

Ultrawideband Phased Array Antenna Technology For Sensing And Communications Systems Mit Lincoln Laboratory Series

Ultra Wideband Antennas: Design, Methodologies, and Performance presents the current state of the art of ultra wideband (UWB) antennas, from theory specific for these radiators to guidelines for the design of omnidirectional and directional UWB antennas. Offering a comprehensive overview of the latest UWB antenna research and development, this book: Discusses the developed theory for UWB antennas in frequency and time domains Delivers a brief exposition of numerical methods for electromagnetics oriented to antennas Describes solid-planar equivalence, which allows flat structures to be implemented instead of volumetric antennas Examines the impedance matching, phase linearity, and radiation patterns as design objectives for omnidirectional and directional antennas Addresses the time domain signal analysis for UWB antennas, from which the distortion phenomenon can be modeled Includes illustrative examples, design equations, CST MICROWAVE STUDIO® simulations, and MATLAB® plot generations Compares the performance of different UWB antennas, supplying useful insight into particular tendencies and unresolved problems Ultra Wideband Antennas: Design, Methodologies, and Performance provides a valuable reference for the scientific community, as UWB antennas have a variety of applications in body area networks, radar, imaging, spectrum monitoring, electronic warfare, wireless sensor networks, and more.

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A comprehensive guide to antenna design, manufacturing processes, antenna integration, and packaging *Antenna-in-Package Technology and Applications* contains an introduction to the history of AiP technology. It explores antennas and packages, thermal analysis and design, as well as measurement setups and methods for AiP technology. The authors—well-known experts on the topic—explain why microstrip patch antennas are the most popular and describe the myriad constraints of packaging, such as electrical performance, thermo-mechanical reliability, compactness, manufacturability, and cost. The book includes information on how the choice of interconnects is governed by JEDEC for automatic assembly and describes low-temperature co-fired ceramic, high-density interconnects, fan-out wafer level packaging–based AiP, and 3D-printing-based AiP. The book includes a detailed discussion of the surface laminar circuit–based AiP designs for large-scale mm-wave phased arrays for 94-GHz imagers and 28-GHz 5G New Radios. Additionally, the book includes information on 3D AiP for sensor nodes, near-field wireless power transfer, and IoT applications. This important book:

- Includes a brief history of antenna-in-package technology
- Describes package structures widely used in AiP, such as ball grid array (BGA) and quad flat no-leads (QFN)
- Explores the concepts, materials and processes, designs, and verifications with special consideration for excellent electrical, mechanical, and thermal performance

Written for students in electrical engineering, professors, researchers, and RF engineers, *Antenna-in-Package Technology and Applications* offers a guide to material selection for antennas and packages, antenna design with manufacturing processes and packaging constraints, antenna integration, and packaging. This resource provides a comprehensive treatment of the methods, analysis, and practice of impulse and ultrawideband (UWB) systems. Sources, antennas, propagation, electromagnetic

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theory, and actual practical systems are explored. This book provides novel perspective on impulse and short-pulse wireless engineering along with practical guidance on how to build antennas and radio hardware for high-power impulse signals. Theoretical and experimental results in the time-frequency domain are presented. The book explains and discusses the scattering of UWB electromagnetic pulses by conducting and dielectric objects. Impulse responses of objects and propagation channels are explored with details of signal models and their spectral characteristics and uses of regularization of a Kramers-Kronig type relation for estimating transfer functions. Readers gain insight into the development of high-power sources of UWB radiation with megavolt effective potential on the base of combined antenna arrays excited with bipolar voltage pulses. This in-depth volume includes chapters on receiving antennas, transmitting antennas, and antenna arrays along with details on high-power UWB radiation sources as well as problem sets.

Ultrawideband (UWB) technology, positioned as the cutting edge of research and development, paves the way to meet the emerging demands set by broadband wireless applications, such as high-speed data transmission, medical imaging, short-range radars, electromagnetic testing, etc. This breathtaking resource builds upon the basics of UWB technology to provide a complete compilation of figures of merit along with a vital state-of-the-art of the different antenna alternatives that are to be employed according to the specific application. Without excessive recourse to mathematics, this volume emphasizes on the UWB antenna design and equips readers with practical prediction techniques based on simple formulas and models. The big picture of UWB antenna technology would not be complete without addressing its applications, and this will serve to provide consultants with key clues for

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slot market searching. Containing over 150 supporting illustrations and figures, this comprehensive overview of UWB technology, antenna design and applications is a vital source of information and reference for R&D organizations, researchers, practitioners, consultants, RF professionals and communication engineers.

