Active Radar Cross Section Reduction Theory And Applications

In this book, a modified improved LMS algorithm is employed for weight adaptation of dipole array for the generation of beam pattern in multiple signal environments. In phased arrays, the generation of adapted pattern according to the signal scenario requires an efficient adaptive algorithm. The antenna array is expected to maintain sufficient gain towards each of the desired source while at the same time suppress the probing sources. This cancels the signal transmission towards each of the hostile probing sources leading to active cancellation. In the book, the performance of dipole phased array is demonstrated in terms of fast convergence, output noise power and output signal-to-interference-and noise ratio. The mutual coupling effect and role of edge elements are taken into account. It is established that dipole array along with an efficient algorithm is able to maintain multilobe beamforming with accurate and deep nulls towards each probing source. This work has application to the active radar cross section (RCS) reduction. This book consists of formulation, algorithm description and result discussion on active cancellation of hostile probing sources in phased antenna array. It includes numerous illustrations demonstrating the theme of the book for different signal environments and array configurations. The concepts in this book are discussed in an easy-to-understand manner, making it suitable even for the beginners in the field of phased arrays and adaptive array processing.

Methods of realizing the load impedance required for radar cross section control of conducting bodies are discussed. It is shown that passive loading, using frequency-dependent dielectric/magnetic materials in a radial or coaxial line, requires a frequency dependence which is not exhibited by any known material. A number of active synthesis approaches are examined, with emphasis on those using the Negative Impedance Converter (NIC). Experimental results are given for a particular NIC realization operating in the 5 - 10 MHz range; the circuit is shown to be capable of producing the load impedance required for a cross-section reduction of 13dB or more over a 2:1 bandwidth.

The design and development of low radar cross section (RCS) phased array has been a challenging subject in stealth technology. The frequency selective surface elements act as absorbers in specific frequency band and facilitate gain enhancement and reduction of antenna RCS. This book presents a comprehensive EM design and analysis of such low-profile patch arrays with high impedance surface-based ground plane. It explains how to determine radiation mode RCS of low-profile antenna arrays with arbitrary configurations. Detailed descriptions of design, workflow of determining radiation and scattering behavior of antenna arrays have been supported with schematics, tables, and illustrations. Aimed at engineers and researchers for RCS, antenna engineers and graduate students in electrical engineering and electromagnetics, it • Discusses both radiation and scattering features of both planar and conformal HIS-based low profile antennas • Describes the theoretical background, design, simulations and analysis of low RCS phased array in detail • Presents the physics behind the resultant radiation and scattering characteristics of designed antenna array • Helps readers understand design and analysis of low RCS antenna

array without any degradation in its radiation performance • Includes figures, schematics and illustrations to provide comprehensive descriptions of both radiation and scattering characteristics of phased arrays of different configurations

This book discusses the active and passive radar cross section estimation and techniques to examine the low observable aerospace platforms.

This book considers a cylindrical phased array with microstrip patch antenna elements and half-wavelength dipole antenna elements. The effect of platform and mutual coupling effect is included in the analysis. The non-planar geometry is tackled by using Euler's transformation towards the calculation of array manifold. Results are presented for both conducting and dielectric cylinder. The optimal weights obtained are used to generate adapted pattern according to a given signal scenario. It is shown that array along with adaptive algorithm is able to cater to an arbitrary signal environment even when the platform effect and mutual coupling is taken into account. This book provides a step-by-step approach for analyzing the probe suppression in non-planar geometry. Its detailed illustrations and analysis will be a useful text for graduate and research students, scientists and engineers working in the area of phased arrays, low-observables and stealth technology.

This volume presents peer reviewed and selected papers of the International Youth Conference on Electronics, Telecommunications and Information Technologies (YETI-2020), held in Peter the Great St. Petersburg Polytechnic University, St. Petersburg on July 10–11, 2020. It discusses current trends and major advances in electronics, telecommunications, optical and information technologies, focusing, in particular, on theoretical and practical aspects of developing novel devices and materials, improving data processing methods and technologies. The conference brings together young researchers and early-career scientists participating in a series of lectures and presentations, establishing contacts with potential partners, sharing new project ideas and starting new collaborations.

