
**Optimization of scalaBle rEaltime modeLs and functIonal testing for e-drive ConceptS**

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## Publishable Executive Summary

**Deliverable D2.1 provides** detailed description of Scalable Real-time Models & Parameter Identification techniques for battery and in particular of:

- Development of electrochemical and electro-thermal models and models of side reactions, runaways and degradation,
- Development of model scalability approaches and real-time models featuring low CPU demand,
- Development of battery parameterisation tools and methods,

which were developed within WP2 and in particular Task 2.1 of the OBELICS project.

**Rationale** for development of these models arises from the fact that model-based development enables engineers to test the system in early phases of the development within a virtual environment, when it is inexpensive to fix problems. Such model-based development is a process that enables faster, more cost-effective development of dynamic systems, including control systems, signal processing, and communications systems. In model-based development, a system model is at the centre of the development process, from requirements development, through design, implementation, and testing. System engineers use models to derive low-level requirements and then use the models to interface with customers and suppliers. Algorithm developers can then reuse and elaborate the same models to build and test more detailed designs. Further in the development process, these models can become the design artefacts from which hardware engineers automatically generate HDL code.

In addition, the system level models and tests can be reused to validate the performance the final hardware against the model level results. Models are re-used and elaborated at every development phase, reducing the amount of translation inefficiencies and errors in the process. With the model at the centre of the design process, design iterations are faster, design artefacts are automatically generated, and engineering teams have a common platform to share design.

**As an answer to this challenge** OBELICS delivers innovative and reliable modelling approaches that are mechanistically based and are real-time capable or allow for systematic scalability towards real-time models. Furthermore, derived models ensure compatibility of the models between different components as well as development levels/phases.

To ensure compliancy of the developed models with these objectives, definition of the models features such as interface inputs, interface outputs, HiL compatibility, expected minimum exchange rates of models, model features that cover requests on the phenomena covered by models and anticipated development and integration platforms is driven through systematic model requirement specifications of relevant use cases.

**The ambition** in the area of advanced battery models arises from development of innovative models, model scalability methodologies and parametrization techniques that push the boundaries of simulation and testing of EVs with the goal to support more efficiently frontloading in the development process. Developed models will also allow for approaching engineering limits with higher certainty compared to the existing state-of-the-art resulting in reduced effort in physical testing and thus supporting development of more efficient EVs in shorter time and with less effort. These features are crucial to improve efficiency, reduce development efforts and thus costs while improving safety of the next generation of EVs. Furthermore, detailed models provide new insights into performance, reliability and safety aspects, which are also crucial for development of next generation of EVs.

**Objectives** that arise from listed ambitions are achieved through:
- higher level of predictability and higher level of accuracy of the developed models,
- their better connectivity and interoperability yielding higher fidelity multi-domain models,
- scalability of the models resulting in more efficient and consistent support through various off- and on-line development stages,
- advanced reliable and highly automated parametrization tools.

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**Project partners:**

| Partner no. | Partner organisation name | Short Name |
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