

1. Record Nr.	UNINA9910816920903321
Autore	Sheng Xin-Qing <1968->
Titolo	Essentials of computational electromagnetics // Xin-Qing Sheng, Wei Song
Pubbl/distr/stampa	Hoboken, New Jersey : , : IEEE, , 2012 [Piscataway, New Jersey] : , : IEEE Xplore, , [2012]
ISBN	0-470-82964-8 0-470-82963-X 0-470-82965-6
Descrizione fisica	1 online resource (x, 279 p.) : ill
Altri autori (Persone)	SongWei
Disciplina	537.0285
Soggetti	Electromagnetism - Data processing Electromagnetism - Mathematical models
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Formerly CIP.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Preface ix -- 1 Mathematical Formulations for Electromagnetic Fields 1 -- 1.1 Deterministic Vector Partial Differential System of the Electromagnetic Fields 1 -- 1.1.1 Maxwell's Equations 1 -- 1.1.2 Constitutive Relations 3 -- 1.1.3 Boundary Conditions 3 -- 1.1.4 Maxwell's Equations in the Frequency Domain 5 -- 1.1.5 Uniqueness Theorem 6 -- 1.2 Vector Wave Equation of the Electromagnetic Fields 8 -- 1.3 Vector Integral Equation of the Electromagnetic Fields 8 -- 1.3.1 Equivalence Principle 9 -- 1.3.2 Solution of Maxwell's Equation in Free Space 11 -- 1.3.3 Integral Equations of Metallic Scattering Problems 14 -- 1.3.4 Integral Equation of Homogeneous Dielectric Scattering Problems 16 -- 1.3.5 Integral Equation of Inhomogeneous Dielectric Scattering Problems 19 -- 1.3.6 Integral Equations of Scattering in Layered Medium 20 -- References 28 -- 2 Method of Moments 29 -- 2.1 Scattering from 3D PEC Objects 29 -- 2.1.1 Formulation of the Problem 30 -- 2.1.2 Discretization in MoM 30 -- 2.1.3 Choice of Basis and Testing Functions 31 -- 2.1.4 Discretized Integral Equation (DIE) and the Numerical Behavior Analysis 34 -- 2.1.5 Handling of Singularity 36 -- 2.1.6 Comparison of EFIE and MFIE 71 -- 2.1.7 Interior Resonance Problem 73 -- 2.1.8 Fast Multipole Method 74 -- 2.1.9

