

Scattering of Electromagnetic Waves

Numerical Simulations

Leung Tsang
Jun Au Kong
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Chi On Ao

Wiley Series in Remote Sensing, Jin Au Kong, Series Editor

Scattering Of Electromagnetic Waves Numerical Simulations

Leung Tsang



Scattering Of Electromagnetic Waves Numerical Simulations:

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rough surfaces Written by leading scientists who have made important contributions to wave scattering over three decades this new work explains the principles methods and applications of this rapidly expanding interdisciplinary field It covers both introductory and advanced material and provides students and researchers in remote sensing as well as imaging optics and electromagnetic theory with a one stop reference to a wealth of current research results Plus Scattering of Electromagnetic Waves contains detailed discussions of both analytical and numerical methods including cutting edge techniques for the recovery of earth land parametric information The three volumes are entitled respectively Theories and Applications Numerical Simulation and Advanced Topics In the second volume Numerical Simulations Leung Tsang University of Washington Jin Au Kong MIT Kung Hau Ding Air Force Research Lab and Chi On Ao MIT cover Layered media simulations Rough surface and volume scattering simulations Dense media models and simulations Electromagnetic scattering by discrete scatterers and a buried object Scattering by vertical cylinders above a surface Electromagnetic waves scattering by vegetation Computational methods and programs used for performing various simulations

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Numerical Simulations Lutz Angermann, 2011-01-30 This book will interest researchers scientists engineers and graduate students in many disciplines who make use of mathematical modeling and computer simulation Although it represents only a small sample of the research activity on numerical simulations the book will certainly serve as a valuable tool for researchers interested in getting involved in this multidisciplinary field It will be useful to encourage further experimental and theoretical researches in the above mentioned areas of numerical simulation

Wave Propagation, Scattering And Emission In Complex Media Ya-qiu Jin, 2005-01-26 This book contains review papers presented at the International Workshop on Wave

Propagation Scattering and Emission on Theory Experiment Simulation and Inversion WPSE The papers are of high quality covering broad areas a new mechanism of interaction of electromagnetic waves with complex media remote sensing information computational electromagnetics etc This book summarizes the most significant progress in wave propagation encompassing theory experiment simulation and inversion It will also serve as a good reference for scientists in future research List of Foreign Invited Speakers Henry Bertoni Brooklyn Polytechnic University Lawrence Carin Duke U Al Chang NASA Goddard Margaret Cheney Rensselaer Polytech Institute Weng Chew U of Illinois at Urbana Champaign Shane Cloude AEL Consultants UK Adrian Fung U of Texas at Arlington Al Gasiewski Environmental Tech Lab NOAA Martti Hallikainen Helsinki U of Technology Akira Ishimaru U of Washington Magdy Iskander U of Hawaii J A Kong MIT Roger Lang George Washington U Alex Maradudin U of California at Irvine Eric Michielssen U of Illinois at Urbana Champaign Eni Njoku Caltech Jet Propulsion Lab Carey Rappaport Northeastern U Marc Saillard Institut Fresnel Kamal Sarabandi U of Michigan David R Smith U of California at San Diego Mitsuo Tateiba Kyushu University George Uslenghi U of Illinois at Chicago and Werner Wiesbeck Karlsruhe U

Electromagnetic Scattering: A Remote Sensing Perspective Yang Du, 2017-03-08 Remote sensing is a fast growing field with many important applications as demonstrated in the numerous scientific missions of the Earth Observation System EOS worldwide Given the inter disciplinary nature of remote sensing technologies the fulfillment of these scientific goals calls for among other things a fundamental understanding of the complex interaction between electromagnetic waves and the targets of interest Using a systematic treatment **Electromagnetic Scattering A Remote Sensing Perspective** presents some of the recently advanced methods in electromagnetic scattering as well as updates on the current progress on several important aspects of such an interaction The book covers topics including scattering from random rough surfaces of both terranean and oceanic natures scattering from typical man made targets or important canonical constituents of natural scenes such as a dielectric finite cylinder or dielectric thin disk the characterization of a natural scene as a whole represented as a random medium and the extraction of target features with a polarimetric radar

