

Phased Array Antenna Patterns— Part I: Linear Array Beam Characteristics and Array Factor

by Peter Delos, Technical Lead, Bob Broughton, Director of Engineering, and Joe Kraft, Senior Staff Field Applications Engineer, Analog Devices, Inc.

Introduction

With the proliferation of digital phased arrays in commercial and aerospace and defense applications, there are many engineers working on various aspects of the design who have limited phased array antenna familiarity. Phased array antenna design is not new, as the theory has been well developed over decades; however, most of the literature is intended for antenna engineers well versed in the electromagnetic mathematics. As phased arrays begin to include more mixed-signal and digital content, there are many engineers who could benefit from a much more intuitive explanation of phased array antenna patterns. As it turns out, there are many analogies between the behavior of phased array antennas and the discrete time sampled systems that the

mixed-signal and digital engineers work with every day.

These articles are not intended to create antenna design engineers, but rather to help the engineer working on a subsystem or component used in a phased array to visualize how their effort may impact a phased array antenna pattern.

Beam Direction

First, let's look at an intuitive example of steering a phased array beam. Figure 1 provides a simple illustration of a wavefront striking four antenna elements from two different directions. A time delay is applied in the receive path after each antenna element, and then all four signals

Analog Devices, Inc., Cont'd on pg 15

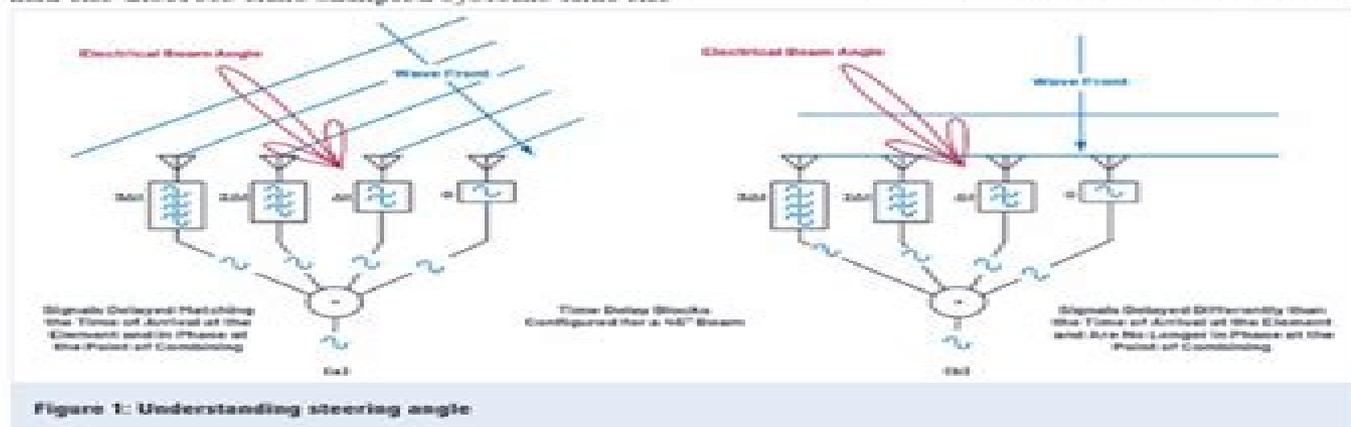


Figure 1: Understanding steering angle

Array And Phased Array Antenna Basics

KJ Lindholm-Leary



Array And Phased Array Antenna Basics:

Array and Phased Array Antenna Basics Hubregt J. Visser,2006-02-03 Reflecting a growing interest in phased array antenna systems stemming from radar radio astronomy mobile communications and satellite broadcasting *Array and Phased Array Antenna Basics* introduces the principles of array and phased array antennas Packed with first hand practical experience and worked out examples this is a valuable learning tool and reference source for those wishing to improve their understanding of basic array antenna systems without relying heavily on a thorough knowledge of electromagnetics or antenna theory Features a general introduction to antennas and explains the array antenna principle through discussion of the physical characteristics rather than the theory Explores topics often not covered in antenna textbooks such as active element pattern array feeding means of phase changing array antenna characterisation sequential rotation techniques and reactively loaded arrays Guides the reader through the necessary mathematics allowing them to move onto specialist books on array and phased array antennas with a greater understanding of the topic Supported by a companion website on which instructors and lecturers can find electronic versions of the figures An ideal introduction for those without a background in antennas this clear concise volume will appeal to technicians researchers and managers working in academia government telecommunications and radio astronomy It will also be a valuable resource for professionals and postgraduates with some antenna knowledge

