



17th – 18th May 2022



Valencia (Spain)

Electromobility Technology Workshop:

Driving a Greener Value Chain

by



i-HeCoBatt

X-in-the-Loop techniques for rapid prototyping



TITLE: Dr. / Project Manager

SPEAKER: Lluís Trilla



X-in-the-Loop techniques for rapid prototyping

MARBEL Background:

MARBEL aims to develop a new modular, compact, lightweight and high-performance battery packs together with flexible and robust battery management systems for BEV and PHEV following Ecodesign principles.

MARBEL will develop and qualify future and innovative performance and safety related test procedures including a flexible test-bench simulating integration-in-EV conditions (electric Vehicle In-the-Loop, eVIL) and AI algorithms to reduce the time of laboratory experiments.

MARBEL consortium is made of 16 partners from 8 different European countries, representative of multi-stakeholder collaboration and business drivers required for developing the battery pack of the future.



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X-in-the-Loop techniques for rapid prototyping | BMS

Development of novel BMS with advanced features:

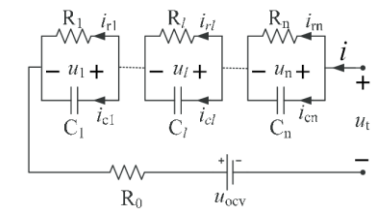
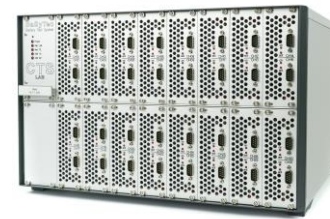
- Wireless communications
- Data-driven model
- Cloud connectivity
- Additional sensors
- Modularity and scalability

- All these additional features need to be validated
- All changes at once cannot be performed
- Physical validation process require long procedures
- Projects are limited in time
- High TRL projects are challenging
- Rapid prototyping strategies are appropriate

Models and algorithms

- In a first step a cell model is developed
- Cells are tested in several operating conditions (Temperature, C-rate and SoH)
- The model and estimation algorithms are evaluated
- Several cells and models can be evaluated in parallel to accelerate validation

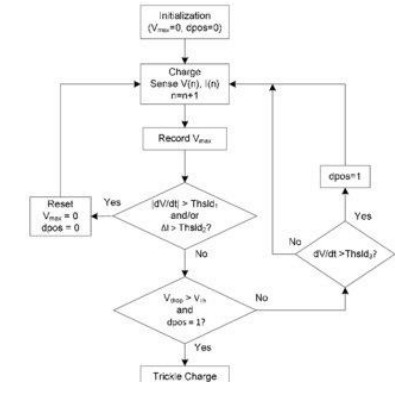
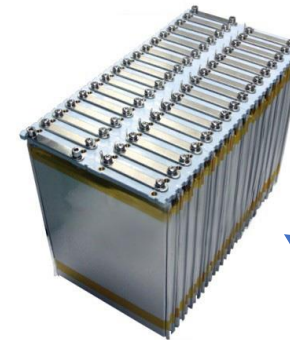
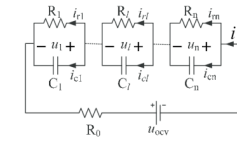
Cell-in-the-Loop



Control

- In the second step the control logic is validated
- It incorporates the previous model and algorithms
- Several cells and sensors are used simultaneously to replicate a module
- Sensor integration, balancing strategy, thermal management, and data sharing (including connectivity) are evaluated digitally

