Accelerated Development and Test of BMS Using an Emulation Based HIL

Testing a Battery Management Systems (BMS) with real Lithium-Ion Batteries (LIB) requires considerable conditioning efforts for each cell in terms of state and temperature, as well as precautions for the case of failures. To overcome these issues, a BMS Hardware-in-the-Loop (HIL) system was developed.

A BMS-HIL consists of an arbitrary number of Cell Emulators (CE), Current Sensor Emulators (CSE) and Temperature Sensor Emulators (TSE) with individual, programmable characteristics. Additional ports for control and communication purposes (e.g. Circuit Braker Emulator (CBE), CAN) and a variety of possible cell interconnections and circuits for failure scenarios are included. The simultaneous calculation of the cell models in real-time provides a precise representation of the behaviour of the batteries. The model (ISETLIB) is based on the simulation of all relevant physical and electrochemical processes, offering a high accuracy over the entire operating range and a precise knowledge of each battery's state.

The structure of the model allows the consideration of production tolerances and aged batteries.

Thus emulator-based HIL environments accelerate the development and testing of a BMS since the conditions can be changed by software. Safety issues are avoided completely. In contrast to a real LIB, it can provide internal battery quantities, thus delivering a reference value for the BMS algorithms.