1. Record Nr. UNINA9911007167803321

Autore	Dávila Carlos A.
Titolo	Radar and EW Modeling in MATLAB and Simulink / / Carlos A. Dávila, Glenn D. Hopkins, Gregory A. Showman
Pubbl/distr/stampa	Norwood : , : Artech House, , [2024] ©2024
ISBN	9781523162468 1523162465 9781630819071 1630819077
Edizione	[1st ed.]
Descrizione fisica	1 online resource (xviii, 477 pages) : illustrations, charts
Collana	Artech House radar library
Soggetti	Electronics in military engineering Radar - Simulation methods
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di contenuto	Radar and EW Modeling in MATLAB® and Simulink® -- Contents -- Foreword -- Preface -- Chapter 1 Introduction -- 1.1Basic Concepts and Terminology -- 1.2The M&amp -- S Pyramid -- 1.3Radar M&amp -- S -- 1.4Concluding Remarks -- References -- Chapter 2 The Radar Equation -- 2.1Introduction -- 2.2Derivation of the Radar Equation -- 2.2.1Received Target Power -- 2.2.2Noise Power Definition -- 2.2.3The SNR Equation -- 2.2.4Search and Track Forms of the Radar Equation -- 2.3MATLAB Model -- 2.4Simulink Model of the Radar Equation -- 2.5Concluding Remarks -- References -- Chapter 3 Antennas -- 3.1Introduction -- 3.2 Antenna Basics -- 3.3Directivity Pattern Basics -- 3.4Fields and Frequencies -- 3.5Polarization -- 3.6Isotropic Antenna Pattern -- 3.7Directivity and Gain -- 3.8Modeling Approaches -- 3.8.1First-Order Antenna Models: Closed-Form Equations and Measured Data -- 3.8.2Third-Order Antenna Models: Full-Wave Solutions to Clerk Maxwell's Equations -- 3.8.3Second-Order Antenna Models: Fourier Transform Models -- 3.9Fourier Transform Model Approaches -- 3.10Fourier Transform Peak-Directivity Normalization -- 3.11

Fourier Transform Model for Antennas That Are Not Arrays -- 3.12 Fourier Transform Modeling of Arrays -- 3.12.1The Array Element Pattern and Its Effect -- 3.12.2Amplitude Tapering for Sidelobe Reduction -- 3.12.3Calculation of the Aperture Efficiency -- 3.12.4 Phase- or Time-Delay Scanned Arrays -- 3.13Multibeam Arrays -- 3.14Fourier Transform Models for 2D Planar Phased Arrays -- 3.15 Modeling of Errors in Phased Arrays -- 3.15.1Quantization of the Phase Shifter and Attenuator -- 3.15.2Random Amplitude and Phase Errors -- 3.15.3Amplifier Failure Errors in Active Arrays -- 3.16 Antenna Modeling Conclusions -- References -- Chapter 4 Propagation -- 4.1Introduction -- 4.2Radar Horizon.
4.3Atmospheric Attenuation -- 4.4Refraction -- 4.5Multipath -- 4.6Summary -- References -- Chapter 5 Radar Cross-Section -- 5.1 Introduction -- 5.2The Concept of RCS -- 5.3Scattering Surfaces -- 5.4Scatterer Integration -- 5.5CEM -- 5.6Swerling Models -- 5.7RCS Table Lookup -- 5.8Concluding Remarks -- References -- Chapter 6 Clutter -- 6.1Introduction -- 6.2From Target Models to Clutter Models -- 6.3Principles of Area Clutter Modeling -- 6.4 Land Clutter Backscatter Coefficients -- 6.4Land Clutter Backscatter Statistics -- 6.5Land Clutter Discretes -- 6.6Land-Clutter Temporal Correlation -- 6.7Site-Specific Clutter -- 6.8Sea Clutter -- 6.9 Volume Clutter -- 6.10Clutter Model Results -- 6.11Summary -- References -- Chapter 7 Waveforms -- 7.1Introduction -- 7.2 Taxonomy of Radar Waveforms -- 7.3CW -- 7.3.1Simulink Example -- 7.3.2Range Estimation -- 7.4Pulse Waveforms -- 7.4.1Range Ambiguities -- 7.4.2Doppler Ambiguities -- 7.4.3Pulse Modulations -- 7.4.4Simulink Example -- 7.5Waveform Generator Model -- 7.6Concluding Remarks -- References -- Chapter 8 Range and Doppler Processing -- 8.1Introduction -- 8.2Target Velocity and Doppler -- 8.3The Fourier Transform (FT) -- 8.4The Discrete Fourier Transform (DFT) -- 8.5Pulse-Compression Waveforms -- 8.5.1PM Waveforms -- 8.5.2Linear Frequency Modulation (LFM) Waveforms -- 8.6Range Processing -- 8.7Doppler Processing -- 8.8Concluding Remarks -- References -- Chapter 9 Monopulse Processing -- 9.1Introduction -- 9.2Monopulse Processing of a Two-Element Array -- 9.3Extension to an N-Element Array -- 9.4A Nonmathematical Description of Monopulse -- 9.5Simulink Model of Monopulse Processor -- 9.6Concluding Remarks -- References -- Chapter 10 Transmitter and Receiver Components -- 10.1 Introduction -- 10.2SSB Upconverter -- 10.3Amplifiers.
10.4Oscillator Phase Noise -- 10.5I/Q Channel Mismatch -- 10.6 Filtering -- 10.7ADC -- 10.8Concluding Remarks -- References -- Chapter 11 Target Detection -- 11.1Introduction -- 11.2Data Processing and Detector Types -- 11.3Noise and Target Statistics -- 11.3.1Noise Distributions -- 11.3.2Target Distributions -- 11.4 Detection Figures of Merit (Pd and Pfa) and the Likelihood Ratio -- 11.5 Receiver-Operating Characteristic (ROC) Curves -- 11.6Noncoherent Integration -- 11.7Detection Performance for Fluctuating Targets -- 11.8Constant False-Alarm Rate (CFAR) Detectors -- 11.9Binary (M-of-N) Detection -- References -- Chapter 12 Pulse-Doppler &amp -- FMCW Signal Processors -- 12.1Introduction -- 12.2FMCW Processing -- 12.2.1LFM Waveform Model -- 12.2.2LFM Waveform Processing -- 12.2.3Simulink Models of the LFMCW System -- 12.2.4 Processed Overlap of FMCW Systems -- 12.3Pulse-Doppler Processing -- 12.3.1Simulink Model of Pulse-Doppler System -- 12.4 Radar-Processing Timeline and Swerling Fluctuation Models -- 12.5 Concluding Remarks -- References -- Chapter 13 Target Tracking -- 13.1Introduction and Basic Terminology -- 13.2Radar Tracking

