URSI GASS 2021, Rome, Italy, 28 August - 4 September 2021

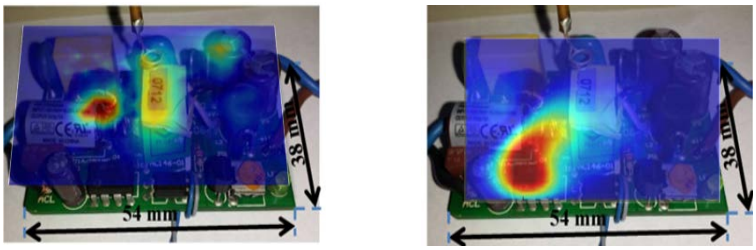
Time Reversal for Identification of Transient Sources in Power Electronics

Sassia Hedia[1], Lionel Pichon[2], J. Ben Hadj Slama[1]

[1]Université de Sousse, Ecole Nationale d'Ingénieurs de Sousse, LATIS-Laboratory of Advanced Technology and Intelligent Systems,4023, Sousse, Tunisie
[2]Université Paris-Saclay, CentraleSupélec, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 91192, Gif-sur-Yvette, France.
Sorbonne Université, CNRS, Laboratoire de Génie Electrique et Electronique de Paris, 75252, Paris, France

The identification and localization of source of perturbations is a critical challenge in complex electromagnetic compatibility problems. For such an objective, Electromagnetic Time Reversal (EMTR) was demonstrated to provide an efficient approach for fault transients in power networks and transmission lines [1,2] and for immunity tests in reverberating environments [3].
Managing EMC constraints in complex configurations such as electric vehicles requires appropriate methodologies to locate source of transient radiated emissions from embedded electronic equipment. The determination of radiating sources helps to design magnetic shielding and reduce electromagnetic radiations Most of the techniques previously developed rely on iterative techniques: From field measurements a set of equivalent dipoles is identified as a behavioral model which can be easily introduced in 3D simulation tools. Such an approach has been successfully applied in the time domain [4] to power electronic circuits.

This presentation addresses the application of EMTR to the characterization of transient disturbances in case of a AC/DC converter. In such a case the perturbation covers a wide frequency band. The EMTR method is shown to extract a set of equivalent dipoles whose radiation is analytically known in time domain. Comparisons between numerical predictions and measurements illustrate the work.



(a) (b)

Figure 1. Measured radiation field maps at different time steps a) t1 = 10.25 µs b) t2 = 10.5 µs

References

[1] F. Rachidi, M. Rubinstein, M. Paolone "Electromagnetic Time Reversal – Application to Electromagnetic Compatibility and Power Systems, Hoboken, NJ, USA, Wiley, 2017.
[2] A. Cozza, Time-Reversal Imaging Techniques for soft-fault detection in cable networks, IEEE Symposium on Electromagnetic Compatibility, Signal and Power Integrity, Long Beach, July 30-August 3rd, CA, USA, 2018.
[3] I. El Baba, S. Lalléchère, P. Bonnet, "Time reversal for electromagnetism: Applications in electromagnetic compatibility," in Trends in Electromagnetism: From Fundamentals to Applications. London, U.K.: IntechOpen, 2012, pp. 177–206.
[4] B. Zitouna and J.B.H. Slama, "Time domain inverse method based on the near field technique to solve electromagnetic interferences problems: Applications to an AC/DC flyback converter", IET Power Electro., vol. 11, n°13, pp. 2133-2139, 2018.