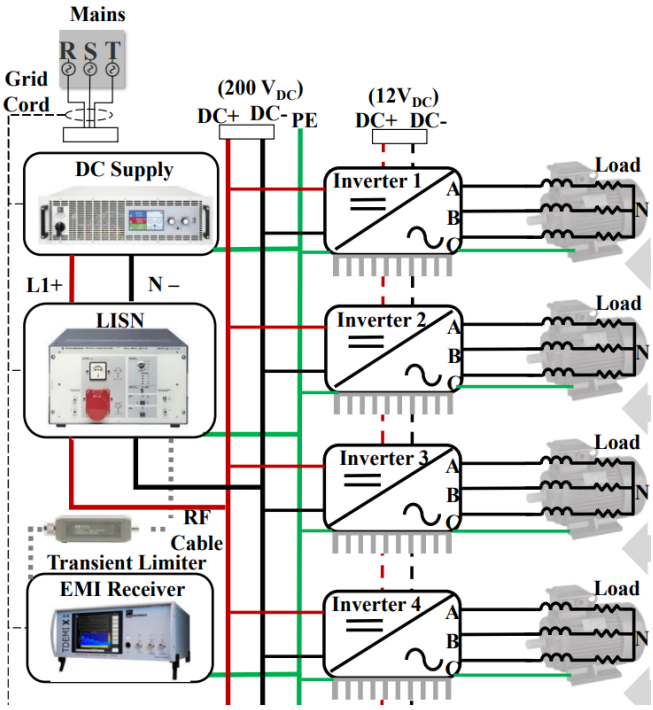
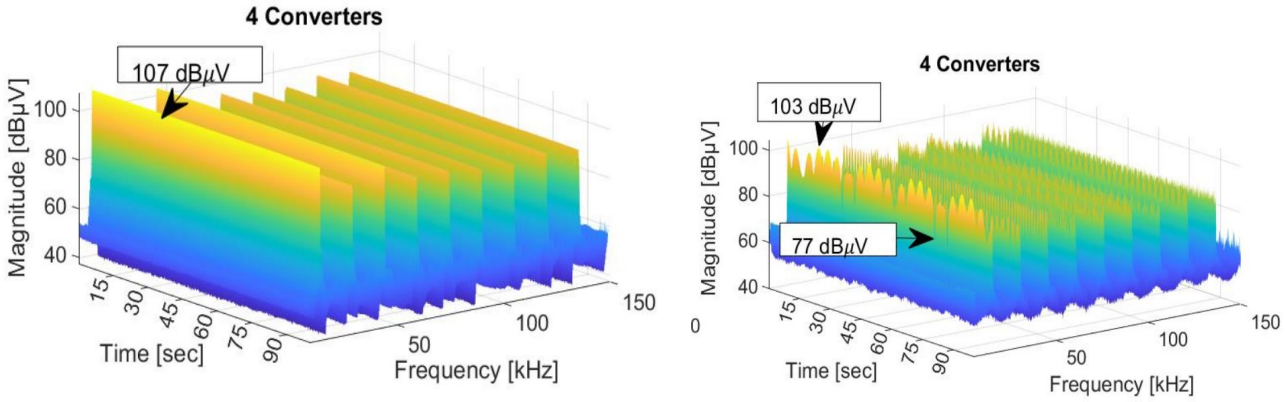
Stochastic EMI Detectors for Multi-conv. Setups

Master thesis project





A measurement schematic of a system consisting of 4 PE inverters supplying variable loads and the resulting EMI emissions with indicated levels varying in time. The question is to develop such measurement method which allows to capture the varying levels of EMI in such conditions, in particular, the worst case and average levels.

Summary:
Develop an EMI detector that enables to capture varying, worst case and average levels of EMI in systems where multiple converters operate simultaneously.

University of Twente.

Power Electronics and Electromagnetic Compatibility **PE Group**

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Problem definition:

When multiple power electronic devices operate together behaviour of each converter influences the grid. To simply envision this problem, consider the sum of two sine waves of frequencies, respectively f_1 and f_2. It can be easily seen that the resulting sine wave will have two beating frequencies present, one equal to $\frac{f_1+f_2}{2}$, and one equal to $\frac{|f_1-f_2|}{2}$ [1]. According to Nyquist theorem in order to capture the presence of these frequencies we need to sample at least twice the largest of them, in this case $f_1 + f_2$. In the EMC world a standard measurement procedure employs an EMI detector, in particular the Peak, Quasi-Peak and Average detector, which can be simulated with an FFT-based approach [2]. Usually, employing such a dector requires long processing time. The task is to create such an EMI detector, or a measurement procedure, which can capture the varying behaviour of a grid in which multiple converters are present. Particular attention should be placed into reducing the time for data processing, possibly by predicting which beating frequencies are present in such grids without the need to directly capture them.

Method:

The student will perform measurements in the lab as well as work with circuit simulators and programming language of choice (Matlab, Python etc.). The student will also be working by studying existing literature approaches.

Research objectives:

The main objective of this task is to create a measurement procedure or develop an EMI detector that captures the varying grid behaviour. The work of the detector should be verified by taking lab measurement of multi-converter setup and comparing it with traditional FFT or EMI-detector approaches. The student will be judged on the basis of how accurate and fast the EMI detector or measurement procedure is.

Courses and supervision:

The student should have a basic EMC knowledge, as well as should have taken a course in Digital Signal Processing. Since the successful implementation might require some knowledge about stochastic processes, it is desirable that the student is able to grasp some mathematical concepts, particularly about simple statistics. In this regard, further help from supervisors may be given. The student should however be able to work independently.

References:

[1] L. C. Long, W. El Sayed, V. Munesswaran, N. Moonen, R. Smolenski, and P. Lezynski, "Assessment of conducted emission for multiple compact fluorescent lamps in various grid topology," *Electronics (Switzerland)*, vol. 10, no. 18. MDPI, Sep. 01, 2021. doi: 10.3390/electronics10182258.

[2] R. Smolenski, *Conducted electromagnetic interference (EMI) in smart grids*, vol. 68. 2012. doi: 10.1007/978-1-4471-2960-8.

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