Modes -- 13.3Tracking Initiation and Management Process -- 13.4 Tracking M&amp -- S Considerations -- 13.5Modeling Examples -- 13.5.1Data Association Model (Nearest Neighbor) -- 13.5.2 STT Model (Kalman Filter) -- 13.6Concluding Remarks -- References -- Chapter 14 Engagement Geometry -- 14.1Introduction -- 14.2CSs and their Transformations -- 14.2.1Coordinate Transformations -- 14.2.2Additional Conventions and Assumptions -- 14.2.3Simulink Model -- 14.3Truth Calculation of Radar Observables -- 14.3.1 (Slant) Range -- 14.3.2Doppler Frequency -- 14.3.3Target Angles -- 14.4Simulink Model of Target Generator -- 14.5Concluding Remarks -- References -- Chapter 15 Engagement Simulation. 15.1Introduction -- 15.2Extending the Radar Equation Model -- 15.3Initial Engagement Model -- 15.4Full Engagement Model -- 15.5Example Single Radar Versus Single Target Engagement -- 15.6 Concluding Remarks -- References -- Chapter 16 M&amp -- S of EA -- 16.1Introduction -- 16.2EA Concepts -- 16.3Coherent Repeater EA -- 16.3.1Example Coherent EA Techniques -- 16.3.2Example Coherent EA Models -- 16.4Engagement Simulation with Coherent Repeater EA -- 16.5Noise EA -- 16.5.1Example Noise EA Techniques -- 16.6Engagement Simulation with Noise EA -- 16.7 Concluding Remarks -- References -- Chapter 17 M&amp -- S of Electromagnetic Protection -- 17.1Introduction -- 17.2Antenna EP Concepts -- 17.3Modeling of Antenna EP -- 17.3.1SLB Modeling -- 17.3.2SLC Modeling -- 17.4Adaptive Beamforming -- 17.5 Concluding Remarks -- References -- Chapter 18 M&amp -- S of ES -- 18.1Introduction -- 18.2Instantaneous Frequency Measurement (IFM) Modeling -- 18.3Generic ES Processor Modeling -- 18.3.1 Signal Detection -- 18.3.2Pulse width and PRI Estimation -- 18.3.3 Simulink Model -- 18.4Time Difference of Arrival (TDOA) Modeling -- 18.4.1Estimation of Emitter Location -- 18.4.2TDOA Measurement Approaches -- 18.5Concluding Remarks -- References -- Appendix A Common Sources of Discrepancy and Confusion in Radar M&amp -- S -- A.1Signal Amplitude (Voltage) and Power -- A. 2Peak and RMS Voltages -- A.3Noise Power Spectral Density (PSD) and Noise Bandwidth -- A.5Optimum Bandwidth for Rectangular Pulse -- A.4Oversampling and Signal Processing Gains -- A.4.1 Oversampling May Inflate Signal Processing Gain -- A.4.2 Oversampling Correlates Receiver Noise So That It No Longer Behaves as White Noise -- A.5Noise Factor -- A.6Assorted Factors of Two -- References -- List of Acronyms -- About the Authors -- Index.

Sommario/riassunto

This resource covers basic concepts and modeling examples for the three pillars of EW: Electronic Attack (EA) systems, Electronic Protection (EP) techniques, and Electronic Support (ES). It develops techniques for the modeling and simulation (M&S) of modern radar and electronic warfare (EW) systems and reviews radar principles, including the radar equation. M&S techniques are introduced, and example models developed in MATLAB and Simulink are presented and discussed in detail. These individual models are combined to create a full end-to-end engineering engagement simulation between a pulse-Doppler radar and a target. The radar-target engagement model is extended to include jamming models and is used to illustrate the interaction between radar and jamming signals and the impact on radar detection and tracking. In addition, several classic EA techniques are introduced and modeled, and the effects on radar performance are explored. This book is a valuable resource for engineers, scientists, and managers who are involved in the design, development, or testing of radar and EW systems. It provides a comprehensive overview of the M&S techniques that are used in these systems, and the book's many

examples and case studies provide a solid foundation for understanding how these techniques can be applied in practice.