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

Laboratoire d'électrotechnique et d'électronique de puissance de Lille

Master project, 2017-2018

— *Influence of Filter Topology on EMC Filter Volume in Power Electronics Converters* —

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Context

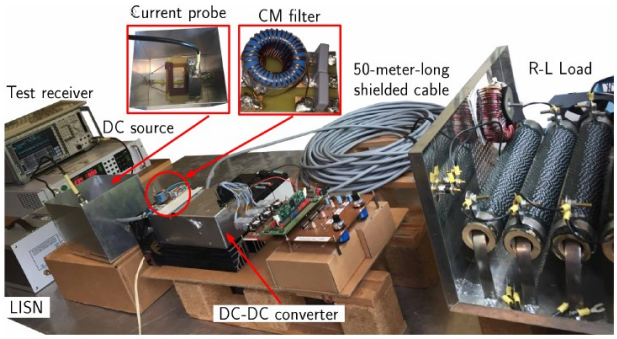
Power electronics converters are key power-processing devices in applications involving the management of electrical energy. However, because of semiconductor commutations, they generate undesirable common-mode voltage (CMV) having fast voltage transients (*dv*/*dt*), which is responsible for conducted 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

A classical DC/DC converter requires an EMC filter that should be as small as possible while enabling the system to meet EMC standard requirements (such as DO-160 for aerospace applications). It is typically constituted of a single-stage LC input filter, than can be designed based on the laboratory know-how [1], in order to provide a reference point for the study of other filter topologies. Then, two-stage (LCLC) filters with similar EMC performace can be investigated by focusing on the optimal distribution of common-mode inductors to minimize overall filter volume while taking care of saturation issues of the magnetic material. Parametric variations such as load cable length should be performed to determine their impact on the optimal filter realization. Finally, investigation on more elaborated structures such as combined input-output filters could be realized.

Work Progress

The internship will be part of currently ongoing research in the Power Electronics group. It will take place in the University P2 building, 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. Different EMC filter topologies will be investigated and compared based on computer simulations. Finally, some filter prototypes will be realized in order to experimentally validate the performance and volume impact of the selected filter topologies.



Studied DC/DC converter system

[1] B. Zaidi, A. Videt and N. Idir, "Design Method for the Minimization of CM Inductor Volume with Consideration of Core Saturation in EMI Filters," *PCIM International Exhibition and Conference for Power Electronics, Intelligent Motion, Renewable Energy and Energy Management*, Nuremberg, Germany, 2017