The first book to present the common mathematical foundations of big data analysis across a range of applications and technologies. Today, the volume, velocity, and variety of data are increasing rapidly across a range of fields, including Internet search, healthcare, finance, social media, wireless devices, and cybersecurity. Indeed, these data are growing at a rate beyond our capacity to analyze them. The tools—including spreadsheets, databases, matrices, and graphs—developed to address this challenge all reflect the need to store and operate on data as whole sets rather than as individual elements. This book presents the common mathematical foundations of these data sets that apply across many applications and technologies. Associative arrays unify and simplify data, allowing readers to look past the differences among the various tools and leverage their mathematical similarities in order to solve the hardest big data challenges. The book first introduces the concept of the associative array in practical terms, presents the associative array manipulation system D4M (Dynamic Distributed Dimensional Data Model), and describes the application of associative arrays to graph analysis and machine learning. It provides a mathematically rigorous definition of associative arrays and describes the properties of associative arrays that arise from this definition. Finally, the book shows how concepts of linearity can be extended to encompass associative arrays. Mathematics of Big Data can be used as a textbook or reference by engineers, scientists, mathematicians, computer scientists, and software engineers who

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analyze big data.

The Handbook of Smart Antennas for RFID Systems is a single comprehensive reference on the smart antenna technologies applied to RFID. This book will provide a timely reference book for researchers and students in the areas of both smart antennas and RFID technologies. It is the first book to combine two of the most important wireless technologies together in one book. The handbook will feature chapters by leading experts in both academia and industry offering an in-depth description of terminologies and concepts related to smart antennas in various RFID systems applications. Some topics are: adaptive beamforming for RFID smart antennas, multiuser interference suppression in RFID tag reading, phased array antennas for RFID applications, smart antennas in wireless systems and market analysis and case studies of RFID smart antennas. This handbook will cover the latest achievements in the designs and applications for smart antennas for RFID as well as the basic concepts, terms, protocols, systems architectures and case studies in smart antennas for RFID readers and tags. This book constitutes the proceedings of the International Conference on Internet of Things, ICIOT 2019, held as part of SCF 2019, in San Diego, CA, USA, in June 2019. The 8 full and 3 short papers presented in this volume were carefully reviewed and selected from 16 submissions. With the rapid advancements of mobile Internet, cloud computing and big data, device-centric traditional Internet of Things (IoT) is now moving into a new era which is termed as Internet of Things Services (IOTS). In this era, sensors and other types of sensing devices, wired and wireless networks, platforms and tools, data processing/visualization/analysis and integration engines, and other components of traditional IoT are interconnected through innovative services to realize the value of connected things, people, and virtual Internet

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spaces.

Written by a leading expert in the field, this practical new resource presents the fundamentals of electromagnetics and antenna technology. This book covers the design, electromagnetic simulation, fabrication, and measurements for various types of antennas, including impedance matching techniques and beamforming for ultrawideband dipoles, monopoles, loops, vector sensors for direction finding, HF curtain arrays, 3D printed nonplanar patch antenna arrays, waveguides for portable radar, reflector antennas, and other antennas. It explores the essentials of phased array antennas and includes detailed derivations of important field equations, and a detailed formulation of the method of moments. This resource exhibits essential derivations of equations, providing readers with a strong foundation of the underpinnings of electromagnetics and antennas. It includes a complete chapter on the details of antenna and electromagnetic test and measurement. This book explores details on 3D printed non-planar circular patch array antenna technology and the design and analysis of a planar array-fed axisymmetric gregorian reflector. The lumped-element impedance matched antennas are examined and include a look at an analytic impedance matching solution with a parallel LC network. This book provides key insight into many aspects of antenna technology that have broad applications in radar and communications.