Antenna Theory and Design Warren L. Stutzman,Gary A. Thiele,2012-05-22 Stutzman s 3rd edition of *Antenna Theory and Design* provides a more pedagogical approach with a greater emphasis on computational methods New features include additional modern material to make the text more exciting and relevant to practicing engineers new chapters on systems low profile elements and base station antennas organizational changes to improve understanding more details to selected important topics such as microstrip antennas and arrays and expanded measurements topic

Conformal Array Antenna Theory and Design Lars Josefsson,Patrik Persson,2006-02-03 This is the first comprehensive treatment of conformal antenna arrays from an engineering perspective While providing a thorough foundation in theory the authors of this publication provide a wealth of hands on instruction for practical analysis and design of conformal antenna arrays Thus you get the knowledge you need alongside the practical know how to design antennas that are integrated into such structures aircrafts or skyscrapers

Antenna Theory and Applications Hubregt J. Visser,2012-03-05 This comprehensive text on antenna theory explains the origin of radiation and discusses antenna parameters in depth This book offers an in depth coverage of fundamental antenna theory and shows how to apply this in practice The author discusses electromagnetic radiation and antenna characteristics such as impedance radiation pattern polarization gain and efficiency In addition the book provides readers with the necessary tools for analyzing complex antennas and for designing new ones Furthermore a refresher chapter on vector algebra including gradient divergence and curl operation is included Throughout the book ample examples of employing the derived theory are given and all chapters are concluded with problems giving the reader the

opportunity to test his/her acquired knowledge

Key Features Covers the mathematical and physical background that is needed to understand electromagnetic radiation and antennas. Discusses the origin of radiation and provides an in-depth explanation of antenna parameters. Explores all the necessary steps in antenna analysis allowing the reader to understand and analyze new antenna structures. Contains a chapter on vector algebra which is often a stumbling block for learners in this field. Includes examples and a list of problems at the end of each chapter. Accompanied by a website containing solutions to the problems for instructors and CST modeling files www.wiley.com/go/visser_antennas. This book will serve as an invaluable reference for advanced last year Bsc/Msc students in antenna and RF engineering, wireless communications, electrical engineering, radio engineers, and other professionals needing a reference on antenna theory. It will also be of interest to advanced senior radio engineers, designers, and developers.

Design of Digital Phase Shifters for Multipurpose Communication Systems Binboga Siddik Yarman, 2022-09-01. This book aims to cover a new emerging need in designing digital phase shifter for modern communication systems. With the advancement of new generation mobile communication systems, directed beams of antenna arrays save a substantial amount of power as well as improve the communication quality. In this regard, beam forming circuits such as digital phase shifters (DPS) constitute essential parts of the antenna array systems. Therefore, this book is devoted to the design of digital phase shifters for various communication systems. Nowadays, phase array systems demand compact phase shifters suitable for chip implementation with wide phase range and broad frequency band. Each chapter of this book is organized as stand-alone in such a way that the reader requires no specific background acquired from the other chapters. For each phase shifter topology introduced in this book, the reader is furnished with explicit design equations to construct the circuit under consideration. Furthermore, design equations are programmed using MATLAB to assess the electrical performance of the phase shifters with ideal and lossy components. MATLAB design programs are given at the end of each chapter as appendices and provided as soft copy on the web page of the book. In chapters 12 and 14, MMIC layouts for the lattice and T-section based DPS are provided for the readers. It is hoped that an interested reader can immediately identify the optimum phase shifter topology for the need under consideration with its estimated electric performance.

Theory and Analysis of Phased Array Antennas Noach Amitay, Victor Galindo, Chen Pang Wu, 1972

Antenna Theory and Design Robert Stratman Elliott, 1981. The IEEE Press Series on Electromagnetic Wave Theory offers outstanding coverage of the field. It consists of new titles of contemporary interest as well as reissues and revisions of recognized classics by established authors and researchers. The series emphasizes works of long-term archival significance in electromagnetic waves and applications. Designed specifically for graduate students, researchers, and practicing engineers, the series provides affordable volumes that explore and explain electromagnetic waves beyond the undergraduate level.

