

## Active Radar Cross Section Reduction

This book presents a detailed analytical formulation, and step-by-step design procedure for the electromagnetic (EM) design of radar absorbing structures (RAS). It discusses both the equivalent circuit model and Smith chart approach with illustrations to provide a clear understanding of the steps involved in designing multilayered RAS according to the desired specifications. This book is a valuable resource for beginners, academicians, and R&D engineers working in the field of RAS design and development.

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.

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This Feetschrift 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 structural 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 contribution 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. I. Gladwell for reading through all of the contributions, Mrs R. Baxter and Mrs o. Constantinides for help in preparing this volume, Godfrey Argent Studio for permission to reproduce Calladine's portrait 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 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.

**Bibliography, with Abstracts, of AFRL Publications from 1 October to 31 December 1970**

**Department of Defense Appropriations for Fiscal Year 1969**

**Hearings Before a Subcommittee of the Committee on Appropriations, House of Representatives, Ninety-third Congress, First Session ...**

**Permanent Magnet Materials and their Application**

**Active Cancellation of Probing in Linear Dipole Phased Array**

**Dept. of the Air Force**

**New Approaches to Structural Mechanics, Shells and Biological Structures**

**Probe Suppression in Conformal Phased Array**

**Radar Cross Section Lectures**

*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.*

*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 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.*

*This volume presents peer reviewed and selected papers of the International Youth Conference on Electronics, Telecommunications and Information Technologies (YEIT-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.*

*Air and Missile Defense Systems Engineering fills a need for those seeking insight into the design procedures of the air and missile defense system engineering process. Specifically aimed at policy planners, engineers, researchers, and consultants, it presents a balanced approach to negating a target in both natural and electronic attack environmen*

*Air and Missile Defense Systems Engineering*

*Radar and Laser Cross Section Engineering*

*Radiation and Scattering Analysis*

*Department of Defense Appropriations for 1974*

*Plasma-based Radar Cross Section Reduction*

*Hearings Before the Subcommittee of the Committee on Appropriations, United States Senate, Ninetieth Congress, Second Session on H.R. 18707, an Act Making Appropriations for the Department of Defense for the Fiscal Year Ending June 30, 1969, and for Other Purposes*

*Turbulence Structure and Modulation*

*Hearings, Reports and Prints of the Senate Committee on Appropriations*

*Theory and Applications*

Advances in Bistatic Radar updates and extends bistatic and multistatic radar developments since the publication of Willis' Bistatic Radar in 1991. New and recently declassified military applications are documented, civil applications are detailed including commercial and scientific systems and leading radar engineers provide expertise to each of these applications. Advances in Bistatic Radar consists of two major sections: Bistatic/Multistatic Radar Systems and Bistatic Clutter and Processing. Starting with a history update, the first section documents the early and now declassified military AN/FPS-23 Fluttar DEW-Line Gap-filler, and high frequency (HF) bistatic radars developed for missile attack warning. It then documents the recently developed passive bistatic and multistatic radars exploiting commercial broadcast transmitters for military and civilian air surveillance. Next, the section documents scientific bistatic radar systems for planetary exploration, who have exploited data link transmitters over the last forty years, ionospheric measurements, again exploiting commercial broadcast transmitters, and 3-D wind field measurements using a bistatic receiver hitchhiking off doppler weather radars. This last application has been commercialized. The second section starts by documenting the full, unclassified bistatic clutter scattering coefficient data base, along with the theory and analysis supporting its development. The section then details major clutter-related developments, spotlight bistatic synthetic aperture radar (SAR), which can now generate high resolution images using bistatic autofocus and related techniques; and adaptive moving target indication (MTI), which allows cancellation of nonstationary clutter generated by moving (i.e. airborne) platforms through the use of bistatic space-time adaptive processing (STAP).

"Provides a comprehensive discussion on active and passive radar cross section (RCS) estimation and techniques to achieve the low observable aerospace platforms"--

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 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.

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 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 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.

**Fundamentals of EM Design of Radar Absorbing Structures (RAS)**

**Advanced Technology Related to Radar, Signal, Imaging, and Radar Cross-Section Measurement**

**Hearings Before a Subcommittee of the Committee on Appropriations, United States Senate, Ninety-third Congress, First Session, on H.R. 11575, an Act Making Appropriations for the Department of Defense for the Fiscal Year Ending June 30, 1974, and for Other Purposes**

**Active Radar Cross Section Reduction**

**Advances in Bistatic Radar**

**Scattering Cross Section of Unequal Length Dipole Arrays**

**Department of Defense Appropriations for Fiscal Year 1974**

**Hearings ...Ninety-third Congress, Second Session, on S. 3000...**

**Techniques for Broadband Control of Radar Cross Sections**

Controlling turbulence is an important issue for a number of technological applications. Several methods to modulate turbulence are currently being investigated. This book describes various aspects of turbulence structure and modulation, and explains and discusses the most promising techniques in detail.

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.

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 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.

**Department of Defense Appropriations for Fiscal Year 1974, Hearings Before ...93-1**

**Aspects of Modern Radar**

**International Youth Conference on Electronics, Telecommunications and Information Technologies**

**Radar Cross Section of Dipole Phased Arrays with Parallel Feed Network**

**Low Radar Cross Section HIS-Based Phased Array**

**Proceedings of the YEIT 2020, St. Petersburg, Russia**

**Introduction to Radar Using Python and MATLAB**

**Radar Cross Section**

**Radar Energy Warfare and the Challenges of Stealth Technology**

*Radar-related technology is mainly processed within the time and frequency domains but, at the same time, is a multi-dimensional integrated system including a spatial domain for transmitting and receiving electromagnetic waves. As a result of the enormous technological advancements of the pioneers actively discussed in this book, research and development in multi-dimensional undeveloped areas is expected to continue. This book contains state-of-the-art work that should guide your research.*

*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 beam 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 is a comprehensive design text for permanent magnets and their application. Permanent magnets are very important industrially, and are widely used in a variety of applications, including industrial drives, consumer products, computers and cars. In the early 1970s a new class of magnet - the rare earths - was discovered, the properties of which showed sustained improvement over the following two decades. New materials such as these have spawned many new markets for magnets, with significant performance gains in the devices for which they are used. Until now, however, there has been no text that unified all the relevant information on the wide range of modern permanent magnet materials. This book is a comprehensive review of the technology, intended for scientists and engineers involved in all stages of the manufacture, design and use of magnets.*

**Technical Abstract Bulletin**

**Index of Limited Documents, Releasable to DTIC Users**

**Fiscal Year 1975 Authorization for Military Procurement, Research, and Development, and Active Duty, Selected Reserve and Civilian Personnel Strengths**

**U.S. Government Research Reports**

**Orbital Futures, Selected Documents in Air Force Space History, Vol. 1, 2004**

**Scientific and Technical Aerospace Reports**

**Multiscale Modelling of Advanced Materials**

**Department of Defense Appropriations for Fiscal Year 1969, Hearings Before ...90-2**