Monte Carlo Methods for Electromagnetics Matthew N.O. Sadiku, 2018-10-03 Until now novices had to painstakingly dig through the literature to discover how to use Monte Carlo techniques for solving electromagnetic problems Written by one of the foremost researchers in the field **Monte Carlo Methods for Electromagnetics** provides a solid understanding of these methods and their applications in electromagnetic computation Including much of his own work the author brings together essential information from several different publications Using a simple clear writing style the author begins with a historical background and review of electromagnetic theory After addressing probability and statistics he introduces the finite difference method as well as the fixed and floating random walk Monte Carlo methods The text then applies the Exodus method to Laplace s and Poisson s equations and presents Monte Carlo techniques for handling Neumann problems It also deals with whole field computation using the Markov chain applies Monte Carlo methods to time varying diffusion problems

and explores wave scattering due to random rough surfaces The final chapter covers multidimensional integration Although numerical techniques have become the standard tools for solving practical complex electromagnetic problems there is no book currently available that focuses exclusively on Monte Carlo techniques for electromagnetics Alleviating this problem this book describes Monte Carlo methods as they are used in the field of electromagnetics Light Scattering and Nanoscale Surface Roughness Alexei A. Maradudin, 2010-05-10 All real surfaces both those occurring naturally and those fabricated artificially and with great care are rough to some degree It is therefore of interest and often of importance to know the extent to which this roughness affects physical processes occurring at a surface A particularly interesting class of physical processes occurring at a rough surface is the scattering of electromagnetic waves from it or their transmission through it In this case the degree of the surface roughness is referred to the wavelength of the waves incident on it The study of the scattering of electromagnetic waves from rough surfaces has been actively carried out for more than a century now since Rayleigh's investigations of the scattering of a monochromatic plane wave incident normally on a sinusoidal interface between two different media The first theoretical treatment of the scattering of an electromagnetic wave from a randomly rough surface was due to Mandelstam in the context of the scattering of light from a liquid surface In these pioneering studies the angular dependence of the intensity of the scattered field was calculated by perturbation theory as an expansion in powers of the surface profile function though the first nonzero term a single scattering approximation Advances in Heat Transfer James P. Hartnett, 2003-10-09 Advances in Heat Transfer presents review articles on topics of current interest Each contribution starts from widely understood principles and brings the reader up to the forefront of the topic being addressed The favorable response by the international scientific and engineering community to the 37 volumes published to date is an indication of the success of our authors in fulfilling this purpose This is recommended reading for all mechanical engineers and researchers Provides an overview of review articles on topics of current interest Bridges the gap between academic researchers and practitioners in industry A long running and prestigious series **Advances in SAR Remote Sensing of Oceans** Xiaofeng Li, Huadong Guo, Kun-Shan Chen, Xiaofeng Yang, 2018-10-12 The oceans cover approximately 71% of Earth's surface 90% of the biosphere and contains 97% of Earth's water Since the first launch of SEASAT satellite in 1978 an increasing number of SAR satellites have or will become available such as the European Space Agency's ERS 1/2 ENVISAT and Sentinel 1 series the Canadian RADARSAT 1/2 and the upcoming RADARSAT Constellation Mission series satellites the Italian COSMO-SkyMed satellites the German TERRASAR-X and TANDEM-X and the Chinese GAOFEN-3 SAR among others Recently European Space Agency has launched a new generation of SAR satellites Sentinel 1A in 2014 and Sentinel 1B in 2016 These SAR satellites provide researchers with free and open SAR images necessary to carry out their research on the global oceans The scope of Advances in SAR Remote Sensing of Oceans is to demonstrate the types of information that can be obtained from SAR images of the oceans and the cutting edge methods needed for analysing SAR

images Written by leading experts in the field and divided into four sections the book presents the basic principles of radar backscattering from the ocean surface introduces the recent progresses in SAR remote sensing of dynamic coastal environment and management discusses the state of the art methods to monitor parameters or phenomena related to the dynamic ocean environment and deals specifically with new techniques and findings of marine atmospheric boundary layer observations Advances in SAR Remote Sensing of Oceans is a very comprehensive and up to date reference intended for use by graduate students researchers practitioners and R D engineers working in the vibrant field of oceans interested to understand how SAR remote sensing can support oceanography research and applications

