

DESIGN OF A MICROSTRIP PATCH ANTENNA ARRAY USING IE3D SOFTWARE

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ABSTRACT

In this paper detailed investigations have been performed on the design of a microstrip patch antenna array of given specifications using IE3D, an electromagnetic simulation package by Zeland Software Inc. Here a new idea of trapezoidal patch has been used to increase the bandwidth of the antenna array.

1. INTRODUCTION

The purpose of this work is to design a microstrip patch antenna array using commercial simulation software like IE3D [1]. The IE3D by Zeland Software Inc. has been recently considered as the benchmark for electromagnetic simulation packages. It is a full wave, method of moment (MOM) simulator solving the distribution on 3D and multilayered structures of general shape. The primary formulation of the IE3D is an integral equation obtained through the use of Green's functions. In the IE3D, it is possible to model both the electric current on a metallic structure and a magnetic current representing the field distribution on a metallic aperture. The specifications for the design purpose of the structure are as follows:

- Number of elements : 4
- Input impedance : 50Ω
- Resonance frequency : 2.5 - 2.7 GHz
- VSWR : 1 - 1.4

These specifications were chosen to design a lightweight and compact microstrip array

antenna at S-band for Manpack Satellite Communication terminals.

The design of the whole structure is performed in the following steps:

- To design a single microstrip patch antenna
- To design the power divider to feed the antenna
- To design the complete array

2. THEORY

2.1. To design a microstrip patch antenna

The rectangular microstrip antenna is a basic antenna element being a rectangular strip conductor on a thin dielectric substrate backed by a ground plane (Figure 1). Considering the patch as a perfect conductor, the electric field on the surface of the conductor is considered as zero. Though the patch is actually open circuited at the edges, due to the small thickness of the substrate compared to the wavelength at the operating frequency, the fringing fields will appear at the edges.

Here, the "Transmission Line Model" [2] has been used to predict the radiation characteristics of the patch. In this model, the patch antenna is treated as two parallel radiating slots and a transmission line interconnecting them (Figure 2). The electric and magnetic fields are calculated separately for each slot and the resultant field pattern is a combination of the two slots. The E-plane radiation pattern of the patch given by this model is expressed as follows [2].

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Microstrip Antennas N Nasimuddin, 2011-04-04 In the last 40 years the microstrip antenna has been developed for many communication systems such as radars sensors wireless satellite broadcasting ultra wideband radio frequency identifications RFIDs reader devices etc The progress in modern wireless communication systems has dramatically increased the demand for microstrip antennas In this book some recent advances in microstrip antennas are presented *Advances in Communications, Signal Processing, and VLSI* T. Laxminidhi, Jyoti Singhai, Sreehari Rao Patri, V. V. Mani, 2021-04-12 This book comprises the peer reviewed proceedings of the International Conference on Communications Signal Processing and VLSI IC2SV 2019 It explores the recent advances in the fields of signal and image processing wireless and mobile communications embedded systems VLSI microwave and antennas The contents provide insights into present technological challenges and discusses the emerging applications of different imaging techniques and communications systems Given the range of topics covered this book can be useful for students as well as researchers interested in the area of communications signal processing and VLSI technologies

Antenna Theory and Microstrip Antennas D. G. Fang, 2017-12-19 Antenna Theory and Microstrip Antennas offers a uniquely balanced analysis of antenna fundamentals and microstrip antennas Concise and readable it provides theoretical background application materials and details of recent progress Exploring several effective design approaches this book covers a wide scope making it an ideal hands on resource for professionals seeking a refresher in the fundamentals It also provides the basic grounding in antenna essentials that is required for those new to the field The book s primary focus is on introducing practical techniques that will enable users to make optimal use of powerful commercial software packages and computational electromagnetics used in full wave analysis and antenna design Going beyond particular numerical computations to teach broader concepts the author systematically presents the all important spectral domain approach to analyzing microstrip structures including antennas In addition to a discussion of near field measurement and the high frequency method this book also covers Elementary linear sources including Huygen s planar element and analysis and synthesis of the discrete and continuous arrays formed by these elementary sources The digital beam forming antenna and smart antenna Cavity mode theory and related issues including the design of irregularly shaped patches and the analysis of mutual coupling Based on much of the author s own internationally published research and honed by his years of teaching experience this text is designed to bring students engineers and technicians up to speed as efficiently as possible This text purposefully emphasizes principles and includes carefully selected sample problems to ease the process of understanding the often intimidating area of antenna technology Paying close attention to this text you will be able to confid

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international experts presented at the International Conference on NextGen Electronic Technologies ICNETS2 2016 ICNETS2 encompasses six symposia covering all aspects of the electronics and communications domains including relevant nano micro materials and devices Highlighting the latest research on Optical And Microwave Technologies the book will benefit all researchers professionals and students working in the core areas of electronics and their applications especially in signal processing embedded systems and networking **International Conference on Antennas and Propagation** ,1993