This book discusses the development of promising technologies for compact antennas for high data-rate communications. It discusses and analyzes the design of compact ultra-wideband (UWB) and multiple input, multiple output (MIMO) antennas, providing essential know-how for designers, practicing engineers and scientists. These wireless

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communication technologies enable consumers to have convenient access to a wide range of services – anytime, anywhere. And the introduction of wireless mobile access points eliminates the limitations to communication imposed by geographical location. The Internet has allowed people to access and share information much more rapidly, but in order to achieve higher data rates with the limited available resources and imposed constraints, wireless communication technology needs to be pushed beyond the physical limits of the propagation channel. This book contributes to achieving this goal.

The book presents basic and advanced concepts of circularly polarized antennas, including design procedure and recent applications. Cross dipole antennas, microstrip antennas, helical antennas, quadrifilar helix antennas, frequency independent antennas, horn antennas, omnidirectional circularly polarized antennas and radial line array antennas are discussed. With abundant examples, the book is an essential reference for researchers and engineers.

Advanced Array Systems, Applications and RF Technologies adopts a holistic view of arrays used in radar, electronic warfare, communications, remote sensing and radioastronomy. Radio frequency (RF) and intermediate frequency (IF) signal processing is assuming a fundamental importance, owing to its increasing ability to multiply a system's capabilities in a cost-effective manner. This book comprehensively covers the important front-end RF subsystems of active phased arrays, so offering

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array designers new and exciting opportunities in signal processing. Provides an up to date record of existing systems from different applications Explores array systems under development Bridges the gap between textbook coverage of idealized phased arrays and practical knowledge of working phased arrays Recognises the significance of cost to the realization of phased arrays Discusses future advances in the field that promise to deliver even more affordable arrays ['intelligent' or self-focussing/-cohering arrays]

Advances in ubiquitous antenna technology is driven by the continuous demand for Internet of Things (IoT) products. To date, the industry has been addressing these demands by enhancing the signaling strength, speed, operating bandwidth, etc which facilitated different generations of wireless technology (1G, 2G, 3G, 4G, and 5G). Several unintended factors have undermined the benefit from the advances in flexible inkjet printed Antenna of Things (AoT) products. Notably, the challenges associated with these are to maintain constant conductive performance at flexible or reconfigurable conditions. Previous studies emphasized more on the design improvements instead of establishing an ideal printing condition for antenna implementation. This research aims to establish a unique, and cost-effective inkjet printing properties on the photo paper using silver nano ink. This step is followed by the fabrication of an antenna and comparing the response with relatively similar antenna architecture with the rigid FR4 substrate. After printing optimization, and fabrication, the flexible printed pattern was

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subjected to several repetitive rolling and bending test. The results confirm the robustness of the specimen. Since a single ultra-wideband (UWB) antenna can replace many single narrow-banded antennas, a UWB antenna was implemented on photo paper with the optimized printing methods. The antenna operates over 3.2–30 GHz frequency range and compliant with UWB standards. Finally, a new 5G phased array antenna design is proposed in order to keep pace with the future IoT and high-speed 5G communication.

Detailed descriptions of detection, direction-finding, and signal-estimation methods, using consistent formalisms and notation, emphasizing HF antenna array sensing applications. Adaptive antenna array technology encompasses many powerful interference suppression approaches that exploit spatial differences among signals reaching a radio receiver system. Today, worldwide propagation phenomenology occurring in the High Frequency (HF) radio regime has made such interference common. In this book, Jay Sklar, a longtime researcher at MIT Lincoln Laboratory, presents detailed descriptions of detection, direction-finding, and signal-estimation methods applicable at HF, using consistent formalisms and notation. Modern electronic system technology has made many of these techniques affordable and practical; the goal of the book is to offer practicing engineers a comprehensive and self-contained reference that will encourage more widespread application of these approaches. The book is based on the author's thirty years of managing MIT Lincoln Laboratory work on

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the application of adaptive antenna array technologies to the sensing of HF communication signals. After an overview of HF propagation phenomenology, communication signal formats, and HF receiver architectural approaches, Sklar describes the HF propagation environment in more detail; introduces important modulation approaches and signaling protocols used at HF; discusses HF receiver system architectural features; and addresses signal processor architecture and its implementation. He then presents the technical foundation for the book: the vector model for a signal received at an adaptive array antenna. He follows this with discussions of actual signal processing techniques for detection and direction finding, including specific direction-finding algorithms; geolocation techniques; and signal estimation.

