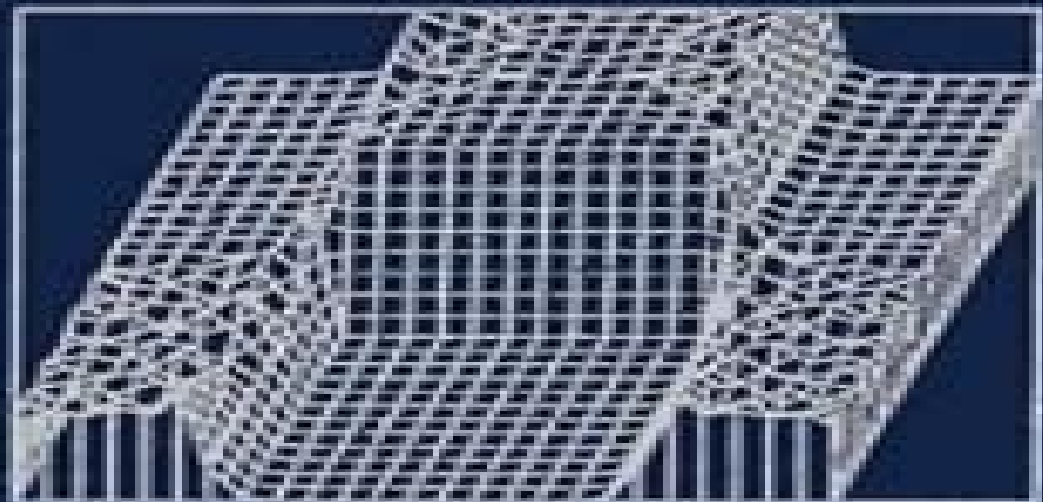# The Generalized Multipole Technique for Computational Electromagnetics

Christian Hafner

Generalized Multipole Technique For Computational Electromagnetics

Heow-pueh Lee,Khin-yong Lam

Generalized Multipole Technique For Computational Electromagnetics:

The Generalized Multipole Technique for Computational Electromagnetics Christian Hafner,1990 Beginning with a detailed comparison of traditional methods of EM field analysis this text leads up to a step by step explication of the Generalized Multiple Technique GMT **Generalized Multipole Techniques for Electromagnetic and Light Scattering** T. Wriedt,1999-12-01 This book is an edited volume of nine papers covering the different variants of the generalized multipole techniques GMT The papers were presented at the recent 3rd Workshop on Electromagnetics and Light Scattering Theory and Applications which focused on current GMT methods These include the multiple multipole method MMP the discrete sources method DSM Yasuura s method method of auxiliary sources and null field method with discrete sources Each paper presents a full theoretical description as well as some applications of the method in electrical engineering and optics It also includes both 2D and 3D methods and other applications developed in the former Soviet Union and Japan **The Generalized Multipole Technique for Computational Electromagnetics** Christian HAFNER,1990-01-01 **The Generalized Multipole Technique for Light Scattering** Thomas Wriedt,Yuri Eremin,2018-03-09 This book presents the Generalized Multipole Technique as a fast and powerful theoretical and computation tool to simulate light scattering by nonspherical particles It also demonstrates the considerable potential of the method In recent years the concept has been applied in new fields such as simulation of electron energy loss spectroscopy and has been used to extend other methods like the null field method making it more widely applicable The authors discuss particular implementations of the GMT methods such as the Discrete Sources Method DSM Multiple Multipole Program MMP the Method of Auxiliary Sources MAS the Filamentary Current Method FCM the Method of Fictitious Sources MFS and the Null Field Method with Discrete Sources NFM DS The Generalized Multipole Technique is a surface based method to find the solution of a boundary value problem for a given differential equation by expanding the fields in terms of fundamental or other singular solutions of this equation The amplitudes of these fundamental solutions are determined from the boundary condition at the particle surface Electromagnetic and light scattering by particles or systems of particles has been the subject of intense research in various scientific and engineering fields including astronomy optics meteorology remote sensing optical particle sizing and electromagnetics which has led to the development of a large number of modelling methods based on the Generalized Multipole Technique for quantitative evaluation of electromagnetic scattering by particles of various shapes and compositions The book describes these methods in detail **Applied Computational Electromagnetics Society Journal. Special Issue on Generalized Multipole Technique (GMT). Volume 9, Number 3. 1994** Christian V. Hafner,NAVAL POSTGRADUATE SCHOOL MONTEREY CA.,1994 A hybrid technique combining the Complex Multipole Beam Approach CMBA with the Method of Moments MoM for the solution of the problems of electromagnetic scattering is presented in this paper In this technique the CMBA provides for a substantial reduction in the matrix size by taking