The two-volume set LNICST 236-237 constitutes the post-conference proceedings of the 12th EAI International Conference on Communications and Networking, ChinaCom 2017, held in Xi’an, China, in September 2017. The total of 112 contributions presented in these volumes are carefully reviewed and selected from 178 submissions. Aside from the technical paper sessions the book is organized in topical sections on wireless communications and networking, satellite and space communications and networking, big data network track, multimedia communications and smart networking, signal processing and communications, network and information security, advances and trends of V2X networks.

This book presents the detailed analytical formulation for the RCS of parallel-fed linear dipole array in the presence of mutual coupling. The radar cross section (RCS) of an object represents its electromagnetic (EM) scattering properties for a given incident wave. The analysis of scattered field is critical in military and defence arenas, especially while designing low-observable platforms. It is well-known that the presence of an antenna/array on the target influences its echo

area significantly. The primary cause for such scattering of the incident signals is reflection that occurs within the antenna aperture and its feed network. In this book, the RCS estimation is done based on the signal path within the antenna system. The scattered field is expressed in terms of array design parameters including the reflection and transmission coefficients. The computed results show the variation in the RCS pattern with and without mutual coupling. The effect of finite dipole-length, inter-element spacing, scan angle, array configuration, amplitude distribution and terminating load impedance on the RCS pattern is studied. It is shown that the array RCS can be controlled by choosing optimum design parameters, including terminating impedance and geometric configuration. This book explains each step of the RCS estimation and analysis of dipole array with detailed schematics, tables and illustrations. Moreover, it includes parametric analysis of RCS estimation and control. This book provides an insight into the phenomenon of scattering within the phased array system.
There have been many new developments in the ten years since the first edition of Radar and Laser Cross Section Engineering was published. Stealth technology is now an important consideration in the design of all types of platforms. The second edition includes a more extensive introduction that covers the important aspects of stealth technology and the unique tradeoffs involved in stealth design. Prediction, reduction, and measurement of electromagnetic scattering from complex three-dimensional targets remains the primary emphasis of this text, developed by the author from courses taught at the Naval Postgraduate School. New topics on computational methods like the finite element method and the finite integration technique are covered, as well as new areas in the application of radar absorbing material and artificial metamaterials. Matlab [registered] software, homework problems, and a solution manual (available to instructors) supplement the text. Written as an instructional text, this book is recommended for upper-level undergraduate and graduate students. introduction to the physics and mathematics of radar cross section in order to better understand the interdisciplinary aspects of stealth. Matlab is a registered trademark of The MathWorks, Inc.
This book is dedicated to studying the ocean with radar tools, in particular, with space radars. Being intended mainly for the scientists preoccupied with the problem (as well as senior course students), it concentrates and generalizes the knowledge scattered over specialized journals. The significant part of the book contains the results obtained by the author. * Systematically collects and describes the approaches used by different laboratories and institutions * Deals with the physics of radar imagery and specifically with ocean surface imagery. * Useful for students and researchers specializing in the area of ocean remote sensing using airborne or space-borne radars, both SAR and RAR
This Festschrift marks the retirement of Professor Chris Calladine, FRS after 42 years on the teaching staff of the Department of Engineering, University of Cambridge. It contains a series of papers contributed by his former students, colleagues, and friends.