Expert contributors drawn from the ranks of academia and industry have authored chapters in such areas as third-generation wireless, wireless sensor networks, RF power amplifiers, spread spectrum modulation, signal propagation, antennas, and other key subjects that engineers working in RF and wireless need to be familiar with. This is far more than just a tutorial or reference guide—it is a "guided tour" through the world of cutting-edge RF and wireless design, combining theory, applications, and philosophies behind the RF/wireless design process. The multiple and sometimes overlapping chapters reiterate and emphasize the fundamentals in the context of different types of wireless applications. Here are just a few benefits that readers will gain from reading

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this book: *A refresher and update of wireless principles and techniques. *Information about the latest (and forthcoming) RF and wireless circuits, products and systems. *Guidelines, approaches, and techniques to RF/wireless design. *Examples of typical applications with an emphasis on real-world situations including existing and forthcoming new components and integrated circuits. *Coverage of new and emerging wireless topics heretofore not widely covered in print (e.g. UWB, RFID, IR, etc.) * A comprehensive survey of current RF and wireless engineering practice * Heavy emphasis on practical applications and design guidelines * Multiple contributors assure a wide range of perspectives and avoids individual bias

Radar Expert, Esteemed Author Gregory L. Charvat on CNN and CBS Author Gregory L. Charvat appeared on CNN on March 17, 2014 to discuss whether Malaysia Airlines Flight 370 might have literally flown below the radar. He appeared again on CNN on March 20, 2014 to explain the basics of radar, and he explored the hope and limitations of the technology i

Based on the author's extensive research at MIT Lincoln Laboratory, this authoritative resource offers an in-depth description of adaptive array design, emphasizing the RF characteristics, mutual coupling among elements, and field testing methods. It provides you with proven techniques for challenging projects involving radar, communication systems and antenna design. For the first time in any book, you find design guidance on specialized types of arrays, using monopole radiating elements, slotted cylinders

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and ultrawideband dipoles. Moreover, this unique book presents a focused near-field technique that quantifies the far-field performance of large aperture radar systems and communication systems. The book presents example prototype phased array antennas, including discussions on monopole phased arrays, finite and infinite array analyses, measurements for planar arrays of monopole elements. Further, you get a detailed explanation of focused near-field polarization characteristics of monopole arrays as related to adaptive array testing in the near field. From the fundamentals of adaptive antennas and degrees of freedom for multiple beam antennas and phased arrays... to a test bed monopole phased array and the planar near field testing technique... to arrays of horizontally polarized loop-fed slotted cylinder antennas and ultrawideband dipole arrays, this comprehensive book offers you invaluable, hands-on knowledge for your work in the field.

In the high frequency world, the passive technologies required to realize RF and microwave functionality present distinctive challenges. SAW filters, dielectric resonators, MEMS, and waveguide do not have counterparts in the low frequency or digital environment. Even when conventional lumped components can be used in high frequency applications, their behavior does not resemble that observed at lower frequencies. RF and Microwave Passive and Active Technologies provides detailed information about a wide range of component technologies used in modern RF and microwave systems. Updated chapters include new material on such technologies as MEMS, device packaging, surface acoustic wave (SAW) filters, bipolar junction and heterojunction transistors, and high mobility electron transistors (HMETs). The

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book also features a completely rewritten section on wide bandgap transistors.

This completely revised third edition of an Artech House classic, *Phased Array Antenna Handbook, Second Edition*, offers an up-to-date and comprehensive treatment of array antennas and systems. This edition provides a wealth of new material, including expanded coverage of phased array and multiple beam antennas. New modern machine learning techniques used for analysis are included. Additional material on wideband antennas and wideband coverage in array antennas are incorporated in this book, including new methods, devices, and technologies that have developed since the second edition. A detailed treatment of antenna system noise, sections on antenna pattern synthesis, developments in subarray technology, and in-depth coverage of array architecture and components are additional new features of this book. The book explores design elements that demonstrate how to size an array system with speed and confidence. Moreover, this resource provides expanded coverage of systems aspects of arrays for radar and communications. Supported with numerous equations and illustrations, this practical book helps evaluate basic antenna parameters such as gain, sidelobe levels, and noise. Readers learn how to compute antenna system noise, design subarray geometries for given bandwidth, scan and sidelobe constraints, and choose array illumination tapers for given sidelobe levels.

