

# Radar Systems Analysis And Design Using Matlab

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## MIMO Radar Signal Processing Artech House

The first book to present a systematic and coherent picture of MIMO radars Due to its potential to improve target detection and discrimination capability, Multiple-Input and Multiple-Output (MIMO) radar has generated significant attention and widespread interest in academia, industry, government labs, and funding agencies. This important new work fills the need for a comprehensive treatment of this emerging field. Edited and authored by leading researchers in the field of MIMO radar research, this book introduces recent developments in the area of MIMO radar to stimulate new concepts, theories, and applications of the topic, and to foster further cross-fertilization of ideas with MIMO communications. Topical coverage includes: Adaptive MIMO radar Beampattern analysis and optimization for MIMO radar MIMO radar for target detection, parameter estimation, tracking, association, and recognition MIMO radar prototypes and measurements Space-time codes for MIMO radar Statistical MIMO radar Waveform design for MIMO radar Written in an easy-to-follow tutorial style, MIMO Radar Signal Processing serves as an excellent course book for graduate students and a valuable reference for researchers in academia and industry.

*Time-Domain Ultra-Wideband Radar, Sensor and Components* Artech House Radar Library (Ha

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.

## MATLAB Simulations for Radar Systems Design CRC Press

This book presents the theory, analysis and design of microwave stepped-frequency radar sensors. Stepped-frequency radar sensors are attractive for various sensing applications that require fine resolution. The book consists of five chapters. The first chapter describes the fundamentals of radar sensors including applications followed by a review of ultra-wideband pulsed, frequency-modulated continuous-wave (FMCW), and stepped-frequency radar sensors. The second chapter discusses a general analysis of radar sensors including wave propagation in media and scattering on targets, as well as the radar equation. The third chapter addresses the analysis of stepped-frequency radar sensors including their principles and design parameters. Chapter 4 presents the development of two stepped-frequency radar sensors at microwave and millimeter-wave frequencies based on microwave integrated

circuits (MICs), microwave monolithic integrated circuits (MMICs) and printed-circuit antennas, and discusses their signal processing. Chapter 5 provides the electrical characterization and test results of the developed microwave and millimeter-wave stepped-frequency radar sensors. Finally, a summary and conclusion is provided.

## Signal Processing for Multistatic Radar Systems Artech House on Demand

An essential task in radar systems is to find an appropriate solution to the problems related to robust signal processing and the definition of signal parameters. Signal Processing in Radar Systems addresses robust signal processing problems in complex radar systems and digital signal processing subsystems. It also tackles the important issue of defining signal parameters. The book presents problems related to traditional methods of synthesis and analysis of the main digital signal processing operations. It also examines problems related to modern methods of robust signal processing in noise, with a focus on the generalized approach to signal processing in noise under coherent filtering. In addition, the book puts forth a new problem statement and new methods to solve problems of adaptation and control by functioning processes. Taking a systems approach to designing complex radar systems, it offers readers guidance in solving optimization problems. Organized into three parts, the book first discusses the main design principles of the modern robust digital signal processing algorithms used in complex radar systems. The second part covers the main principles of computer system design for these algorithms and provides real-world examples of systems. The third part deals with experimental measurements of the main statistical parameters of stochastic processes. It also defines their estimations for robust signal processing in complex radar systems. Written by an internationally recognized professor and expert in signal processing, this book summarizes investigations carried out over the past 30 years. It supplies practitioners, researchers, and students with general principles for designing the robust digital signal processing algorithms employed by complex radar systems.

*Ultrawideband Radar* Artech House  
Offering radar-related software for the analysis and design of radar waveform and signal processing, Radar Signal Analysis and Processing Using MATLAB® provides

a comprehensive source of theoretical and practical information on radar signals, signal analysis, and radar signal processing with companion MATLAB® code. After an overview of radar systems operation and design, the book reviews elements of signal theory relevant to radar detection and radar signal processing, along with random variables and processes. The author then presents the unique characteristic of the matched filter and develops a general formula for the output of the matched filter that is valid for any waveform. He analyzes several analog waveforms, including the linear frequency modulation pulse and stepped frequency waveforms, as well as unmodulated pulse-train, binary, polyphase, and frequency codes. The book explores radar target detection and pulse integration, emphasizing the constant false alarm rate. It also covers the stretch processor, the moving target indicator, radar Doppler processing, beamforming, and adaptive array processing. Using configurable MATLAB code, this book demonstrates how to apply signal processing to radar applications. It includes many examples and problems to illustrate the practical application of the theory.

