LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

MEGEVH
French network on HEV's

Master thesis, 2017-2018

— *Modelling Li-ion battery for Electric Vehicles simulation* —

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Context

Energy storage is a major concern with the electrification of vehicles. This master thesis is a part of a common project between the laboratory L2EP (Université Lille 1) and the laboratory Ampère (Université Lyon 1), within the framework of MEGEVH, French scientific network on EVs (Electric Vehicles) and HEVs (Hybrid Electric Vehicles)[1].

- L2EP is working on the model control and energy management organizations of EV and HEVs [1].
- Ampère is working on the reliability of Energy Storage Systems (ESS) such as batteries [2], supercapacitors [3] and lithium capacitors.

The philosophy is, to study the battery behaviour in EVs used as a main ESS.

L2EP and Ampere have started common works on battery modelling since 2017. The goal is to build a simple electro-thermal model able to accurately reproduce the experimental electric and thermal behaviour of one real cell.

- Ampère and L2EP proposed an electrical and thermal model for Li-ion large cells.
- L2EP organized the electro-thermal model using Energetic Macroscopic Representation.
- Ampère proceeded to the characterization of the electro-thermal parameters with charge / discharge tests.
- L2EP extracted power solicitation of battery as a function of the driving cycle for the EV considered.

The proposed project aims to check the right complexity necessary for a battery model used in EV from a system point of view. The model developed by L2EP and Ampère will be first tested using various driving cycles. Including real one from the vehicle Tazzari Zero of L2EP. Then, simplified models will be deduced and evaluated using the initial and validated model as a reference.

Objective

The aim of this Master thesis is to propose different battery models for the simulation of the complete traction of electric vehicles. From real driving cycles, different batteries models will then be compared in terms of accuracy of energy consumption and computation time. At the end of the projects, one can be able to select the right battery model for a vehicle simulation in function of the study objective.

Scientific axis of L2EP, control team*: multiphysics modelling; model organization; EV model;*
Scientific axis of Ampère, Safe systems and energies priority*: battery model; equivalent circuit model; ageing law.*

Work steps

To achieve this goal, some steps could be performed:

- analysis of standard driving cycles for EV,
- record of real driving cycles on the vehicle Tazzari Zero,
- validation of the complex model using experimental driving cycles,
- evaluation of simplified models.

Key word

Electric Vehicle; Energetic Macroscopic Representation; Battery modelling, Model Accuracy.

[1] L. Horrein, A. Bouscayrol, W. Lhomme, C. Depature, "Impact of heating system on the range of an electric vehicle ", *IEEE transactions on Vehicular Technology*, to be published in 2017.
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[3] R. German, A. Sari, O. Briat, J.-M. Vinassa, and P. Venet, "Impact of Voltage Resets on Supercapacitors Aging," *IEEE Trans. Ind. Electron.*, vol. 63, no. 12, pp. 7703–7711, Dec. 2016.

[1] http://www.megevh.org/