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all types of electrified vehicles and components

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Publishable Executive Summary

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The goal of the PANDA project is to provide unified organisations of digital models for the simulation of the powertrain of all types of electrified vehicles. The introduced methodology in PANDA sets up an innovative cloud-based simulation environment, allowing a wide range of different powertrain component models to be interconnected and interacting with each other. Through the reduction of the computational effort to simulate a large variety of powertrain designs, PANDA aims to reduce the time-to-market of EVs up to 20% by the possibility of a reliable and easy-to-use virtual validation in the development process.

The battery of an electrified vehicle plays a key role in terms of costs and performance. Two methods are explored in PANDA to build battery models: either using a knowledge-based or a behaviour-based approach. Unlike a knowledge model, a behaviour model doesn't rely on modelling the physical phenomena of the battery components. Behaviour models are exclusively data driven, i.e. based on measurable features and machine learning methods to automatically generate the models. Although knowledge and data driven models correspond to two different approaches, the inputs (for example the battery current) and outputs (for example the battery voltage) must be identical. This is to ensure interoperability of the models for vehicle simulation, which is another goal of the PANDA project. Any user of the PANDA project can use both kinds of models. This report presents the development of a methodology to obtain a battery model using exclusively measurement data and an application example using data of a Renault ZOE.

After a comparative introduction to the behaviour-based approach and a presentation of machine learning techniques, this report details the organisation of the battery model and its equivalent as an energy source in the EMR formalism. Then, the exploration of the available datasets precedes the description of the plan to select and validate suitable machine learning algorithms. Then comes the concrete application of machine learning techniques to the datasets, including the whole process of pre-selection, selection and optimization of algorithms. And finally, the question of the validity of the data driven models is treated.

Because the models base exclusively on the available data, the quality and the quantity of the datasets are limiting factors and influence the final properties of the model (accuracy, ability to be generalized, etc.). Although the successfully applied method to the battery of the Renault ZOE demonstrates that the framework established in this report is practically usable, exploiting the full potential of this framework requires to employ more suitable datasets which is possible involving further batteries of the project in order to obtain better performing models.

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Table 1: Project Partners

#	Type	Partner	Partner Full Name
1	UNIV	ULille	Université de Lille
2	IND	SISW	Siemens Industry Software SRL
3	UNIV	VUB	Vrije Universiteit Brussels
4	IND	VEEM	VALEO Equipement Electriques Moteur SAS
5	UNIV	UTCN	Universitatea Tehnica Cluj Napoca
6	SME	TY	Tajfun HIL (Typhoon HIL)
8	UNIV	UBFC	Université Bourgogne Franche-Comté
9	SME	UNR	Uniresearch BV
10	IND	RTR	Renault Technologie Roumanie
11	SME	Bluways	BlueWays International bva
12	IND	TUV-BT	TUV SUD BATTERY TESTING GMBH

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