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Identification of temporal sources for transmission lines applications

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The idea of identifying a source that produces a specified electromagnetic field at a given point in space has received considerable attention over the past twenty years or so. Many techniques allow in theory to generate arbitrary electromagnetic fields in any given environment. One of them, the time reversal (TR) method, first applied in acoustics, has been popularized by M. Fink and his team [1] and has since spread in various other domains, including electromagnetic compatibility applications [2]. The advantage of such method is its simplicity, however, its major weakness lies in focusing a quantity of interest (electric field, current ...) at one physical point of the domain and one instant of time. If more complex conditions are needed (e.g. enforcing the duration or the form of the imposed current/voltage/electric field), alternative methods are required.
In this contribution we propose to compare the TR method with the Linear Combination of Configuration Fields (LCCF) method [3]. This latter technique is more complex to implement but the possibility offered by the LCCF to impose an electric field at one point in space over an interval of time (and not just an instant) paved the way to important applications such that the detection of modifications or defects in complex or reverberating environments. After recalling the LCCF principle, we will present a new application of this method for transmission line networks. Finally, parametric test cases will exhibit the respective efficiency of TR and LCCF for active shaping of electromagnetic fields or voltage.

1. M. Fink, “Time Reversal of Ultrasonic Fields: part I. Basic Principles”, IEEE Trans. Ultrason. Ferro-elect. Control, **39**, 5, Sept. 1992, pp. 555-556, doi: 10.1109/58.156174.

2. P. Bonnet, S. Lalléchère, F. Paladian, "From Electromagnetic Time-Reversal Theoretical Accuracy to Practical Robustness for EMC Applications", in Electromagnetic Time Reversal: Application to EMC and Power Systems (eds F. Rachidi, M. Rubinstein and M. Paolone), John Wiley & Sons, 2017.

3. J. Benoit, C. Chauvière, P. Bonnet, "Source Identification in Time Domain Electromagnetics", Journal of Computational Physics Vol. 231, Issue 8, April 2012, pp 3446-3456.