By 1990 the wireless revolution had begun. In late 2000, Mike Golio gave the world a significant tool to use in this revolution: *The RF and Microwave Handbook*. Since then, wireless technology spread across the globe with unprecedented speed, fueled by 3G and 4G mobile technology and the proliferation of wireless LANs. Updated to reflect this tremendous growth, the second edition of this widely embraced, bestselling handbook divides its coverage

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conveniently into a set of three books, each focused on a particular aspect of the technology. Six new chapters cover WiMAX, broadband cable, bit error ratio (BER) testing, high-power PAs (power amplifiers), heterojunction bipolar transistors (HBTs), as well as an overview of microwave engineering. Over 100 contributors, with diverse backgrounds in academic, industrial, government, manufacturing, design, and research reflect the breadth and depth of the field. This eclectic mix of contributors ensures that the coverage balances fundamental technical issues with the important business and marketing constraints that define commercial RF and microwave engineering. Focused chapters filled with formulas, charts, graphs, diagrams, and tables make the information easy to locate and apply to practical cases. The new format, three tightly focused volumes, provides not only increased information but also ease of use. You can find the information you need quickly, without wading through material you don't immediately need, giving you access to the caliber of data you have come to expect in a much more user-friendly format.

This book presents novel research ideas and offers insights into radar system design, artificial intelligence and signal processing applications. Further, it proposes a new concept of antenna spatial polarization characteristics (SPC), suggesting that the antenna polarization is a function of the spatial direction and providing new ideas for radar signal processing (RSP) and anti-jamming. It also discusses the design of an advanced signal-processing algorithm, and proposes new polarimetric and anti-jamming methods using antenna inherent properties. The book helps readers discover the potential of radar information processing and improve its anti-interference and target identification ability. It is of interest to university researchers, radar engineers and graduate students in computer science and electronics who wish to learn the

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core principles, methods, algorithms, and applications of RSP.

An introduction to decision making under uncertainty from a computational perspective, covering both theory and applications ranging from speech recognition to airborne collision avoidance. Many important problems involve decision making under uncertainty—that is, choosing actions based on often imperfect observations, with unknown outcomes. Designers of automated decision support systems must take into account the various sources of uncertainty while balancing the multiple objectives of the system. This book provides an introduction to the challenges of decision making under uncertainty from a computational perspective. It presents both the theory behind decision making models and algorithms and a collection of example applications that range from speech recognition to aircraft collision avoidance. Focusing on two methods for designing decision agents, planning and reinforcement learning, the book covers probabilistic models, introducing Bayesian networks as a graphical model that captures probabilistic relationships between variables; utility theory as a framework for understanding optimal decision making under uncertainty; Markov decision processes as a method for modeling sequential problems; model uncertainty; state uncertainty; and cooperative decision making involving multiple interacting agents. A series of applications shows how the theoretical concepts can be applied to systems for attribute-based person search, speech applications, collision avoidance, and unmanned aircraft persistent surveillance. Decision Making Under Uncertainty unifies research from different communities using consistent notation, and is accessible to students and researchers across engineering disciplines who have some prior exposure to probability theory and calculus. It can be used as a text for advanced undergraduate and graduate students in fields including computer science,

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aerospace and electrical engineering, and management science. It will also be a valuable professional reference for researchers in a variety of disciplines.

IMDC-SDSP conference offers an exceptional platform and opportunity for practitioners, industry experts, technocrats, academics, information scientists, innovators, postgraduate students, and research scholars to share their experiences for the advancement of knowledge and obtain critical feedback on their work. The timing of this conference coincides with the rise of Big Data, Artificial Intelligence powered applications, Cognitive Communications, Green Energy, Adaptive Control and Mobile Robotics towards maintaining the Sustainable Development and Smart Planning and management of the future technologies. It is aimed at the knowledge generated from the integration of the different data sources related to a number of active real-time applications in supporting the smart planning and enhance and sustain a healthy environment. The conference also covers the rise of the digital health, well-being, home care, and patient-centred era for the benefit of patients and healthcare providers; in addition to how supporting the development of a platform of smart Dynamic Health Systems and self-management.

Radio Frequency Micromachined Switches, Switching Networks, and Phase Shifters discusses radio frequency microelectromechanical systems (RF MEMS)-based control components and will be useful for researchers and R&D engineers. It offers an in-depth study, performance analysis, and extensive characterization on micromachined switches and phase shifters. The reader will learn about basic design methodology and techniques to carry out extensive measurements on MEMS switches and phase shifters which include electrical, mechanical, power handling, linearity, temperature stability, reliability, and radio frequency performance.

