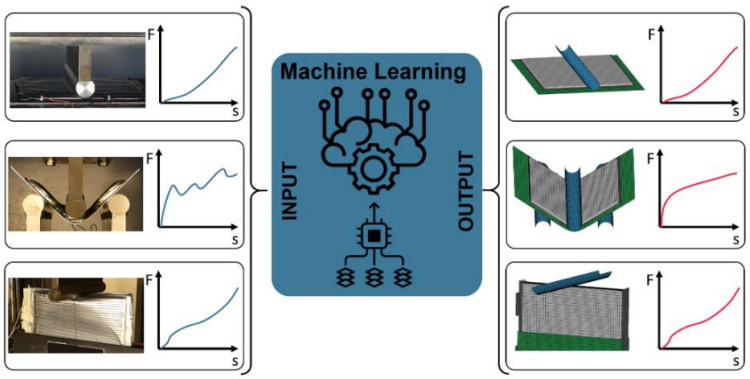
SUCCESS STORY

SafeLIB
Safety Aspects of Lithium-Based Traction Batteries Including the Qualification for Second Life Applications

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Project

Type of project: P1 TRANSFER, 04/2021 – 03/2025, multi-firm



SafeLIB

BATTERY SIMULATION: MORE EFFICIENCY THROUGH MACHINE LEARNING

INTEGRATION OF MACHINE LEARNING INTO THE DEVELOPMENT PROCESS LEADS TO FASTER CALIBRATION OF SIMULATION MODELS.

In order to ensure the safety of all persons involved in an accident, it is of great importance to understand the behaviour of electric vehicle batteries. A profound knowledge of the crash behaviour of these vehicles as well as their electrical energy storage systems is essential to be able to evaluate and, if necessary, prevent such situations. Until now, the traction batteries of electric vehicles have generally had a hierarchical structure. The battery system consists of several modules, which in turn are made up of individual cells. Mechanical damage to these cells can lead to a so-called thermal runaway. To analyse the behaviour of such cells under mechanical loads, simulations are used in addition to experiments. An essential advantage of such simulations in contrast to experiments is the non-existing hazard potential. Furthermore, simulations are characterised by their repeatability, defined boundary conditions and the simple implementation of parameter studies.

Challenges of the future

The field of eMobility, like battery technology itself, is a field of research that is characterised by great changes. New batteries are constantly appearing, some of them fundamentally different in terms of cell chemistry, design and structure. The intervals between these innovations are also becoming shorter and shorter. This also leads to challenges in the field of simulation. For macroscopic cell models, the determination of suitable model parameters can be tedious depending on which parameters and against how many load cases one calibrates. This calibration process needs to be made more efficient to keep up with the emerging dynamics.

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie
Bundesministerium Arbeit und Wirtschaft
COMET Competence Centers for Excellent Technologies
Das Land Steiermark
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Increasing efficiency through machine learning

In the course of the SafeLIB project, machine learning was integrated into this process to make it more efficient. Meta-models were created that are able to predict the result of a simulation without having to carry it out at all. However, this requires a database. To create this basis, the parameters to be calibrated must first be identified. For these parameters, intelligently chosen test combinations are defined by statistical methods. All load cases against which the model is calibrated are automatically simulated with these parameter combinations. The regression models are trained with this database. However, the dimensionality is first reduced by means of singular value decomposition. In this way, the data basis can be compressed to the essential characteristics. The regression model works in this reduced basis. The training process is carried out using a fixed point algorithm. After successful training, this meta-model is able to predict the results of thousands of parameter combinations within one second. By comparing the results with those of the experiments carried out, the best parameter values can be determined. Thus, we are able to efficiently calibrate simulation models of batteries against a large number of experiments.

More safety through artificial intelligence

Artificial intelligence offers us the opportunity to use the huge amount of measurement data that is already being generated and stored. This is not only limited to the field of simulation. The analysis of data from real vehicles offers the possibility to better understand and model complex processes such as the ageing of batteries, the response to multi-physical loads or the thermal runaway itself. This knowledge can in turn be used to optimise future systems in terms of safety.

Project coordination
Ass. Prof. Dipl.-Ing. Dr. techn. Christian Ellersdorfer
Dipl.-Ing. Alexander Schmid, BSc (Story)
Vehicle Safety Institute

T +43 (0) 316 873 –30318
christian.ellersdorfer@tugraz.at

SafeLIB
Vehicle Safety Institute, VSI
Inffelgasse 23/I
8010 Graz
T +43 (0) 316 873 30301
office.vsi@tugraz.at
https://www.tugraz.at/en/projekte/safelib/home/

Project partners

- Audi, GER
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- Fill, AUT
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- JKU (LIT Law Lab), AUT
- Mercedes Benz, GER
- TU-Graz (ICTM/VSI), AUT
- VIF, AUT
- Wacker Neuson (AUT)

SafeLIB is a COMET project within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMAW, province of Upper Austria, the province of Styria as well as SFG. COMET is managed by FFG. Further information on COMET: www.ffg.at/comet