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Broadbanding Techniques for Radomes

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The phenomenon of electric and magnetic field vector (wave) propagation through the free-space, or any other medium is considered within the ambit of electromagnetics. The media themselves, in general, could be of diverse type, such as linear/non-linear, isotropic/non-isotropic, homogeneous/inhomogeneous, reciprocal/non-reciprocal, etc. Such electromagnetic wave propagation problems are formulated with the set of Maxwell's equations. Computational Electromagnetics endeavors to provide the solution to the Maxwell's equations for a given formulation. It is often difficult to find closed forms solutions to the Maxwell's equation formulations. The advent of computers, and particularly the initial developments of efficient coding for numerical analysis, encouraged the development of numerical electromagnetics. A second motivation came from the interaction of the electromagnetic wave with the matter. This could be visualized as scattering bodies, which required incorporation of the phenomena of reflection, refraction, diffraction and polarization. The finite/large nature of the scatterer required that problem of electromagnetics is considered with respect to the operation wavelength leading to the classification of low-frequency, high-frequency and resonance region problems. This also inspired various asymptotic and grid-based finite-method techniques, for solving specific electromagnetic problems. Surface modeling and ray tracing are also considered for such electromagnetic problems. Further, design optimization towards hardware realization have led to the recourse to various soft computing algorithms. Computational Electromagnetics is deemed to encompass the numerical electromagnetics along with all other above developments. With the wide availability of massively parallel high performance parallel computing platforms, new possibilities have emerged for reducing the computation time and developing macro models that can even be employed for several practical multi-physics scenarios. Both volume and surface discretization methods have been given a new boost, and several acceleration techniques including GPU based computation, learning based approaches, and model order reduction have been attempted. Limitations of generating meshes and modifying these for parametric estimation have been addressed by statistical approaches and smart solvers. Many nature-inspired algorithms and other soft computing approaches have been employed for electromagnetic synthesis problems. One of the recent additions is Game Theoretic optimization.

Finally, the emergence of Computational Electromagnetics has been motivated by myriad applications. These diverse application include but are not restricted to those in Electronics and Communication, Wireless Propagation, Computer Hardware, Aerospace Engineering, Biomedical Engineering, Radio-astronomy, Terahertz Technology, Photonics, etc for modelling of devices, components, systems and even large structures. Some of the well-known applications are in Analysis and design of radio frequency (RF) circuit, antennas and systems, Analysis of antenna on structures, radar imaging, radar cross section (RCS) computation and reduction, and analysis of electromagnetic wave-matter interactions at discrete, random and periodic geometries including metamaterials. Authors are encouraged to submit original research work in the area of Computational Electromagnetics. The content could be either theoretical development, or specific to particular applications. This Series also encourages state-of-the-art reviews and easy to comprehend tutorials.

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To

Late Dr. Rakesh Mohan Jha

Founder Scientist
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Preface

Broadbanding of radomes has been widely used for the enhancement of transmission efficiency of the radomes. Major goals while broadbanding are to obtain high transmission efficiency, low cross-polarization levels, and low boresight error characteristics over the entire broadband with requisite modifications of radome wall configuration. Many techniques are employed for modifying the radome wall configurations for enhancing its EM performance.

Modification of the radome wall configuration can be accomplished by using different techniques like (i) inclusion of metallic wiregrids in the radome walls, (ii) inclusion of metallic strip gratings in the radome layers, (iii) inclusion of FSS-based structures in between the radome layers, and (iv) use of inhomogeneous dielectric structures as radome wall.

This book presents a detailed formulation for the broadbanding of radomes using various techniques. This book is organized into six chapters: Chapter 1 deals with the introduction of radomes, Chap. 2 deals with the EM performance characteristics of radomes, Chap. 3 includes the broadbanding techniques based on the metallic wiregrids, Chap. 4 is about the broadbanding techniques based on the metallic strip gratings, and in Chap. 5, broadbanding techniques based on the FSS structures are discussed. The broadbanding of radomes based on inhomogenous planar layers is described in Chap. 6, and finally, it concludes with the summary of various broadbanding techniques discussed in the brief.

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About This Book

Modern airborne radomes have very stringent electromagnetic (EM) performance requirements. Hence novel techniques have to be used in the EM design of airborne radomes to meet these requirements. Broadbanding of radomes has been widely used for the enhancement of transmission efficiency of the radomes. This brief deals with various techniques employed for enhancing the EM performance parameters by modifying the radome wall configurations.

Modification of the radome wall configuration has been accomplished by using different techniques such as inclusion of metallic wiregrids/meshes in the radome walls, inclusion of metallic stripgratings in the radome layers, inclusion of FSS based structures in between the radome layers and the use of inhomogeneous dielectric structures as radome wall. This book presents a detailed formulation for the broadbanding of radomes using these techniques.

Contents