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Practical examples included in the book will help readers to build high performance systems/subsystems using micromachined circuits. Key Features Provides simple design methodology of MEMS switches and switching networks including SPST to SP16T switches Gives an in-depth performance study of micromachined phase shifters. Detailed study on reliability and power handling capability of RF MEMS switches and phase shifters presented Proposes reconfigurable micromachined phase shifters Verifies a variety of MEMS switches and phase shifters experimentally

This book focuses on soft computing and its applications to solve real-life problems occurring in different domains ranging from medical and health care, supply chain management and image processing to cryptanalysis. It presents the proceedings of International Conference on Soft Computing: Theories and Applications (SoCTA 2016), offering significant insights into soft computing for teachers and researchers and inspiring more and more researchers to work in the field of soft computing. >The term soft computing represents an umbrella term for computational techniques like fuzzy logic, neural networks, and nature inspired algorithms. In the past few decades, there has been an exponential rise in the application of soft computing techniques for solving complex and intricate problems arising in different spheres of life. The versatility of these techniques has made them a favorite among scientists and researchers working in diverse areas. SoCTA is the first international conference being organized at Amity University Rajasthan (AUR), Jaipur. The objective of SoCTA 2016 is to provide a common platform to researchers, academicians, scientists, and industrialists working in the area of soft computing to share and exchange their views and ideas on the theory and application of soft computing techniques in multi-disciplinary areas. The aim of the conference is to bring together

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young and experienced researchers, academicians, scientists, and industrialists for the exchange of knowledge. SoCTA especially encourages the young researchers at the beginning of their career to participate in this conference and present their work on this platform.

A rigorous introduction to the theory and applications of state estimation and association, an important area in aerospace, electronics, and defense industries. Applied state estimation and association is an important area for practicing engineers in aerospace, electronics, and defense industries, used in such tasks as signal processing, tracking, and navigation. This book offers a rigorous introduction to both theory and application of state estimation and association. It takes a unified approach to problem formulation and solution development that helps students and junior engineers build a sound theoretical foundation for their work and develop skills and tools for practical applications. Chapters 1 through 6 focus on solving the problem of estimation with a single sensor observing a single object, and cover such topics as parameter estimation, state estimation for linear and nonlinear systems, and multiple model estimation algorithms. Chapters 7 through 10 expand the discussion to consider multiple sensors and multiple objects. The book can be used in a first-year graduate course in control or system engineering or as a reference for professionals. Each chapter ends with problems that will help readers to develop derivation skills that can be applied to new problems and to build computer models that offer a useful set of tools for problem solving. Readers must be familiar with state-variable representation of systems and basic probability theory including random and stochastic processes.

Practical ultrawideband phased array technology used in airborne and ground-based systems

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applications.

This book explores both the state-of-the-art and the latest achievements in UWB antennas and propagation. It has taken a theoretical and experimental approach to some extent, which is more useful to the reader. The book highlights the unique design issues which put the reader in good pace to be able to understand more advanced research.

This comprehensive summary of the state of the art in Ultra Wideband (UWB) system engineering takes you through all aspects of UWB design, from components through the propagation channel to system engineering aspects. Mathematical tools and basics are covered, allowing for a complete characterisation and description of the UWB scenario, in both the time and the frequency domains. UWB MMICs, antennas, antenna arrays, and filters are described, as well as quality measurement parameters and design methods for specific applications. The UWB propagation channel is discussed, including a complete mathematical description together with modeling tools. A system analysis is offered, addressing both radio and radar systems, and techniques for optimization and calibration. Finally, an overview of future applications of UWB technology is presented. Ideal for scientists as well as RF system and component engineers working in short range wireless technologies.

