, the annual IEEE conference for Control and Modeling for Power Electronics. The research work is part of the AMPED project for which UPEL is working with a multi-disciplinary team including the University of Colorado at Boulder and Colorado Springs, National Renewable Energy Laboratory (NREL) and Ford Motor Company. The project is funded in part by the United States Department of Energy's Advanced Research Projects (ARPA-E).

Muneeb's paper, titled 'Control of a series-input, parallel-output cell balancing system for electric vehicle battery packs', highlights research on control of an active balancing system for electric vehicle battery packs. The balancing system consists of low-voltage bypass dc-dc converters that perform real-time active cell balancing using a shared low-voltage (LV) bus. The control strategy proposed by the group results in SOC balancing and proper LV load sharing among bypass converters. It also allows for advanced balancing goals which improve battery pack lifetime and reduce cost and weight. Muneeb was one of the recipients of student travel grant from COMPEL.

Hongjie's paper, titled 'SIMULINK based hardware-in-the-loop rapid prototyping of an electric vehicle battery balancing controller', features research work on real-time battery balancing system implemented using Simulink on a personal computer (PC). The development approach is valid for a variety of systems including battery balancing system and it does not require a computationally powerful DSP, or ECU. It can be implemented using software and hardware readily available in most laboratories. Results showed that the system satisfies real-time constraints for SOC estimation and balancing of a twenty-one cell pack and is scalable to large battery packs.

Another paper by the students, titled 'State-of-charge estimation based on microcontroller-implemented sigma-point Kalman filter in a modular cell balancing system for Lithium-Ion battery packs', focuses on battery cell state-of-charge (SOC) estimation in a micro-controller environment. This work was led by Fan Zhang (at CUB) who developed a lower-order cell model and sigma-point Kalman filter. Previously Kalman filter based estimation algorithms have been shown to provide accurate SOC estimates using higher –order cell models. However the computation requirement for such algorithms is high. The proposed algorithm was implemented in a low-cost, generic TI microcontroller and shown to provide good SOC estimates under various drive cycles.