Multiple Scattering of Light by Particles Michael I. Mishchenko, Larry D. Travis, Andrew A. Lacis, 2006-04-27 This monograph on multiple scattering of light by small particles is an ideal resource for science professionals engineers and graduate students

Mathematical Analysis of Deterministic and Stochastic Problems in Complex Media Electromagnetics G. F. Roach, I. G. Stratis, A. N. Yannacopoulos, 2012-03-04 Electromagnetic complex media are artificial materials that affect the propagation of electromagnetic waves in surprising ways not usually seen in nature Because of their wide range of important applications these materials have been intensely studied over the past twenty five years mainly from the perspectives of physics and engineering But a body of rigorous mathematical theory has also gradually developed and this is the first book to present that theory Designed for researchers and advanced graduate students in applied mathematics electrical engineering and physics this book introduces the electromagnetics of complex media through a systematic state of the art account of their mathematical theory The book combines the study of well posedness homogenization and controllability of Maxwell equations complemented with constitutive relations describing complex media The book treats deterministic and stochastic problems both in the frequency and time domains It also covers computational aspects and scattering problems among other important topics Detailed appendices make the book self contained in terms of mathematical prerequisites and accessible to engineers and physicists as well as mathematicians

Wave Propagation Concepts for Near-Future Telecommunication Systems Sandra Costanzo, 2017-05-03 Wave Propagation Concepts for Near Future Telecommunication Systems is an edited book discussing recent researches for the development of innovative telecommunication systems with particular focus on the propagation aspects and radiating systems design It is divided into two sections Section 1 devoted to the illustration of advanced results in terms of microwave propagation at high operating frequencies and Section 2 illustrating new electromagnetic concepts and applications

Methods and Applications for Modeling and Simulation of Complex Systems Wenhui Fan, Lin Zhang, Ni Li, Xiao Song, 2022-12-22 The two volume set CCIS 1712 and 1713 constitutes the proceedings of the 21st Asian Simulation Conference AsiaSim 2022 which took place in Changsha China in January 2023 Due to the Covid pandemic AsiaSim 2022 has been postponed to January 2023 The 97 papers presented in the proceedings were carefully reviewed and selected from 218 submissions The contributions were organized in topical sections as follows Modeling theory

and methodology Continuous system discrete event system hybrid system intelligent system modeling and simulation Complex systems and open complex and giant systems modeling and simulation Integrated natural environment and virtual reality environment modeling and simulation Networked Modeling and Simulation Flight simulation simulator simulation support environment simulation standard and simulation system construction High performance computing parallel computing pervasive computing embedded computing and simulation CAD CAE CAM CIMS VP VM VR SBA Big data challenges and requirements for simulation and knowledge services of big data ecosystem Artificial intelligence for simulation Application of modeling simulation in science engineering society economy management energy transportation life biology medicine etc Application of modeling simulation in energy saving emission reduction public safety disaster prevention mitigation Modeling simulation applications in the military field Modeling simulation applications in education and training Modeling simulation applications in entertainment and sports **Terahertz Spectroscopy and Imaging**

Kai-Erik Peiponen, Axel Zeitler, Makoto Kuwata-Gonokami, 2012-10-04 This book presents the state of the art of Terahertz spectroscopy It is a modern source for a beginners and researcher interested in THz spectroscopy The basics and physical background of THz spectroscopy and technology are explained and important applications are described The book presents the highlights of scientific research in the field of THz science and provides an excellent overview of the field and future directions of research Over the last decade the field of terahertz spectroscopy has developed into one of the most rapidly growing fields of spectroscopy with large impact across a wide range of scientific disciplines Due to substantial advances in femtosecond laser technology terahertz time domain spectroscopy THz TDS has established itself as the dominant spectroscopic technique for experimental scientists interested in measurements in this frequency range In solids and liquids terahertz radiation is at resonance with both phonon modes and hydrogen bonding modes which makes it an ideal tool to study the interaction between molecules in a unique way thus opening a wealth of opportunities for research in physics chemistry biology materials science and pharmaceuticals This book provides an easy access to scientists engineers and students alike who want to understand the theory and applications of modern terahertz spectroscopy Electrical Modeling

