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Editorial

Special Issue on Advanced Technologies in Electromagnetic Compatibility

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Electromagnetic Compatibility (EMC) rules the maximum emission levels and the minimum immunity requirements for devices at the scope to ensure their correct interoperability in a real operational environment. Due to the growing exposition of human beings to the electromagnetic fields, the EMC field also studies the effects of non-ionizing radiations, and it establishes the physical quantities involved in such phenomena and their biological effects on the function of exposure values.

Historically, EMC was born in the last century, when the electromagnetic environment was significantly different with respect to the one in which we are living in; for this reason, EMC is a science that is in constant evolution, and it always faces new fields of application. At this scope, in this issue, all the newest EMC topics will be investigated.

A total of seven articles was submitted to this Special Issue, concerning the latest research on Electromagnetic Compatibility.

In [1], Lin et al.'s proposed smooth-bend structure was implemented with a 150-degree bend to reduce the asymmetrical part of the differential bend and, thus, prevent mode conversion loss and common-mode noise. The smooth-bend structure maintained the differential signal's integrity. In addition, they proposed several hybrid compensation methods to enhance common-mode noise suppression and concluded that a smooth bend using the "L-C-L" compensation method offered the best performance.

In [2], Song et al., used a C-shaped cylindrical device combined with an active shielding system and passive shielding techniques to reduce EMI for online monitoring. The active shielding system was wrapped with a permalloy composite material as a tubular device. A C-shaped opening was made on the tubular structure vertically or horizontally to guide the propagation of the electromagnetic field. This C-shaped cylindrical device further reduced electromagnetic noise up to -5.06 dB and redirected the electromagnetic field toward the opening direction on the cylindrical device. The results demonstrated a practical reduction in the electromagnetic field.

Cristofolini et al. [3] proposed a numerical methodology for the calculation of transient electromagnetic interference induced by overhead high-voltage power lines in metallic structures buried in soil pipelines for oil or gas transportation. A series of 2D finite element simulations was employed to sample the harmonic response of a given geometry section. The numerical inverse Laplace transform of the results allowed obtaining the time-domain evolution of the induced voltages and currents in the buried conductors, for any given condition of the power line.

In [4], Cai et al., focuses on the electromagnetic sensitivity interference coupling effect analysis and EMC evaluation method of the receiver under pulsed interference environments. First, based on the analysis of the interference mechanism of the pulse signal on receivers, the formula for the bit error ratio (BER) was derived. Then, a system model was proposed to verify the theoretical analysis' results using numerical simulations. With the established relationship between the parameters of the pulsed interference and the BER performance of the receiver, a novel EMC evaluation method was proposed. This paper

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focuses on the EMS interference coupling effect analysis and EMC evaluation method of the receiver under pulsed interference environments.

Gao et al. [5] presented a topological approach to decouple and model the vehicle-level radiation problem. By this topological model, each technical factor is analyzed from both of its contribution and sensitivity to the radiation emission, which are further integrated together using the entropy weight method to generate the technical evaluation score. Then, other untechnical factors, i.e., the cost and application difficulty, are further combined with technical evaluation results using the analytic hierarchy process to determine the final solution. This strategy has been applied to solve the radiation problem comprising an electric vehicle at low frequencies to validate its effectiveness and to show some application details.

De Leo and al. [6] presented an optimization of a method to reconstruct the radiated emissions of an equipment under testing conditions by measuring electric field samples collected on the walls of a reverberation chamber. This means that only the orthogonal component of the electric field is necessary to obtain the radiative behavior of the device in free space conditions. The use of the equivalence principle allows one to reduce the number of equivalent sources used to reconstruct the radiation of the device. In fact, in the previous version of the method, the sources are placed into the entirety of working volume of the reverberation chamber. In the current version of the method, only the surface surrounding the equipment under test is discretized. The analytical implementation of the method is proposed for a particular stirring action: the multiple monopole source-stirring technique. This technique is based on an array of monopoles placed onto the walls of the cavity; therefore, no further hardware is needed for the reconstruction of the radiated emissions. The method is experimentally validated in a real scenario.

Finally, Antonini et al. [7] presented the utilization of non-local operators, defining Riemann-Liouville or Caputo derivatives, and it is a very useful tool for studying problems involving non-conventional diffusion problems. The case of electric circuits, ruled by non-integer derivatives or capacitors with fractional dielectric permittivity, is a fairly natural frame of relevant applications. They used techniques, involving generalized exponential operators, to obtain suitable solutions for this type of problems and discussed specific problems in applications.

In conclusion, this Special Issue reports seven very interesting papers on different aspects of the Electromagnetic Compatibility. By reading these contributes, the reader can update the state-of-the-art methods in various aspects of this discipline and obtain important sparks for new research activities in this area.

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