The development of deep space surveillance technology and its later application to near-Earth surveillance, covering work at Lincoln Laboratory from 1970 to 2000. In the 1950s, the United States and the Soviet Union raced to develop space-based intelligence gathering capability. The Soviets succeeded first, with SPUTNIK I in 1957. The United States began to monitor the growing Soviet space presence by developing technology for the detection and tracking of man-made resident space objects (RSOs) in near-Earth orbit. In 1972, the Soviet Union launched a

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satellite into deep space orbit, and the U.S. government called on MIT Lincoln Laboratory to develop deep space surveillance technology. This book describes these developments, as well as the later application of deep space surveillance technology to near-Earth surveillance, covering work at Lincoln Laboratory on space surveillance from 1970 to 2000. The contributors, all key participants in developing these technologies, discuss topics that include narrow beam, narrow bandwidth radar for deep surveillance; wide bandwidth radar for RSO monitoring; ground-based electro-optical deep space surveillance and its adaptation for space-based surveillance; radar as the means of real-time search and discovery techniques; methods of analyses of signature data from narrow bandwidth radars; and the collision hazard for satellites in geosynchronous orbit, stemming initially from the failure of TELSTAR 401. They also describe some unintended byproducts of this pioneering work, including the use of optical space surveillance techniques for near-Earth asteroid detection. Contributors Rick Abbott, Robert Bergemann, E.M. Gaposchkin, Israel Kupiec, Richard Lambour, Antonio F. Pensa, Eugene Rork, Jayant Sharma, Craig Solodyna, Ramaswamy Sridharan, J. Scott Stuart, George Zollinger

The future national security environment will present the naval forces with operational challenges that can best be met through the development of military capabilities that effectively leverage rapidly advancing technologies in many areas. The panel envisions a world where the naval forces will perform missions in the future similar to those they have historically undertaken. These missions will continue to include sea control, deterrence, power projection, sea lift, and so on. The missions will be accomplished through the use of platforms (ships, submarines, aircraft, and spacecraft), weapons (guns, missiles, bombs, torpedoes, and

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information), manpower, materiel, tactics, and processes (acquisition, logistics, and so on.). Accordingly, the Panel on Technology attempted to identify those technologies that will be of greatest importance to the future operations of the naval forces and to project trends in their development out to the year 2035. The primary objective of the panel was to determine which are the most critical technologies for the Department of the Navy to pursue to ensure U.S. dominance in future naval operations and to determine the future trends in these technologies and their impact on Navy and Marine Corps superiority. A vision of future naval operations ensued from this effort. These technologies form the base from which products, platforms, weapons, and capabilities are built. By combining multiple technologies with their future attributes, new systems and subsystems can be envisioned. Technology for the United States Navy and Marine Corps, 2000-2035 Becoming a 21st-Century Force: Volume 2: Technology identifies those technologies that are unique to the naval forces and whose development the Department of the Navy clearly must fund, as well as commercially dominated technologies that the panel believes the Navy and Marine Corps must learn to adapt as quickly as possible to naval applications. Since the development of many of the critical technologies is becoming global in nature, some consideration is given to foreign capabilities and trends as a way to assess potential adversaries' capabilities. Finally, the panel assessed the current state of the science and technology (S&T) establishment and processes within the Department of the Navy and makes recommendations that would improve the efficiency and effectiveness of this vital area. The panel's findings and recommendations are presented in this report.

This book covers terahertz antenna technology for imaging and sensing, along with its various applications. The authors discuss the use of terahertz frequency and photoconductive antenna

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technology for imaging applications, such as biological and bio-medical applications, non-destructive inspection of fabrics and plastics, analysis of hydration levels or detecting the presence of metallic components in samples, and detecting a variety of materials with unique spectral fingerprints in the terahertz frequency range, such as different types of explosives or several compounds used in the fabrication of medicines. Provides a comprehensive review of terahertz source and detector for imaging and sensing; Discusses photoconductive antenna technology for imaging and sensing; Presents modalities for improving the photoconductive dipole antenna performance for imaging and sensing; Explores applications in tomographic imaging, art conservation and the pharmaceutical and aerospace industries.

