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Ultra Wideband Antennas

DESIGN, METHODOLOGIES, AND PERFORMANCE

Giselle M. Galvan-Tejada
Marco A. Peyrot-Solis
Hildeberto Jardón-Aguilar

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To my beloved husband, Aldo Gustavo and young children Gustavo Stuart and Minerva Montserrat, for their love, support and encouragement all the time. You are always in my mind and heart.

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This book is dedicated to my wife Cynthia, and my son and daughter Marco Antonio Cesar and Cynthia Carolina for their patience and support through the long nights when this work was completed.

Marco Antonio

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Preface

Over the past decades ultra wideband antennas have attracted the attention of the scientific community due to their wide variety of applications such as body area networks, radar, imaging, spectrum monitoring, electronic warfare, and wireless sensor networks, among others. As a result, a vast quantity of work presenting diverse designs has been reported around the world. In spite of this, some other possibilities have to be explored in the UWB antenna's design in such a way that current challenges may be solved.

Thus, this book was conceived as reference material for the development of UWB antennas. Different aspects are considered in this text, from recent proposals on ultra wideband antennas reported in diverse forums, theory specific for these radiators, up to guidelines for the design of omnidirectional and directional UWB antennas.

According to current tendencies, two types of antennas are identified based on their structures, planarized and planar, to distinguish between those flat radiators embedded and non-embedded on the ground plane. An important concept used here is the solid-planar equivalence, which allows that flat structures can be implemented instead of volumetric antennas. This principle is vital for the developments of UWB antennas on portable equipment and for the recent body area networks, where small low profile radiators are intended to integrate to wearable devices.

Time domain signal analysis for UWB antennas, from which the distortion phenomenon can be modeled through group delay and phase linearity, is addressed as well. It is one of the main differences with traditional narrowband or wideband antennas where transient response has not been considered. Thus, in particular, some important quantities associated with the impulse response of UWB antennas are reviewed.

Design methodologies for omnidirectional and directional antennas are described, and the dependence on their operation as a function of distinct factors (ground plane, beveling on radiator, height/wide proportion, reflector, etc.) is examined in depth. In all cases, three objectives are considered: Impedance matching, phase linearity, and variations of the shape of the radiation pattern. Performance comparisons among different reported UWB designs are discussed.

Some current tendencies and unresolved problems in the field of UWB antennas are also noted. The book ends with a brief exposition of numerical techniques for electromagnetics, including the generalities of the classical Finite Differences Method, Finite Element Method, and Method of Moments.

Certain antenna models are taken to illustrate particular conceptual aspects of these methods.

Outline

In summary, the main points addressed in this book are

- An outline of recent developments on UWB antennas
- Developed theory for UWB antennas in frequency and time domains
- Design methodologies for omnidirectional and directional UWB antennas
- Performance comparisons of different UWB antennas
- A vision of tendencies and unresolved problems to date
- An exposition of numerical methods for electromagnetics oriented to antennas

Regarding simulations, it is worth mentioning that CST Microwave Studio was the platform used through this book.

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Plots presented in distinct sections of chapters were generated using MATLAB®.

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Finally, we would like to express the honor we feel on writing this book in the year of the 150th anniversary of the publication of the dissertation of James Clerk Maxwell, *A Dynamical Theory of the Electromagnetic Field*, who has been an academic guide and inspiration for our work with antennas.

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