

---



---

## Master project, 2017-2018

### — *Optimized topology of the interface converters of a Hybrid Energy Storage System* —

**supervisor:** Patrick BARTHOLOMEUS, [Patrick.bartholomeus@centralelille.fr](mailto:Patrick.bartholomeus@centralelille.fr) , Philippe Le Moigne, [philippe.lemoine@centralelille.fr](mailto:philippe.lemoine@centralelille.fr) , L2EP – Centrale Lille

#### Context

---

For some applications, neither electrical source is able to achieve the required performances. It is particularly true in the field of transportation. Hybrid energy storage systems (HESS) can be a very interesting solution for specific transportation application. HESS are generally composed of two sources: a first one with a high energy density and another with a high power density, which allows a good autonomy and sufficient acceleration/braking capability.

Since about ten years, numerous works on this subject have been published and have presented innovative solutions, among others by the L2EP laboratory [*Allegre 10*], [*Sadoun 13*], [*Mesbahi 16*] *et-and* [*Castaings 16*]. The great majority of these ones dealt with the association of sources and with the methods of power sharing between the two sources, in order to optimize the performance, the volume, the weight, the efficiency or the life-time.

The great majority of these works focuses on energy sources and the way to manage the distribution. But converters, which are generally an important part of the system, are studied very briefly and the choice of topology and its control is not deeply studied.

This topic has been discussed in a particular case [*Allali 16*] and needs to be extended and improved.

#### Objective

---

The aim of this work is to answer to these questions :

- Taking into account the constraints of size, weight, cost, life-time, reliability and also according to the characteristics of the selected sources, which association and topology of converter is the best adapted for a specific HESS?

#### Work steps

---

- Bibliography and Study of the existing solutions (topology, energy management methods)
- Assimilation of the interests and drawbacks of existing solutions  
*These two first steps can be made during the bibliographic project*
- Definition of the main parameters that allow the definition of the better topology
- Definition of a method to determine the better topology on the bases of the specifications
- Study of the influence of the energy management methods on the power electronic converter structure and vice versa.  
*Simulations with some examples of specifications of HESS will validate these last steps.*

#### Key words

---

hybrid energy storage system (HESS), Power electronics converter, electric and hybrid vehicles, energy management strategy, optimization.

#### References

- [*Allegre 10*] A-L. Allegre , “*Méthodologies de modélisation et de gestion de l’énergie de systèmes de stockage mixtes pour véhicules électriques et hybrides.*” Thèse de doctorat, Univ. Lille1 2010
- [*Sadoun 13*] R. Sadoun, “*Intérêt d’une Source d’Energie Electrique Hybride pour véhicule électrique urbain – dimensionnement et tests de cyclage.*” Thèse de doctorat, *Centrale Lille, Ecole Centrale de Lille*, 2013.
- [*Mesbahi 16*] T. Mesbahi, “*Influence des stratégies de gestion d’une source hybride de véhicule électrique sur son dimensionnement et sa durée de vie par intégration d’un modèle multi-physique.*” Thèse de doctorat, Centrale Lille, 2016.
- [*Castaings 16*] A. Castaings, “*Gestion d’énergie de véhicules multi-sources électriques et hybrides au travers de la Représentation Energétique Macroscopique.*” Thèse de doctorat, Univ. Lille 1 2016

[Allali 16] N. ALLALI, "Convertisseur à dimensionnement réduit pour batteries hybridées puissance/énergie de véhicule électrique : principe de source de courant contrôlée" Thèse de doctorat, [Centrale Lille](#), ~~École Centrale de Lille~~, 2016.