**Design and Analysis of Modern Tracking Systems** Artech House

This book presents the basic principles, analyses, design formulas, and characteristics of various fin-line configurations. You'll find summaries of hundreds of rigorous formulas as well as approximate closed-form expressions, which can be readily programmed to generate design data for any structure. Discover millimeter-wave integrated circuits and components realized using the various fin-line techniques presented in the text, including directional couplers, power dividers, attenuators, detectors, modulators, and oscillators. An Artech House bestseller!

System Engineering Analysis, Design, and Development John Wiley & Sons

The national interest in large radio and radar telescope systems spans the entire engineering and scientific community, and there is every indication that the country will embark upon the construction of still more of these systems in the near future. Radio and radar astronomers now require very large mechanical devices. The system specifications lead to structural criteria which are unique and outside the immediate interest and/or capability of most of the structures community. Radio and radar telescopes and the radomes that may protect them are often enormous structures. Their design presents extremely complicated technological problems. These instruments must operate with precision in varied environments and environmental conditions. Radomes must protect radio and radar antennas

without seriously interfering with the incoming information. The Office of Naval Research and MIT cosponsored an international conference in 1967 on the structural problems associated with large radio and radar telescope systems, the proceedings of which are collected here. The papers in this books deal with the problems outlined above from several points of view. The contents of the papers can be grouped roughly as follows: 1. Requirements and standards for supporting structures, tracking equipment, antennas, and radomes. 2. Design and performance of existing systems. 3. Theoretical analysis of the structures of supporting structures, antennas, and radomes. In some cases the analysis is made for a structure under stress. Computer techniques are described for several problems. 4. Methods for evaluating actual or predicted performance of various structures. Here again computer techniques are employed.

*Introduction to Radar Using Python and MATLAB* CRC Press

This book helps you master critical system analysis and design skills, and shows you how to use digital computer simulation to verify that an analysis is correct and that a design is optimal. This comprehensive resource covers a wide range of essential topics, from matrix, vector and linear equations, noise and clutter generation, Filters (FIR and IIR), and fast Fourier transforms ... to ambiguity functions, antennas, target detection, and the Kalman filter ... to the Monte Carlo method, constant false alarm rate (CFAR) processing, and moving target indicators (MTI).

Radar RF Circuit Design CRC Press

In planning a radar system, having the proper mathematical modeling of propagation effects, clutter, and target statistics is essential. Radar Systems Principles provides a strong theoretical basis for the myriad of formulas and rules of thumb required for analysis, conceptual design, and performance evaluation of radar systems. Mathematical derivations of formulas commonly used by radar engineers are presented, with detailed discussions of the assumptions behind these expressions and their ranges of validity. These principles are used in a wide range of radar applications. Radar Systems Principles makes it easy to understand the steps in calculating various formulas and when and how these formulas are used. A set of problems is provided for each chapter, enabling you to check your progress in applying the principles discussed in each section of the text. There are more than 170 figures illustrating key concepts. Numerous references to well-known books on radar for coverage of practical design issues and other specialized topics are given. Radar Systems Principles is an ideal textbook for advanced undergraduates and first-year graduate students and also makes an excellent vehicle for self-study by engineers wishing to enhance their understanding of radar principles and their implication in actual systems.