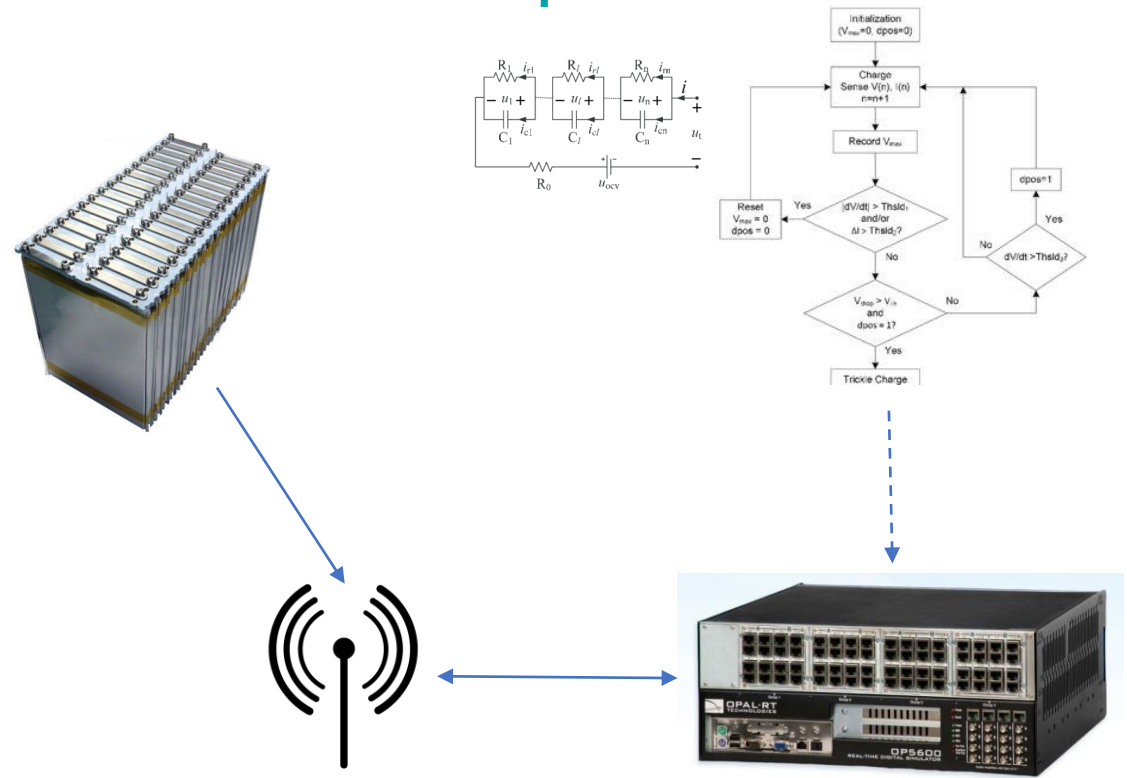
Software-in-the-Loop



Data transmission

- In the third step the communications system is tested
- It incorporates the previous control logic, model and algorithms
- The communications system interface the module
- Data transmission is validated (signals structure, bandwidth, update rate...) are validated
- The experimental setup replicates battery and module interaction
- Interferences and data loss can be evaluated

Comms-in-the-Loop



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Scenarios and faults

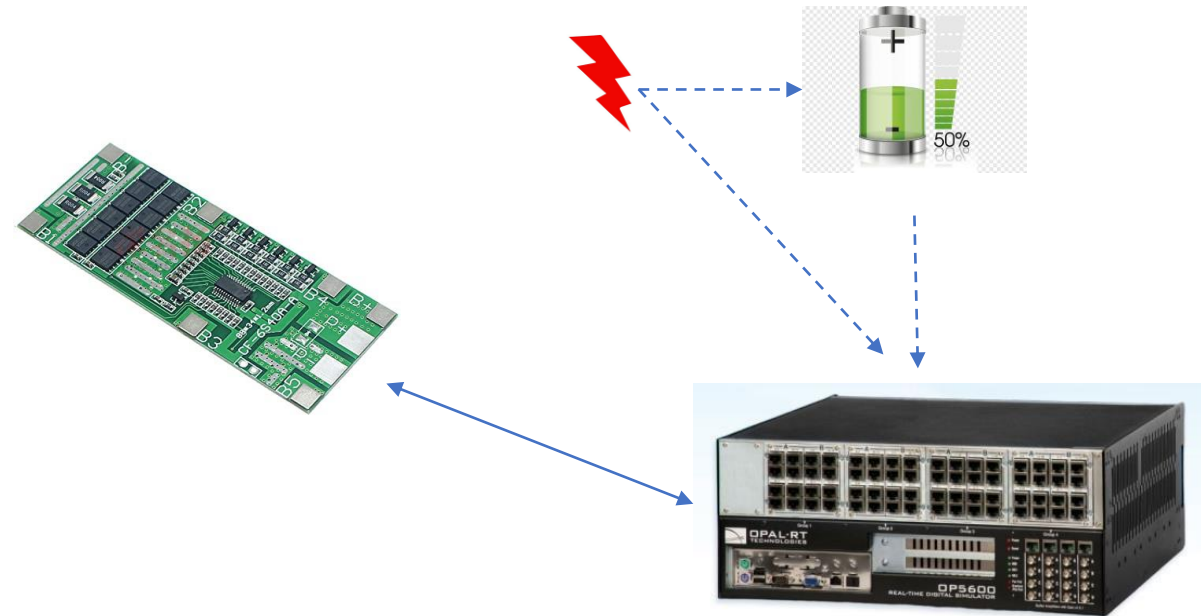
- In the final step the hardware prototype is evaluated
- It includes previous developments
- The battery is emulated in several conditions to replicate different scenarios
- Fault insertion is possible to validate warnings and alarms
- Objective: to evaluate scenarios and operating modes including handling faulty conditions

The rapid prototyping process enables the development of complex systems in shorter time to match project timings



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Hardware-in-the-Loop





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