and Design for 3D System Integration Er-Ping Li, 2012-04-10 New advanced modeling methods for simulating the electromagnetic properties of complex three dimensional electronic systems Based on the author s extensive research this book sets forth tested and proven electromagnetic modeling and simulation methods for analyzing signal and power integrity as well as electromagnetic interference in large complex electronic interconnects multilayered package structures integrated circuits and printed circuit boards Readers will discover the state of the technology in electronic package integration and printed circuit board simulation and modeling In addition to popular full wave electromagnetic computational methods the book presents new more sophisticated modeling methods offering readers the most advanced tools for analyzing and designing large complex electronic structures Electrical Modeling and Design for 3D System Integration begins with a

comprehensive review of current modeling and simulation methods for signal integrity power integrity and electromagnetic compatibility Next the book guides readers through The macromodeling technique used in the electrical and electromagnetic modeling and simulation of complex interconnects in three dimensional integrated systems The semi analytical scattering matrix method based on the N body scattering theory for modeling of three dimensional electronic package and multilayered printed circuit boards with multiple vias Two and three dimensional integral equation methods for the analysis of power distribution networks in three dimensional package integrations The physics based algorithm for extracting the equivalent circuit of a complex power distribution network in three dimensional integrated systems and printed circuit boards An equivalent circuit model of through silicon vias Metal oxide semiconductor capacitance effects of through silicon vias Engineers researchers and students can turn to this book for the latest techniques and methods for the electrical modeling and design of electronic packaging three dimensional electronic integration integrated circuits and printed circuit boards

Optical Thin Films and Coatings Angela Piegari,François Flory,2018-06-19 *Optical Thin Films and Coatings From Materials to Applications* Second Edition provides an overview of thin film materials and their properties design and manufacture across a wide variety of application areas Sections explore their design and manufacture and their unconventional features including the scattering properties of random structures in thin films optical properties at short wavelengths thermal properties and color effects Other chapters focus on novel materials including organic optical coatings surface multiplasmonics optical thin films containing quantum dots and optical coatings including laser components solar cells displays and lighting and architectural and automotive glass The book presents a technical resource for researchers and engineers working with optical thin films and coatings It is also ideal for professionals in the security automotive space and other industries who need an understanding of the topic Provides thorough review of applications of optical coatings including laser components solar cells glazing displays and lighting One stop reference that addresses deposition techniques properties and applications of optical thin films and coatings Novel methods suggestions for analysis and applications makes this a valuable resource for experts in the field as well

Signal Theory Methods in Multispectral Remote Sensing David A Landgrebe,2003-01-31 An outgrowth of the author s extensive experience teaching senior and graduate level students this is both a thorough introduction and a solid professional reference Material covered has been developed based on a 35 year research program associated with such systems as the Landsat satellite program and later satellite and aircraft programs Covers existing aircraft and satellite programs and several future programs An Instructor s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department

Quantitative Remote Sensing of Land Surfaces Shunlin Liang,2005-02-25 Processing the vast amounts of data on the Earth s land surface environment generated by NASA s and other international satellite programs is a significant challenge Filling a gap between the theoretical physically based modelling and specific applications this in depth study presents practical quantitative algorithms

for estimating various land surface variables from remotely sensed observations A concise review of the basic principles of optical remote sensing as well as practical algorithms for estimating land surface variables quantitatively from remotely sensed observations Emphasizes both the basic principles of optical remote sensing and practical algorithms for estimating land surface variables quantitatively from remotely sensed observations Presents the current physical understanding of remote sensing as a system with a focus on radiative transfer modelling of the atmosphere canopy soil and snow Gathers the state of the art quantitative algorithms for sensor calibration atmospheric and topographic correction estimation of a variety of biophysical and geophysical variables and four dimensional data assimilation

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