**Structures Technology for Large Radio and Radar Telescope Systems** Artech House  
**Signal Processing for Multistatic Radar Systems: Adaptive Waveform Selection,**

**Optimal Geometries and Pseudolinear Tracking Algorithms** addresses three important aspects of signal processing for multistatic radar systems, including adaptive waveform selection, optimal geometries and pseudolinear tracking algorithms. A key theme of the book is performance optimization for multistatic target tracking and localization via waveform adaptation, geometry optimization and tracking algorithm design. Chapters contain detailed mathematical derivations and algorithmic development that are accompanied by simulation examples and associated MATLAB codes. This book is an ideal resource for university researchers and industry engineers in radar, radar signal processing and communications engineering. Develops waveform selection algorithms in a multistatic radar setting to optimize target tracking performance. Assesses the optimality of a given target-sensor geometry and designs optimal geometries for target localization using mobile sensors. Gives an understanding of low-complexity and high-performance pseudolinear estimation algorithms for target localization and tracking in multistatic radar systems. Contains the MATLAB codes for the examples used in the book.

*Solutions Manual for Radar Systems Analysis And Design Using Matlab* CRC Press

**Radar Systems Analysis and Design Using MATLAB** CRC Press

**Radar Limitations and the Advent of the Automatic Dependent Surveillance Broadcast** Springer

An introduction to radar systems should ideally be self-contained and hands-on, a combination lacking in most radar texts. The first edition of Radar Systems Analysis and Design Using MATLAB® provided such an approach, and the second edition continues in the same vein. This edition has been updated, expanded, and reorganized to include advances in the field and to be more logical in sequence. Ideal for anyone encountering the topic for the first time or for professionals in need of on-the-job reference, this book features an abundance of MATLAB programs and code. Radar Systems Analysis and Design Using MATLAB®, Second Edition presents the fundamentals and principles of radar along with enough rigorous mathematical derivations to ensure that you gain a deep understanding. The author has extensively revised chapters on radar cross-section and polarization, matched filter and radar ambiguity function, and radar wave propagation. He also added information on topics such as PRN codes, multipath and refraction, clutter and MTI processing, and high range resolution. With all MATLAB functions updated to reflect version 7.0 and an expanded set of self-test problems, you will find this up-to-date text to be the most complete treatment of radar available, providing the hands-on tools that will enrich your learning.

CRC Press

An authoritative text covering the key topics, concepts and analytical tools needed to understand modern communication and radar systems. With numerous examples, exercises and computational results, it is an invaluable resource for graduate

students in electrical and computer engineering, and practitioners in communications and radar engineering.

*Handbook of Radar Signal Analysis* CRC Press

Introduction to Radar Analysis, Second Edition is a major revision of the popular textbook. It is written within the context of communication theory as well as the theory of signals and noise. By emphasizing principles and fundamentals, the textbook serves as a vital source for students and engineers. Part I bridges the gap between communication, signal analysis, and radar. Topics include modulation techniques and associated Continuous Wave (CW) and pulsed radar systems. Part II is devoted to radar signal processing and pulse compression techniques. Part III presents special topics in radar systems including radar detection, radar clutter, target tracking, phased arrays, and Synthetic Aperture Radar (SAR). Many new exercises are included and the author provides comprehensive easy-to-follow mathematical derivations of all key equations and formulas. The author has worked extensively for the U.S. Army, the U.S. Space and Missile Command, and other military agencies. This is not just a textbook for senior level and graduate students, but a valuable tool for practicing radar engineers. Features Authored by a leading industry radar professional. Comprehensive up-to-date coverage of radar systems analysis issues. Easy to follow mathematical derivations of all equations and formulas Numerous graphical plots and table format outputs. One part of the book is dedicated to radar waveforms and radar signal processing.

*Radar System Design and Analysis* McGraw-Hill Companies

This new handbook on radar signal analysis adopts a deliberate and systematic approach. It uses a clear and consistent level of delivery while maintaining strong and easy-to-follow mathematical details. The emphasis of this book is on radar signal types and their relevant signal processing and not on radar systems hardware or components. This handbook serves as a valuable reference to a wide range of audience. More specifically, college-level students, practicing radar engineers, as well as casual readers of the subject are the intended target audience of the first few chapters of this book. As the book chapters progress, these grow in complexity and specificity. Accordingly, later chapters are intended for practicing engineers, graduate college students, and advanced readers. Finally, the last few chapters contain several special topics on radar systems that are both educational and scientifically entertaining to all readers. The presentation of topics in this handbook takes the reader on a scientific journey whose major landmarks comprise the different radar subsystems and components. In this context, the chapters follow the radar signal along this

journey from its birth to the end of its life.

