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

Master project, 2018-2019

— NUMERICAL STUDY AND MODELING OF THE MAGNETIC CIRCUIT OF A WIRELESS CHARGER FOR ELECTRIC VEHICLES —

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Context

The transportation industry is currently facing major technological transformation. The fast depletion of fossil resources, as well as environmental concerns, lead to the industry to work on less environmentally impacting vehicles, such as electric and hybrid vehicles. The electrical charge of these vehicles is classically performed with regular cable connection (Fig. 1). Recent developments have improved the charging speed with 80% charging of the battery in less than half an hour. Nevertheless the drawbacks of cable connection still remain unchanged. The driver must manipulate the charging cable to be plugged into an electrical outlet. The cable must be regularly checked for maintenance and is also not convenient to handle: rigidity and dirt because of ground contact. To avoid these drawbacks a wireless charging (Fig. 2), based on the principle of transformer energy conversion, is an attractive and elegant alternative solution.

Fig. 1. Regular cable connection (http://jalopnik.com/)

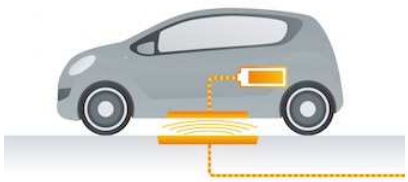

Fig. 2. Wireless charging (http://www.ipwatchdog.com/)

Nevertheless, the wireless charging implies a large distance, with an air gap, between the primary and secondary sides, which leads then to a weak coupling. Therefore, to obtain a significant power transfer, a high reactive power must be managed. The solution consists in placing resonant elements, on both primary and secondary sides, in order to compensate the reactive power and ensure good efficiency. In addition, the output parameters, at the load side, must be regulated in order to keep the charger operating at a given voltage with the current required by the battery. The control of the output parameters also allows the protection of the load.

Objective

The main objective of the internship is to compare different topologies in terms of performances of the magnetic circuit in wireless charging structures. This study will be performed through a numerical approach by investigating the effects of different magnetic materials, misalignment between primary and secondary sides ... The work will be especially focused on a numerical technique for fast identification of inductances and coupling factors in different misalignment scenarios.

Work steps

The following steps are planed:

- Bibliographic study on wireless charging techniques, structures and associated materials,
- Choice of a wireless charging structure and numerical modeling,
- Calculation of inductances and coupling factors for different scenarios of misalignments.