EVALUATION OF PERFORMANCES OF HYBRID ELECTRIC ENERGY STORAGE SYSTEM (LI-ION BATTERIES/ SUPERCAPACITORS): EV AND HEV APPLICATIONS

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Electric and hybrid electric vehicles sound the best alternative to internal combustion engines. However, energy storage systems must have a sufficient power and energy density (to answer accelerations, regenerate breaking power and have sufficient autonomy).
The advantage of batteries is their relatively large energy capacity. But batteries life time and capacity are limited by the number and the magnitude of current peaks [1]. The efficiency also depends on the discharge current regime. More there is high peak current, more the efficiency decreases [2].
Electrical double layer capacitors (EDLC) have a huge specific power and long life cycle because of their internal working principles especially based on charges transfer [3]. The main disadvantage is low specific energy.
A combination of the two systems is interesting to gain energy capacity and lengthens the life of the batteries by limiting current peaks inside.
The aim of this study is to evaluate the performances of a hybrid energy storage system (Li-ion batteries and EDLC) using a simulation tool. Batteries and EDLC are assembled in parallel in a high power bus. Batteries are directly linked on the bus because their nearly constant voltage. Conversely EDLC have to be connected with a DC/DC converter.
Efficiencies of the elements are dependent on the actual current within each component. Given a total energy capacity and a current profile, the difference in final energy capacity may vary from about 15% whether the storage system is composed of batteries and EDLC or not.
With hybrid energy storage the batteries are less discharged because of presence of EDLC (particularly due to efficiency difference) and their life cycle is longer.

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