Ultrawideband (UWB) phased antenna arrays are critical to the success of future multi-functional communication, sensing, and countermeasure systems, which will utilize a few UWB phased arrays in place of multiple antennas on a platform. The success of this new systems approach relies in part on the ability to manufacture and assemble low-cost UWB phased arrays with excellent radiation characteristics. This dissertation presents the theory and design of a new class of UWB arrays that is based on unbalanced fed tightly-coupled horizontal dipoles over a ground plane. Practical implementation of this concept leads to two inexpensive wideband array topologies, the Banyan Tree Antenna (BTA) Array, and the Planar Ultrawideband Modular Antenna (PUMA) Array. The key challenge in designing unbalanced-fed tightly-coupled dipole arrays lies in the control of a common mode resonance that destroys UWB performance. This work introduces a novel feeding strategy that eliminates this resonance and results in wideband, wide-angle radiation. More importantly, the new feeding scheme is simple and intuitive, and can be implemented at low-cost in both vertically and

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planarly-integrated phased array architectures. Another desirable byproduct of this topology is the electrical and mechanical modularity of the aperture, which enables easy manufacturability and assembly. A theoretical framework is presented for the new phased array topologies, which is then applied to the design of infinite BTA and PUMA arrays that achieve 4:1 and 5:1 bandwidths, respectively. A practical application of this technology is demonstrated through the full design, fabrication, and measurement of a 7.25-21GHz 16x16 dual-pol PUMA array prototype for SATCOM applications.

Ultra-wideband (UWB), short-pulse (SP) electromagnetics are now being used for an increasingly wide variety of applications, including collision avoidance radar, concealed object detection, and communications. Notable progress in UWB and SP technologies has been achieved by investigations of their theoretical bases and improvements in solid-state manufacturing, computers, and digitizers. UWB radar systems are also being used for mine clearing, oil pipeline inspections, archeology, geology, and electronic effects testing. Ultra-wideband Short-Pulse Electromagnetics 9 presents selected papers of deep technical content and high scientific quality from the UWB-SP9 Conference, which was held from July 21-25, 2008, in Lausanne, Switzerland. The wide-ranging coverage includes contributions on electromagnetic theory, time-domain computational techniques, modeling techniques, antennas, pulsed-power, UWB interactions, radar systems, UWB communications, broadband systems and components. This book serves as a state-of-the-art reference for scientists and engineers working in these applications areas.

A guide to defense systems analysis by experts who have worked on systems that range from air defense to space defense.

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Advances in digital signal processing algorithms and computer technology have combined to produce real-time systems with capabilities far beyond those of just few years ago. Nonlinear, adaptive methods for signal processing have emerged to provide better array gain performance, however, they lack the robustness of conventional algorithms. The challenge remains to develop a concept that exploits the advantages of both-a scheme that integrates these methods in practical, real-time systems. The Advanced Signal Processing Handbook helps you meet that challenge. Beyond offering an outstanding introduction to the principles and applications of advanced signal processing, it develops a generic processing structure that takes advantage of the similarities that exist among radar, sonar, and medical imaging systems and integrates conventional and nonlinear processing schemes.

Ultra wideband technology is one of the most promising directions in the rapidly developing modern communications. Ultra wideband communication system applications include radars, wireless personal area networks, sensor networks, imaging systems and high precision positioning systems. Ultra wideband transmission is characterized by high data rate, availability of low-cost transceivers, low transmit power and low interference. The proposed book consisting of 19 chapters presents both the state-of-the-art and the latest achievements in ultra wideband communication system performance, design and components. The book is addressed to engineers and researchers who are interested in the wide range of topics related to ultra wideband communications.

Analysis, design, and development of various antennas
Design of wide band antennas and small antennas
Empirical, theoretical, and computational models of antennas and arrays
Material properties and their applications in antennas
Reconfigurable and tunable antennas,

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optical and nano antennas Antenna arrays and MIMO systems Signal processing for antennas Theoretical and computational methods of predicting wave propagation and sensing Characterization of propagation channels Applications in wireless communications, radar, and imaging systems Multiple antenna systems for spatial, polarization, pattern, and other diversity applications Measurement, specification, and standards of electrical quantities Measurement techniques for antennas, electromagnetic radiation, propagation, and scattering Fundamental and advanced theory, analytical and numerical solutions Radiation, scattering, radar cross section, propagation, and interaction with all media Inverse scattering

This book presents ultrawideband antennas and their applications on microwave imaging. The chapters focus on recent techniques, analysis, and applications along with the future vision of this emerging field of applied electromagnetics. Several emerging topics are essayed, including dielectric resonator antennas and planar ultrawideband antennas for microwave imaging. This resource incorporates modern design concepts, analysis, and optimization techniques based on recent developments. Readers are also provided with an extensive overview of current regulations, including those related to microwave effects in biological tissues.

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