Chris Calladine's research has ranged very widely across the field of struc tural mechanics, with a particular focus on the plastic deformation of solids and structures, and the behaviour of thin-shell structures. His insightful books on Engineering Plasticity and Theory of Shell Structures have been appreciated by many generations of students at Cambridge and elsewhere. His scientific contri bution outside engineering, in molecular structures, is at least as significant, and he is unique among engineers in having co-authored a book on DNA. Also, he has been keenly interested in the research of many students and colleagues, and on many occasions his quick grasp and physical insight have helped a student, and sometimes a colleague, find the nub of the problem without unnecessary effort. Many of the papers contained in this volume gratefully acknowledge this generous contribution. We thank Professor G. M. l. Gladwell for reading through all of the contri butions, Mrs R. Baxter and Mrs o. Constantinides for help in preparing this volume, Godfrey Argent Studio for permission to reproduce Calladine's por trait for the Royal Society, and Dr A. Schouwenburg -from Kluwer- for his assistance. Horace R. Drew Sergio Pellegrino ix CHRIS CALLADINE SOME THOUGHTS ON RESEARCH c. R.

This book discusses the active and passive radar cross section (RCS) estimation and techniques to examine the low observable aerospace platforms. It begins with the fundamentals of RCS, followed by the dielectric, magnetic and metamaterials parameters of the constituent materials and then explains various methods and the emerging trends followed in this area of study. The RCS estimation of phased array including the mutual coupling effect is also presented in detail in the book. The active RCS reduction is carefully touched upon through the performance of phased arrays, sidelobe cancellers and mitigation of multipath effect. Providing information on various adaptive algorithms like least mean square (LMS), recursive least square (RLS) and weighted least square algorithms, the authors also mention the recent developments in the area of embedded antennas, conformal load bearing antenna, metamaterials and frequency selective surface (FSS) based RCS reduction.

Active Radar Cross Section ReductionTheory and Applications

This book provides a solid foundation for understanding radar energy warfare and stealth technology. The book covers the fundamentals of radar before moving on to more advanced topics, including electronic counter and electronic counter-counter measures, radar absorbing materials, radar cross section, and the science of stealth technology. A final section provides an introduction to Luneberg lens reflectors. The book will provide scientists, engineers, and students with valuable guidance on the fundamentals needed to understand state-of-the-art radar energy warfare and stealth technology research and applications.

The leading text and reference on radar cross section (RCS) theory and applications, this work presents a comparison of two radar signal strengths. One is the strength of the radar bean sweeping over a target, the other is the strength of the reflected echo senses by the receiver. This book shows how the RCS "gauge" can be predicted for theoretical objects.

This book presents a comprehensive review of plasma-based stealth, covering the basics, methods, parametric analysis, and challenges towards the realization of the idea. The concealment of aircraft from radar sources, or stealth, is achieved through shaping, radar absorbing coatings, engineered materials, or plasma, etc. Plasma-based stealth is a radar

cross section (RCS) reduction technique associated with the reflection and absorption of incident electromagnetic (EM) waves by the plasma layer surrounding the structure. A plasma cloud covering the aircraft may give rise to other signatures such as thermal, acoustic, infrared, or visual. Thus it is a matter of concern that the RCS reduction by plasma enhances its detectability due to other signatures. This needs a careful approach towards the plasma generation and its EM wave interaction. The book starts with the basics of EM wave interactions with plasma, briefly discuss the methods used to analyze the propagation characteristics of plasma, and its generation. It presents the parametric analysis of propagation behaviour of plasma, and the challenges in the implementation of plasma-based stealth technology. This review serves as a starting point for the graduate and research students, scientists and engineers working in the area of low-observables and stealth technology.

Due to its extensive applications in stealth technology, much of the research effort in radar absorbing materials (RAM) has remained classified. As is the wont with classified topics, it has resulted in much awe and unfounded speculation. The aim of this book is to demystify this topic. The book in hand is concise but complete in itself. The attention of the readers is first drawn towards the historical evolution of RAM to emphasize that the elementary principles of electromagnetics lead to the fundamental concepts of RAM. These also form the basis for further mathematical analysis and design of RAM. The performance plots for the various RAM designs, to the extent possible, are taken with respect to power reflection; this should facilitate comparison of their relative performances. In order to further induce the reader to take the first step towards RAM design, we have included the relevant computer codes in a companion diskette. This would enable the reader to try out elementary designs on his own. * .EXE files should facilitate ready execution of codes on most DOS based computing platforms. The corresponding source codes with comments are also included as * .FOR files. The reader may wish to modify some of these codes for examining RAM design algorithms further. We welcome comments from the reader on these codes.

