Implementation of IMM in Battery Management System

Centre for Mechatronics and Hybrid Technology
Mechanical Engineering McMaster University
Reza Hosseinenejad, Farzaneh Ebrahimi, Saeid Habibi

**What IS the BMS?**

The Battery Management System (BMS) ensures the safe and reliable operation of a battery pack by monitoring, predicting, and protecting against potential faults or dangerous trends in the system. It accomplishes this by processing information from monitoring sensors and communicating with other components of the vehicle.

**Thermal control**

There are air cooling, liquid cooling and cooling using PCM. Air cooling and liquid cooling are commonly applied.

**Charging Modes**

Battery charging optimized with BMS: constant current and voltage techniques used for efficient and safe charging.

- **Constant current charging**: An easy way to characterize the battery behavior. The battery behavior remains uniform as the coulombic charge is forced at a constant rate throughout the charging process.
- **Constant voltage**: It is used as a saturation charging step. The method mainly prevents over-charging with a carefully selected threshold voltage.
- **Semi-constant current method**: Uses impedance of the circuit to control the charging current. As the voltage of the battery increases with charge, the current starts to decrease.

Based on the infrastructure and power capacity, battery chargers are categorized in three levels.

**Cell Balancing**

- Improves the cycle life of the battery.
- Achieves the uniform aging of the battery pack so that the SoH of the cells is relatively close.
- Cell balancing prevents under-charging of good cells and over-charging of weak cells, which increase the overall age of the pack.
- There are different types of cell balancing topologies which can be categorized as active and passive.

**Battery States Estimation**

- Flat region in the SoC curve
- Batter model and process uncertainties
- Estimator-model combination

**References**

We acknowledge the support of the Natural Sciences and Engineering Council of Canada (NSERC), which invests annually over $1 billion in people, discovery and innovation.