LABORATOIRE D'ÉLECTROTECHNIQUE ET D'ÉLECTRONIQUE DE PUISSANCE DE LILLE

Master project, 2016-2017

— *EMC Filter Design for Power Converters* —

L2EP supervisors: Arnaud Videt

Contact: arnaud.videt@univ-lille1.fr
L2EP – University of Lille 1, bldg. P2, 1st floor

Context

Power electronics converters are key power-processing devices in applications involving the management of electrical energy. However, because of semiconductor commutations, they generate undesirable common-mode voltage (CMV) having fast voltage transients (dv/dt), which is responsible for conducted electromagnetic emissions, notably high-frequency (HF) common-mode currents (CMC). These CMC spread by capacitive coupling to the ground conductor of the power supply and the load, thereby polluting the electrical network. Notably, these emissions may exceed the limits imposed by electromagnetic compatibility (EMC) standards, and cause malfunctions in neighbor electronic devices. Therefore, bulky and expensive EMC filters are required on both the input (grid) side and the output (load) side of power converters. Limiting the weight and volume impact of these filters is an important issue to improve the power density of power conversion systems, especially in embedded applications such as automotive or aerospace.

Objectives

When EMC filters are put both at the input and the output of power converters, HF perturbations are confined within the converter itself so that HF noise is reduced both on the load and the grid sides. However, thinking of the filters as a mere addition of separate input and output filters may not be a optimal way to tackle the EMC issue, especially when CM perturbations are concerned. Instead, new combined input/output filter topologies may be considered, with a focus on reducing the total filter volume. For instance, a patent has been recently issued by Schneider Electric [1] where a new topology that looks like an output filter actually achieves a by-pass function so as to eliminate input-to-output CMV, and thereby significantly reduce CMC on the input side as well. Thus, it is certainly possible to optimize a complete input/output EMC filter to meet EMC standards with a minimal impact on the filter volume. The proposed filter design should also be compared with a conventional EMC filter to assess its interest in practical application.

Work Progress

The internship will be part of currently ongoing research in the L2EP Power Electronics group. It will take place in the P2 building of the University, and will be in relation with a PhD student working on EMC improvement of power electronics systems. The candidate will first have to perform bibliographic research on EMC filtering solutions for power converters, and get familiar with the approach developed in the L2EP. An appropriate solution for both input-side and output-side noise reduction will be proposed and designed to achieve similar EMC performance compared with conventional filters. Computer simulations will be carried out based on this design. A prototype will also be built in order to experimentally validate the ideas and assess the interest of the proposed filter based on EMC results and total volume.

Reference

[1] A. Videt, P. Loizelet (Schneider Toshiba Inverter), "Power converter equipped at the output with a filtering device", patent WO2012084389/FR2969419, priority date 2010/12/20
(http://worldwide.espacenet.com)