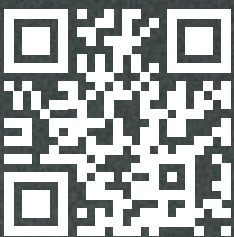




Software innovations

ADVANCED BMS SOFTWARE, REAL-TIME EXECUTION, AND CLOUD INTEGRATION IN NEMO

As a key enabler of the Battery Management System (BMS) concepts explored in the NEMO project, the software stack and BMS architecture allow advanced physics-based and data-driven models to be executed, integrated and validated in real systems. Learn how embedded software, hybrid on-board and cloud execution, and robust integration layers enable EIS-based sensing, advanced state estimation coupled to active state of health based balancing and scalable battery analytics in next-generation BMS solutions.



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Research approaches

The NEMO project demonstrates that advanced battery management concepts only become practically exploitable when software architecture is designed as an enabling platform. Early consideration of real-time constraints, integration effort and data flows is essential to bridge the gap between research-grade algorithms and industrially relevant BMS solutions.

Software expertise contributed by project partners, including IAV, combined with model and algorithm developments from research partners such as CSEM, VUB and TUG, enables a scalable BMS software stack suitable for both laboratory demonstrators and future series-level systems.



Findings

Usage of high-performance embedded BMS software:

- ◆ Execution of advanced battery and algorithms on automotive-grade microcontrollers
- ◆ Support for real-time state estimators (including EIS based state of charge and state of temperature), safety monitoring and control functions
- ◆ Efficient use of multicore architectures and hardware accelerators
- ◆ Deterministic behavior under automotive real-time and safety constraints

Usage of hybrid on-board and cloud-supported software:

- ◆ On-board processing for real-time functions
- ◆ Cloud-supported data storage, and computationally intensive processing (such as estimator recalibration), offline analysis and long-term model validation
- ◆ Enablement of data-driven development and benchmarking using high-resolution battery data
- ◆ Support for FAIR data principles and research reuse

Usage of software interfaces and integration layers:

- ◆ Standardized interfaces to sensor hardware, including EIS-capable sensing boards and active balancing
- ◆ Integration of embedded BMS software with hardware platforms and communication layers
- ◆ Interfaces to cloud services for data exchange and analytics
- ◆ Modular integration of models and algorithms from multiple project partners