Calculation of Scattered Fields 86 -- 2.1.10 Writing Computer Program 89 -- 2.1.11 Numerical Examples 94 -- 2.1.12 Parallel Technology 100 -- 2.1.13 Strong Scalability 106 -- 2.1.14 Weak Scalability 107 -- 2.2 Scattering from Three-Dimensional Homogeneous Dielectric Objects 109 -- 2.2.1 Mathematic Formulation of the Problem 111 -- 2.2.2 Discretized Forms and Their Numerical Performance 112 -- 2.2.3 Numerical Examples 118 -- 2.2.4 Implementation of Single Integral Equation and the Numerical Characteristics 122 -- 2.3 Scattering from Three-Dimensional Inhomogeneous Dielectric Objects 128 -- 2.3.1 Mathematic Formulation of the Problem 129 -- 2.3.2 Rooftop Basis Functions 130 -- 2.3.3 Discretization of the VIE 131. 2.3.4 Singularity Processing 134 -- 2.3.5 Fast Solution of the Discretized VIE 135 -- 2.3.6 Numerical Examples 136 -- 2.4 Essential Points in MoM for Solving Other Problems 136 -- 2.4.1 Scattering from Two-Dimensional Objects 138 -- 2.4.2 Scattering from Periodic Structures 141 -- 2.4.3 Scattering from Two-and-Half-Dimensional Objects 144 -- 2.4.4 Radiation Problems 146 -- References 150 -- 3 Finite-Element Method 153 -- 3.1 Eigenmodes Problems of Dielectric-Loaded Waveguides 153 -- 3.1.1 Functional Formulation 154 -- 3.1.2 Choice of Basis Functions 159 -- 3.1.3 Discretization of the Functional 161 -- 3.1.4 Imposition of the Boundary Condition 164 -- 3.1.5 Solution of the Generalized Eigenvalue Equation 165 -- 3.1.6 Computer Programming 166 -- 3.1.7 Numerical Examples 170 -- 3.2 Discontinuity Problem in Waveguides 170 -- 3.2.1 Functional Formulation 171 -- 3.2.2 Choice of the Basis Functions 174 -- 3.2.3 Discretization of the Functional 176 -- 3.2.4 Solution of the Linear Equations 178 -- 3.2.5 Extraction of the Scattering Parameters 180 -- 3.2.6 Numerical Examples 182 -- 3.3 Scattering from Three-Dimensional Objects 184 -- 3.3.1 Mathematic Formulation of the Problem 184 -- 3.3.2 Writing Computer Program 187 -- 3.3.3 Numerical Results 190 -- 3.4 Node-Edge Element 192 -- 3.4.1 Construction of Node-Edge Element 192 -- 3.4.2 Implementation of Node-Edge Element 193 -- 3.4.3 Numerical Examples 195 -- 3.5 Higher-Order Element 196 -- 3.6 Finite-Element Time-Domain Method 200 -- 3.7 More Comments on FEM 203 -- References 205 -- 4 Finite-Difference Time-Domain Method 207 -- 4.1 Scattering from a Three-Dimensional Objects 207 -- 4.1.1 FDTD Solution Scheme 208 -- 4.1.2 Perfectly Matched Layers 209 -- 4.1.3 Yee Discretizing Scheme 215 -- 4.1.4 Discretization of the Scatterer Model 220 -- 4.1.5 Treatment on the Curved Boundary 220 -- 4.1.6 Determination of the Unit Size and the Time Step 222 -- 4.1.7 Plane Waves in Time Domain 223 -- 4.1.8 Calculation of Incident Plane Waves in Time Domain 225. 4.1.9 Calculation of the Radar Cross Section 227 -- 4.1.10 Computer Programing and Numerical Examples 229 -- 4.2 Treatment for Special Problems 233 -- 4.2.1 Treatments for Thin Metallic Wires 233 -- 4.2.2 Treatments for Dispersive Media 235 -- 4.2.3 Treatments for Lumped Elements 237 -- 4.3 Comparison of the MoM, FEM and FDTD Methods 239 -- References 240 -- 5 Hybrid Methods 243 -- 5.1 Hybrid High-Frequency Asymptotic Methods and Full-Wave Numerical Methods 244 -- 5.1.1 Hybrid Physical Optics Method and FEM 244 -- 5.1.2 Hybrid Physical Optics Method and Moment Method 248 -- 5.2 Hybrid Full-Wave Numerical Methods 251 -- 5.2.1 Hybrid FE-BI-MLFMA 252 -- 5.2.2 Hybrid Method Combining EFIE and MFIE 266 -- 5.2.3 Hybrid Method Combining FEM and Mode-Matching Method 271 -- References 276 -- Index 277.

(MoM), the finite element method (FEM), and the finite-difference time-domain (FDTD) method. Numerous monographs can be found addressing one of the above three methods. However, few give a broad general overview of essentials embodied in these methods, or were published too early to include recent advances. Furthermore, many existing monographs only present the final numerical results without specifying practical issues, such as how to convert discretized formulations into computer programs, and the numerical characteristics of the computer programs. In this book, the authors elaborate the above three methods in CEM using practical case studies, explaining their own research experiences along with a review of current literature. A full analysis is provided for typical cases, including characteristics of numerical methods, helping beginners to develop a quick and deep understanding of the essentials of CEM. . Outlines practical issues, such as how to convert discretized formulations into computer programs. Gives typical computer programs and their numerical characteristics along with line by line explanations of programs. Uses practical examples from the authors' own work as well as in the current literature. Includes exercise problems to give readers a better understanding of the material. Introduces the available commercial software and their limitations. This book is intended for graduate-level students in antennas and propagation, microwaves, microelectronics, and electromagnetics. This text can also be used by researchers in electrical and electronic engineering, and software developers interested in writing their own code or understanding the detailed workings of code. Companion website for the book: www.wiley.com/go/sheng/cem.