Optical Technology for Microwave Applications, 1991

Wiley Encyclopedia of Telecommunications, 5 Volume Set John G. Proakis, 2003-01-06. Online encyclopedia dedicated to telecommunications for

electrical engineers Topics Include Optical communications modulation and demodulation coding and decoding communication networks and antennas Regular updates 1974 *U.R.S.I. Symposium on Electromagnetic Wave Theory, 9-12, July 1974 [held at The] Imperial College of Science and Technology*, 1974 **Science Abstracts**, 1995 *Microwave Engineering and Systems Applications* Edward A. Wolff, Roger Kaul, 1988-03-03 Systems Microwave transmission control detection and generation Microwave measurements Microwave subsystems **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 *International Aerospace Abstracts*, 1998 Photonic Aspects of Modern Radar Henry Zmuda, Edward N. Toughlian, 1994 Here s all the engineering information needed to integrate the fields of optics and electronics Assembling a unique blend of expertise from industry academia and government Photonic Aspects of Modern Radar shows the applications of this technology both in the evolution of today s radar and in future systems **A Collection of the 22nd AIAA International Communications Satellite Systems Conference and Exhibit Technical Papers**, 2004 **The RF and Microwave Handbook** John Michael Golio, Janet Golio, 2008 The growth of wireless technology over the past decade is reflected in this guide It covers WiMAX broadband cable a comprehensive range of other topics This volume RF and Microwave Applications and Systems includes a wide range of articles that discuss RF and microwave systems used for communication and radar and heating applications Commercial avionics medical and military applications are addressed An overview of commercial communications systems is provided Past current and emerging cellular systems navigation systems and satellite based systems are discussed Specific voice and data commercial systems are investigated more thoroughly in individual chapters that follow Detailed discussions of military electronics avionics and radar both military and automotive are provided in separate chapters A chapter focusing on FR microwave energy used for therapeutic medicine is also provided Systems considerations including thermal mechanical reliability power management and safety are discussed in separate chapters Engineering processes are also explored in articles about corporate initiatives cost modeling and design reviews The book closes with a discussion of the underlying physics of electromagnetic propagation and interference In addition to new chapters on WiMAX and broadband cable nearly every existing chapter features extensive updates and several were completely rewritten to reflect the massive changes areas such as radio navigation and electronic warfare **Free-space Laser Communication Technologies**, 1992 **Antenna**

Engineering Handbook John Volakis, 2018-11-05 The gold standard reference on the design and application of classic and modern antennas fully updated to reflect the latest advances and technologies This new edition of the bible of antenna engineering has been updated to provide start to finish coverage of the latest innovations in antenna design and application You will find in depth discussion of antennas used in modern communication systems mobile and personal wireless technologies satellites radar deployments flexible electronics and other emerging technologies including 5G terahertz and wearable electronics Antenna Engineering Handbook Fifth Edition is bolstered by real world examples hundreds of illustrations and an emphasis on the practical aspects of antennas Featuring 60 chapters and contributions from more than 80 renowned experts this acclaimed resource is edited by one of the world's leading antenna authorities This edition features all of the classic antenna types plus new and emerging designs with 13 all new chapters and important updates to nearly all chapters from past editions Antenna Engineering Handbook Fifth Edition clearly explains cutting edge applications in WLANs automotive systems PDAs and handheld devices making it an indispensable companion for today's antenna practitioners and developers Coverage includes Antenna basics and classic antennas Design approaches for antennas and arrays Wideband and multiband antennas Antennas for mobile devices and PDAs automotive applications and aircraft Base station and smart antennas Beamforming and 5G antennas Millimeter wave and terahertz antennas Flexible wearable thin film origami dielectric and on chip antennas MIMO antennas and phased arrays Direction finding and GPS antennas Active antennas Low profile wideband antennas Nanoantennas Reflectors and other satellite and radio telescope antennas Low frequency HF VHF UHF ECM and ESM antennas Impedance matching techniques and material characteristics Metastructured and frequency selective surfaces Propagation and guided structures Computational techniques and toolsets Indoor and outdoor measurements

InspeC Thesaurus 1995 INSPEC (Information service), 1995

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