This comprehensive resource provides readers with the tools necessary to perform analysis of various waveforms for use in radar systems. It provides information about how to produce synthetic aperture (SAR) images by giving a tomographic formulation and implementation for SAR imaging. Tracking filter fundamentals, and each parameter associated with the filter and how each affects tracking performance are also presented. Various radar cross section measurement techniques are covered, along with waveform selection analysis through the study of the ambiguity function for each particular waveform from simple linear frequency modulation (LFM) waveforms to more complicated coded waveforms. The text includes the Python tool suite, which allows the reader to analyze and predict radar performance for various scenarios and applications. Also provided are MATLAB® scripts corresponding to the Python tools. The software includes a user-friendly graphical user interface (GUI) that provides visualizations of the concepts being covered. Users have full access to both the Python and MATLAB source code to modify for their application. With examples using the tool suite are given at the end of each chapter, this text gives readers a clear understanding of how important target scattering is in areas of target detection, target tracking, pulse integration, and target discrimination.

This volume covers the recent advances and research on the modeling and simulation of materials. The primary aim is to take the reader through the mathematical analysis to the theories of electricity and magnetism using multiscale modelling, covering a variety of numerical methods such as finite difference time domain (FDTD), finite element method (FEM) and method of moments. The book also introduces the multiscale Green’s function (GF) method for static and dynamic modelling and simulation results of modern advanced nanomaterials, particularly the two-dimensional (2D) materials. This book will be of interest to researchers and industry professionals working on advanced materials.

In recent years, increasing deployment of large wind-turbine farms has become an issue of growing concern for the radar community. The large radar cross section (RCS) presented by wind turbines interferes with radar operation, and the Doppler shift caused by blade rotation causes problems identifying and tracking moving targets. Each new wind-turbine farm installation must be carefully evaluated for potential disruption of radar operation for air defense, air traffic control, weather sensing, and other applications. Several approaches currently exist to minimize conflict between wind-turbine farms and radar installations, including procedural adjustments, radar upgrades, and proper choice of low-impact wind-farm sites, but each has problems with limited effectiveness or prohibitive cost. An alternative approach, heretofore not technically feasible, is to reduce the RCS of wind turbines to the extent that they can be installed near existing radar installations. This report summarizes efforts to reduce wind-turbine RCS, with a particular emphasis on the blades. The report begins with a survey of the wind-turbine RCS-reduction literature to establish a baseline for comparison. The following topics are then addressed: electromagnetic model development and validation, novel material development, integration into wind-turbine fabrication processes, integrated-absorber design, and wind-turbine RCS modeling. Related topics of interest, including alternative mitigation techniques (procedural, at-the-radar, etc.), an introduction to RCS and electromagnetic scattering, and RCS-reduction modeling techniques, can be found in a previous report.

This book presents a detailed and systematic analytical treatment of scattering by an arbitrary dipole array configuration with unequal-length dipoles, different inter-element spacing and load impedance. It provides a physical interpretation of the scattering phenomena within the phased array system. The antenna radar cross section (RCS) depends on the field scattered by the antenna towards the receiver. It has two components, viz. structural RCS and antenna mode RCS. The latter component dominates the former, especially if the antenna is mounted on a low observable platform. The reduction in the scattering due to the presence of antennas on the surface is one of the concerns towards stealth technology. In order to achieve this objective, a detailed and accurate analysis of antenna mode scattering is required. In practical phased array, one cannot ignore the finite dimensions of antenna elements, coupling effect and the role of feed network while estimating the antenna RCS. This book presents the RCS estimation of an array with unequal-length dipoles. The signal reflections within the antenna system and the mutual coupling effect are considered to arrive at the total RCS for series and parallel feed. The computations are valid for any arbitrary array configurations, including side-by-side arrangement, parallel-in-echelon, etc.