Analysis of the Propagation of High Frequency Disturbances along Low-Voltage Test Raceway

N. Mora[1], C.Kasmi[2,3], F. Rachidi[1], M. Darces[3], M. Hélier[3], M. Rubinstein[4]
[1] EMC Lab, Swiss Federal Institute of Technology in Lausanne (EPFL), Lausanne, Switzerland
[2] Wireless security Lab, French Network and Information Security Agency (ANSSI), Paris, France
[3] Sorbonne Universités, UPMC Univ. Paris 06, UR2, L2E, F-75005, Paris, France
[4] IICT, University of Applied Sciences and Arts Western Switzerland, Yverdon, Switzerland

***Abstract*—The propagation of high frequency disturbances along a low-voltage power mockup is assessed through experiments and numerical simulations with MTL models up to 200MHz.**

Keywords- IEMI; MTL modeling; low-voltage power network

I. INTRODUCTION

This paper discusses the experimental and modeling procedures that were used in the assessment of the propagation of high frequency disturbances along a low-voltage power raceway. The transfer functions between the power sockets of the raceway were modeled using (i) CST Cable Studio, and (ii) the CRIPTE code [1] up to 200 MHz.

Preliminary results of this study in which the magnitudes of the transfer functions were measured with a Spectrum Analyzer and validated through MTL models have been presented in [2]. In this work, the validation of the phase measurements is included and the total time domain response is recovered by using an inverse Fourier transform of the transfer functions.

II. EXPERIMENTAL SETUP

A schematic diagram illustrating one of the injection tests performed with the low-voltage power raceway is shown in Figure 1. The impulse responses were measured by injecting a rectangular impulse into socket AC1 and measuring the output voltage with an oscilloscope in the other sockets.

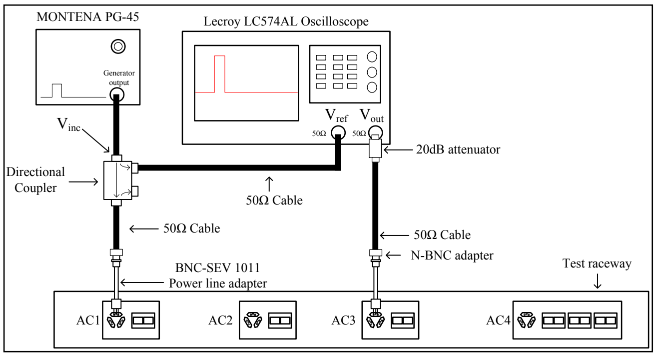

Figure 1. Schematic diagram of the experimental setup.

This study is financially supported by the Swisselectric Research and the European Community's 7th Framework Programme under the grant agreement 285257, STRUCTURES (Strategies for the improvement of critical infrastructure resilience to electromagnetic Attacks).

III. RESULTS

The obtained simulation results are in fair agreement with the experimental data and reproduce the overall characteristics of the measured transfer functions and impulse responses. However, due to the uncertainty of the cable lengths and dielectric parameters of the PVC, the predicted resonance frequencies do not always match with the measured ones.

An example of the impulse response results obtained from measurements and numerical simulations with CRIPTE and CST is presented in Figure 2. Both tools produce waveforms that are in fair agreement with the measured results. It can be seen that the peak voltage predicted by CRIPTE is about 15% lower than that predicted by CST, which matches the experimental value. This discrepancy might be attributed to the presence of a highly non-uniform cabling in the junction box of the raceway that are modeled with approximate cross-sections in both tools. The correct delay between the input and the output waveforms shows that the permittivity of the insulators was correctly chosen.

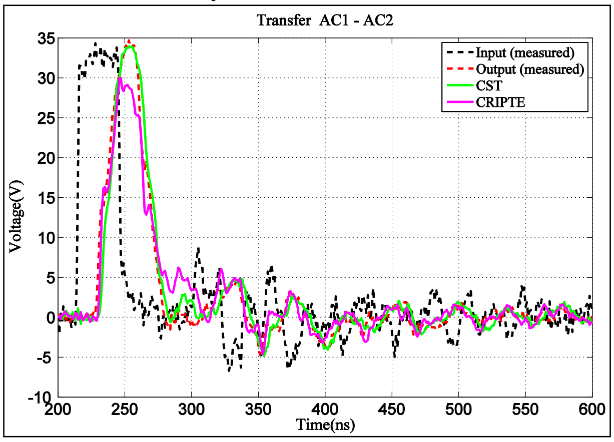

Figure 2. Example of a comparison between the measurement and simulation results obtained with CRIPTE and CST CS.

REFERENCES

[1] P. D. J-P. Parmantier, "Topology Based Modeling of Very Large Systems," in *Modern Radio Science*, O. U. P. J. Hamelin, Ed., ed, 1996, pp. 151-177.

[2] N. Mora, C. Kasmi, F. Rachidi, M. Darces, and M. Helier, "Modeling of the propagation along low voltage power networks for IEMI studies," in *Electromagnetics in Advanced Applications (ICEAA), 2013 International Conference on*, 2013, pp. 436-439.