Modern EMC Analysis Techniques

Volume II: Models and Applications

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ABSTRACT

The objective of this two-volume book is the systematic and comprehensive description of the most competitive time-domain computational methods for the efficient modeling and accurate solution of modern real-world EMC problems. Intended to be self-contained, it performs a detailed presentation of all well-known algorithms, elucidating on their merits or weaknesses, and accompanies the theoretical content with a variety of applications. Outlining the present volume, numerical investigations delve into printed circuit boards, monolithic microwave integrated circuits, radio frequency microelectromechanical systems as well as to the critical issues of electromagnetic interference, immunity, shielding, and signal integrity. Biomedical problems and EMC test facility characterizations are also thoroughly covered by means of diverse time-domain models and accurate implementations. Furthermore, the analysis covers the case of large-scale applications and electrostatic discharge problems, while special attention is drawn to the impact of contemporary materials in the EMC world, such as double negative metamaterials, bi-isotropic media, and several others.

KEYWORDS

electromagnetic compatibility (EMC), time-domain methods, computational electromagnetics

Preface

In writing a book on contemporary electromagnetic compatibility (EMC) analysis techniques, the authors are well aware that they are delving into a field of challenging innovations pertinent to a large readership ranging from students and academics to engineers and seasoned professionals. Nowadays, EMC technology is more pervasive than ever in many educational, social, industrial, and commercial sectors. Essentially, the widely recognized significance of EMC problems and applications has turned the interest of the scientific community toward their in-depth investigation, with an emphasis on the simulation of the relevant electromagnetic phenomena via highly advanced time-domain methodologies. This is exactly the aim of the two-volume book, which basically reflects the outgrowth of a systematic research performed by the authors for almost a 10-year period in the area of EMC/electromagnetic interference (EMI) measurement and modeling. Intended to be self-contained from the computational perspective, the book performs a detailed presentation of most time-domain algorithms, elucidating on their merits or weaknesses, and accompanies the theoretical content with a variety of real-world applications. Thus, having acquired the necessary evidence for every numerical approach, the reader is then free to decide on the best possible scheme for his/her requirements.

Outlining the second volume, dealing with the numerical solution of modern EMC problems and comparisons with measurement data, Chapter 1 gives a short introduction on the different types of applications and discusses which time-domain techniques can be utilized for their treatment. Hence, proceeding to the central task of this book, Chapter 2 investigates the topic of printed circuit boards and after some short theoretical analysis, addresses diverse power bus configurations, decoupling devices, and switching interconnects. Furthermore, special sections are devoted to the examination of monolithic microwave integrated circuits and radio frequency microelectromechanical systems. Next, Chapter 2 handles the critical issues of EMI, immunity, shielding, and signal integrity that are proven very instructive during the design of an EMC device. A variety of structures is pursued, such as antennas, wireless local area networks, slot cavities, and multiport waveguides. Biomedical problems and human exposure to electromagnetic fields, in particular, are the subject of Chapter 4. Herein, the concept of dispersive time-domain algorithms is comprehensively clarified and several ways to compute the specific absorption rate and thermal gauges are discussed. The

chapter contains an elaborate set of results from exposure to realistic cellular phones, antennas, and wireless radiators. Moreover, the characterization of EMC test facilities is performed in Chapter 5. To this aim, a large list of already constructed anechoic/semianechoic, reverberation chambers and TEM cells is explored, whereas new designs are thoroughly verified according to international standards. Chapter 6, on the other hand, suggests alternative means for the affordable manipulation of large-scale problems and electrostatic discharge cases, whereas Chapter 7 closes the book with an extensive reference to contemporary materials, such as the double-negative metamaterials, bi-isotropic media, nanotechnology layouts, and photonic crystal arrangements.

Finally, the authors would like to thank Dr. T. T. Zygiridis for his thorough proofreading and valuable suggestions during the preparation of the manuscripts. Above all, they do anticipate that the theoretical formulations and numerical results provided in both volumes will inspire the reader to expand its material beyond the prescribed limits and efficiently reimburse the lack of a microwave laboratory, which is rather expensive to construct, but so indispensable in teaching.

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December 2007 **T. D. Tsiboukis**

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