Along the way, the different relevant radar subsystems are analyzed and discussed in great detail. The chapter contributors of this new handbook comprise experienced academia members and practicing radar engineers. Their combined years of academic and real-world experiences are in excess of 175. Together, they bring a unique, easy-to-follow mix of mathematical and practical presentations of the topics discussed in this book. See the "Chapter Contributors" section to learn more about these individuals.

*Introduction to Radar Systems* Artech House Publishers

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 in **Multifunction Array Radar** John Wiley & Sons

In recent years, various algorithms for radar signal design, that rely heavily upon complicated processing and/or antenna architectures, have been suggested. These techniques owe their genesis to several factors, including revolutionary technological advances (new flexible waveform generators, high speed signal processing hardware, digital array radar technology, etc.) and the stressing performance requirements, often imposed by defence applications in areas such as airborne early warning and homeland security. Increasingly complex operating scenarios calls for sophisticated algorithms with the ability to adapt and diversify dynamically the waveform to the operating environment in order to achieve a performance gain over classic radar waveforms. Thus, for example, a modern multifunction phased array radar can adapt the waveform, dwell time and update interval according to the nature of the particular target, e.g. the likely type of target, the clutter environment, the signal-to-noise ratio, the threat that it may represent and the degree to which it is manoeuvring. This is essentially the subject of waveform diversity. This new flexibility demands new ways of characterising waveform properties and optimising waveform design. This ability is very critical in increasing our objective performance as the ability will match the transmission waveform to the transmission environment and the sensing objective. This is the first book, in which several quintessential concepts inherent to the application of waveform design and diversity for advanced radar detection, tracking, and classification are brought together.

*Basic Radar Analysis, Second Edition* Cambridge University Press

This book presents the theory, analysis, and design of ultra-wideband (UWB) radar and

sensor systems (in short, UWB systems) and their components. UWB systems find numerous applications in the military, security, civilian, commercial and medicine fields. This book addresses five main topics of UWB systems: System Analysis, Transmitter Design, Receiver Design, Antenna Design and System Integration and Test. The developments of a practical UWB system and its components using microwave integrated circuits, as well as various measurements, are included in detail to demonstrate the theory, analysis and design technique. Essentially, this book will enable the reader to design their own UWB systems and components. In the System Analysis chapter, the UWB principle of operation as well as the power budget analysis and range resolution analysis are presented. In the UWB Transmitter Design chapter, the design, fabrication and measurement of impulse and monocycle pulse generators are covered. The UWB Receiver Design chapter addresses the design and measurement of the strobe pulse generator, sampling mixer, low-noise amplifier and synchronous sampling receiver. Next, the UWB Antenna Design chapter details the design and measurement of two UWB antennas: the microstrip quasi-horn antenna and the UWB uniplanar antenna. The System Integration and Test chapter covers the transmission-reception test, signal processing, system integration, and evaluation of the UWB sensor. The final chapter provides a summary and conclusion of the work. *Modern Radar System Analysis* CRC Press Developed from the author's graduate-level courses, the first edition of this book filled the need for a comprehensive, self-contained, and hands-on treatment of radar systems analysis and design. It quickly became a bestseller and was widely adopted by many professors. The second edition built on this successful format by rearranging and updating *Radar Range-performance Analysis* CRC Press Since the publication of the second edition of "Introduction to Radar Systems," there has been continual development of new radar capabilities and continual improvements to the technology and practice of radar. This growth has necessitated the addition and updating of the following topics for the third edition: digital technology, automatic detection and tracking, doppler technology, airborne radar, and target recognition. The topic coverage is one of the great strengths of the text. In addition to a thorough revision of

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topics, and deletion of obsolete material, the author has added end-of-chapter problems to enhance the "teachability" of this classic book in the classroom, as well as for self-study for practicing engineers.