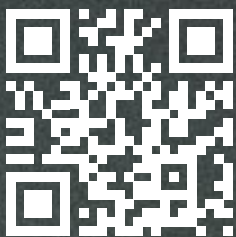




SoS estimator based on BMS data

As a key enabler of the safety monitoring concepts explored in the NEMO project, a State-of-Safety (SoS) assessment framework combines data-driven modelling with physics-informed indicators to detect early signs of battery damage. Learn how integrating operational history with mechanical, electrical and thermal models extends conventional State-of-Health approaches, enabling early failure detection, long-term safety forecasting, and cloud-supported, system-level risk management within next-generation BMS solutions.



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Research approach

The NEMO project contributes to advancing the state of the art in battery safety monitoring by enabling integrated, predictive State-of-Safety (SoS) assessment beyond conventional State-of-Health approaches. The focus is on improving early failure detection and lifetime safety prediction through data-driven and model-based methods that extend the capabilities of Battery Management Systems (BMS).

Within KER6, a SoS assessment framework was developed using BMS data. The approach combines data-driven modeling with physics-informed safety indicators to detect deviations from normal operating behavior and identify emerging safety risks.

The methodology integrates experimental characterization, aging and abuse datasets, and model-based feature extraction. It is designed for cloud-supported execution and demonstrates a unified concept for battery safety assessment, supporting early risk identification and proactive safety management.

photo of the
experimental
characterization

Key Findings

Usage of the history-based SoS estimator:

- ◆ A history-based SoS estimator was developed that enables early detection and classification of safety-relevant battery damage using BMS data.
- ◆ The approach supports improved Battery Management System functionality by providing enhanced safety indicators beyond standard State-of-Health metrics.

Usage of the long-term SoS predictor:

- ◆ A long-term SoS predictor was implemented to quantify safety margin degradation over the battery lifetime using mechanical, electrical, and thermal models.
- ◆ The combined framework enables unified short-term diagnostics and long-term safety forecasting, supporting predictive safety management and early risk mitigation.

Usage of the cloud-based implementation:

- ◆ Cloud-based implementation allows scalable processing and integration with other NEMO models for system-level safety assessment.

Key insight:

- ◆ Reliable SoS estimation requires combining operational history data with physics-based constraints to ensure robustness across varying degradation and abuse scenarios.