Radio Frequency Identification Mamun Bin Ibne Reaz,2013-06-05 RFID based application creates tremendous new business opportunities such as the support of independent living of elderly and disabled persons efficient supply chains efficient anti counterfeiting and better environmental monitoring RFID data management scalable information systems business process reengineering and evaluating investments are emerging as significant technical challenges to applications underpinned by new developments in RFID technology This book presents the contributions from world leading experts on the latest developments and state of the art results in the RFID field to address these challenges The book offers a comprehensive and systematic description of technologies architectures and methodologies of various efficient secure scalable and reliable RFID and RFID based applications *Microwave Component Mechanics* Harri Eskelinen,Pekka Eskelinen,2003 HereOCOs a first of its kind resource that offers you detailed guidance in the mechanical aspects of designing and manufacturing microwave components The book takes an interdisciplinary approach that combines design and manufacturing mechanical and electrical design and microwave component performance and productivity By exploring the immediate connection between electrical and mechanical quality you more easily arrive at cost effective solutions and reduce the unnecessary use of OC double tolerancingOCO **Eleventh International Conference on Antennas and**

Propagation ,2001 *Radioengineering* ,2006 *Digest* IEEE Antennas and Propagation Society. International Symposium,2004 *Proceedings* ,2003 *Design of Linearly Polarized Rectangular Microstrip Patch Antenna Using IE3D/PSO.* , **Microstrip Patch Antennas: A Designer's Guide** Rod Waterhouse,2013-04-17 Microstrip Patch Antennas A Designer s Guide provides the reader with a current overview of where microstrip patch antenna technology is at and useful information on how to design this form of radiator for their given application and scenario The book describes the general properties and the many different forms of microstrip patch antennas highlighting the advantages and disadvantages of each from a designer s prospective The book outlines procedures on how to optimize antennas in terms of bandwidth size polarization control and radiation performance Practical design cases are provided for each goal Throughout the book design philosophies are presented to ensure the best performance from the printed antenna is always achieved Important performance trends are given enabling the designer to understand what the most appropriate printed antenna solution exists for the problem at hand Companies specializing in antenna development using printed antennas in their systems and graduate students alike will find Microstrip Patch Antennas A Designer s Guide is a useful tool **Stacked Antennas** Ankita

Malhotra, Ananjan Basu, 2024-12-12 The text focuses primarily on details related to design concepts of stacked microstrip antennas performance characteristics and complete static analysis based on different approaches It will further provide readers with an in depth understanding of static analysis approaches for analyzing and understanding the performance of multi layered stacked antennas The book covers important topics such as conformal mapping the transmission line equivalent model based approach and the microstrip patch antenna model The book also discusses reconfigurable stacked microstrip antennas stacked microstrip antenna arrays and a wide range of potential applications of stacked microstrip antennas This book Presents systematic and simplified design steps of stacked antennas the factors involved and various design examples and explains static analysis of multi layered stacked antennas in an easy to understand manner Discusses topics such as conformal mapping the transmission line equivalent model based approach and the microstrip patch antenna model and reconfigurable stacked microstrip antennas and their applications along with briefly discussing the design concepts of stacked microstrip antenna arrays Covers simulation design concepts and measurement techniques for stacked microstrip antennas Illustrates microstrip stacked antenna parameters including bandwidth polarization radiation pattern gain directivity and efficiency Focuses on covering a wide range of potential applications of stacked microstrip antennas It is primarily written for senior undergraduates graduate students and academic researchers in fields including electrical engineering electronics and communications engineering

Microwave Journal, 2004 *Handbook of Microstrip Antennas* James R. James, Peter S. Hall, 1989 The book reviews developments in the following fields circular microstrip antennas microstrip patch antennas circular polarisation and bandwidth microstrip dipoles multilayer and parasitic configurations wideband flat dipole and short circuit microstrip patch elements and arrays numerical analysis multiport network approach transmission line model rectangular microstrip antennas low cost printed antennas printed phased array antennas circularly polarised antenna arrays microstrip antenna feeds substrate technology computer aided design of microstrip and triplate circuits resonant microstrip antenna elements and arrays for aerospace applications mobile and satellite systems conical conformal microstrip tracking antenna and microstrip field diagnostics

Microstrip Antenna Design Handbook Ramesh Garg, 2001 Based on Bahl and Bhartia's popular 1980 classic *Microstrip Antennas* this all new book provides the detail antenna engineers and designers need to design any type of microstrip antenna After addressing essential microchip antenna theory the authors highlight current design and engineering practices emphasizing the most pressing issues in this area including broadbanding circular polarization and active microstrip antennas in particular Special design challenges ranging from dual polarization high bandwidth and surface wave mitigation to choosing the proper substrate and shaping an antenna to achieve desired results are all covered

Analysis Of Dual Band Rectangular Microstrip Antenna Using IE3D/PSO. , This thesis covers three aspects of Microstrip antenna designs The first is the analysis and design of single element rectangular Microstrip antenna which operates at the central frequency of 2.4 GHz The

second aspect is the design of dual band rectangular microstrip antenna which operates at 2.4308 GHz. Both antennas are modeled, designed and simulated. Here transmission line and cavity modeling are used to model both antennas. First the design parameters for single element of rectangular patch antenna is calculated from the transmission line model equation and then the antenna design is extended to Dual Band rectangular Microstrip patch antenna using the slots at radiating edge. The simulation process has been carried out through IE3D electromagnetic software which is based on method of moment (MOM). The third is the interfacing between IE3D and PSO (MATLAB). In this part optimization is done through Particle Swarm Optimization (PSO) and then the antenna is designed using IE3D simulation software.

The book delves into Ie3d Manual On Microstrip Patch Antenna. Ie3d Manual On Microstrip Patch Antenna is a vital topic that must be grasped by everyone, ranging from students and scholars to the general public. This book will furnish comprehensive and in-depth insights into Ie3d Manual On Microstrip Patch Antenna, encompassing both the fundamentals and more intricate discussions.

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