LABORATOIRE DES SCIENCES DE L'INGENIEUR, DE L'INFORMATIQUE ET DE L'IMAGERIE (ICube-UMR7357)

Master project, 2018-2019

Development of Advanced Control Software Platform for Battery-Supercapacitor Hybrid Energy Storage System

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Context

In the Industry 4.0, the energy storage system ESS used in electric or hybrid vehicles remains the weak link: very expensive, limited in autonomy, slow to recharge, etc. Today, the main axis of progress is undoubtedly based on the development of embedded ESS's providing solutions for improving the vehicle range, lifetime, volume, mass, or even the investment or use cost of these storage systems. One of the solutions proposed by manufactures and researchers in the field of the E-mobility is the hybridization of sources. The principle consists in combining two complementary storage technologies (high specific energy for the first, high specific power and available over short periods of time for the second). This hybridization makes it possible to exploit the advantages of both storage systems and gives additional degrees of freedom during design. In electric vehicle drive applications, there are various known technological solutions, for example the combination of fuel cells, batteries or supercapacitors. In return, intelligent on-board energy management of hybrid storage sources is becoming essential to enable their development, in order to effectively manage energy exchanges between the sources on board the vehicle. The typical configuration of the Li-ion battery-supercapacitor Hybrid Energy Storage System HESS is shown in Fig. 1.

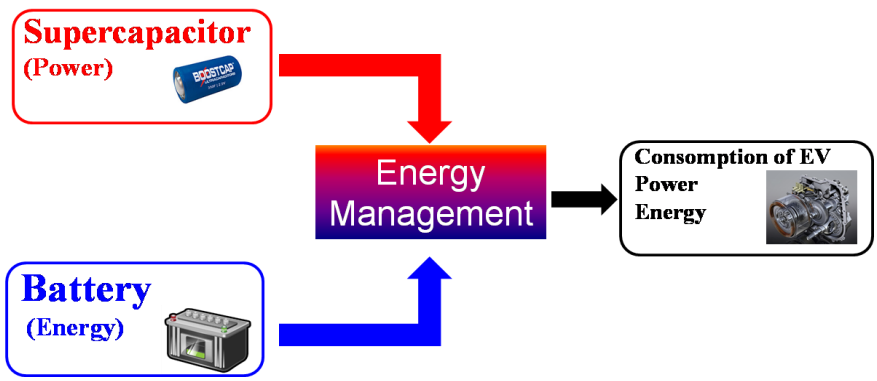

Fig. 1.Li-ion battery-supercapacitor Hybrid Energy Storage System HESS

Objective

The aim of this internship is to develop an advanced control software platform for Li-ion battery-supercapacitor HESS. More specifically, the work would concern an autonomous electric trolley with two energy sources. To optimize the energy consumed for a typical cycle (vehicle range), the battery lifetime, the volume, the mass, as well as the Total Cost of Ownership (TCO), we would like to develop an advanced energy management based on optimal/predictive control.

Work Progress

The candidate must spend a minimum of six consecutive months from the day on which the internship is started in the Icube laboratory (INSA Strasbourg). He/she will work closely with, a PhD student, one or more INSA professors, and lab technician. The first step in this internship will be the understanding of battery-supercapacitor HESS working principal in electric vehicle application. This step will be completed by the modeling of the proposed system as state equations. Computer simulations using the developed model of battery-supercapacitor HESS will be carried out to test regular energy management strategies of the existing literature. Based on state system model and also the theory of optimal/predictive control, an advanced energy management strategy for battery-supercapacitor HESS will be designed. Lastly, many experimental and simulation tests will be done to define all necessary parameters.

Key words

Industry 4.0, electric trolley, li-ion battery/supercapacitor hybrid energy storage system, state model, and energy management strategy.

Reference

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