advantage of the essentially band limited spatial spectrum of the scattered field in the vicinity of smooth surfaces while the MoM is employed for the modeling of non smooth or inhomogeneous regions within the problem geometry The key step in the CMBA is to represent the scattered field in terms of a series of beams produced by multipole sources located in a complex space The CMBA not only reduces the number of unknowns but also generates a generalized impedance matrix with a banded structure and a low condition number In the present hybrid technique the scattering properties of each complex region requiring a relatively large number of unknowns per unit volume are described in terms of a Beam matrix which is constructed numerically to relate the amplitudes of outgoing beams to those of incoming ones The proposed direct solution scheme takes into account the interactions between all of the complex regions and the smooth portions of the scatterer geometry using an algorithm similar to the recursive T matrix approach This hybrid technique that combines the CMBA with other conventional methods is a versatile tool and is expected to enhance the scope of application of the CMBA to a much wider class of problems **Computational Electromagnetics with MATLAB, Fourth Edition** Matthew N.O. Sadiku,2018-07-20 This fourth edition of the text reflects the continuing increase in awareness and use of computational electromagnetics and incorporates advances and refinements made in recent years Most notable among these are the improvements made to the standard algorithm for the finite difference time domain FDTD method and treatment of absorbing boundary conditions in FDTD finite element and transmission line matrix methods It teaches the readers how to pose numerically analyze and solve EM problems to give them the ability to expand their problem solving skills using a variety of methods and to prepare them for research in electromagnetism Includes new homework problems in each chapter Each chapter is updated with the current trends in CEM Adds a new appendix on CEM codes which covers commercial and free codes Provides updated MATLAB code **Circuit Oriented Electromagnetic Modeling Using the PEEC Techniques** Albert Ruehli,Giulio Antonini,Lijun Jiang,2017-05-30 Bridges the gap between electromagnetics and circuits by addressing electrometric modeling EM using the Partial Element Equivalent Circuit PEEC method This book provides intuitive solutions to electromagnetic problems by using the Partial Element Equivalent Circuit PEEC method This book begins with an introduction to circuit analysis techniques laws and frequency and time domain analyses The authors also treat Maxwell s equations capacitance computations and inductance computations through the lens of the PEEC method Next readers learn to build PEEC models in various forms equivalent circuit models non orthogonal PEEC models skin effect models PEEC models for dielectrics incident and radiate field models and scattering PEEC models The book concludes by considering issues like stability and passivity and includes five appendices some with formulas for partial elements Leads readers to the solution of a multitude of practical problems in the areas of signal and power integrity and electromagnetic interference Contains fundamentals applications and examples of the PEEC method Includes detailed mathematical derivations Circuit Oriented Electromagnetic Modeling Using the PEEC Techniques is a reference for students researchers

and developers who work on the physical layer modeling of IC interconnects and Packaging PCBs and high speed links

    <u>2-D Electromagnetic Simulation of Passive Microstrip Circuits</u> Alejandro Jimenez,2018-10-03 Global Demand for Streamlined Design and Computation The explosion of wireless communications has generated a tidal wave of interest and development in computational techniques for electromagnetic simulation as well as the design and analysis of RF and microwave circuits Learn About Emerging Disciplines State of the Art Methods 2 D Electromagnetic Simulation of Passive Microstrip Circuits describes this simple procedure in order to provide basic knowledge and practical insight into quotidian problems of microstrip passive circuits applied to microwave systems and digital technologies The text dissects the latest emerging disciplines and methods of microwave circuit analysis carefully balancing theory and state of the art experimental concepts to elucidate the process of analyzing high speed circuits The author covers the newer techniques such as the study of signal integrity within circuits and the use of field map interpretations employed in powerful electromagnetic simulation analysis methods But why and how does the intrinsic two dimensional simulation model used here reduce numerical error Step by Step Simulation Provides Insight and UnderstandingThe author presents the FDTD electromagnetic simulation method used to reproduce different microstrip test circuits as well as an explanation of the complementary electrostatic method of moments MoM Each reproduces different microstrip test circuits that are physically constructed and then studied using a natural methodological progression to facilitate understanding This approach gives readers a solid comprehension and insight into the theory and practical applications of the microstrip scenario with emphasis on high speed interconnection elements   **Optical Properties of Nanoparticle Systems** Michael Quinten,2010-11-29 Filling the gap for a description of the optical properties of small particles with sizes less than 1000 nm and to provide a comprehensive overview on the spectral behavior of nanoparticulate matter this is the most up to date reference on the optical physics of nanoparticle systems The author an expert in the field with both academic and industrial experience concentrates on the linear optical properties elastic light scattering and absorption of single nanoparticles and on reflectance and transmittance of nanoparticle matter   **Diffraction Gratings and Applications** Erwin G. Loewen,Evgeny Popov,2018-10-08 Offers and up to date assessment of the entire field of diffraction gratings including history physics manufacture testing and instrument design Furnishes for the first time in a single source reference a thorough review of efficiency behavior examining echelles as well as concave binary transmission fiber and waveguide gratings   *New Directions in Wireless Communications Systems* Athanasios G. Kanatas,Konstantina S. Nikita,Panagiotis (Takis) Mathiopoulos,2017-10-16 Beyond 2020 wireless communication systems will have to support more than 1 000 times the traffic volume of today s systems This extremely high traffic load is a major issue faced by 5G designers and researchers This challenge will be met by a combination of parallel techniques that will use more spectrum more flexibly realize higher spectral efficiency and densify cells Novel techniques and paradigms must be developed to meet these goals The book addresses diverse key point issues of next generation

wireless communications systems and identifies promising solutions The book s core is concentrated to techniques and methods belonging to what is generally called radio access network   Subwavelength Optics Theory and Technology Yongqi Fu,2009 From the beginning of this century there has been a dramatic increase in interest in the study of surface plasmon polaritons based metallic subwavelength structures and learning This is a refreshing concise book on issues and considerations in designing   *Nano-Optics* Sabu Thomas,Yves Grohens,Guillaume Vignaud,Nandakumar Kalarikkal,Jemy James,2020-07-06 Nano Optics Fundamentals Experimental Methods and Applications offers insights into the fundamentals and industrial applications of nanoscale light emitting materials and their composites This book serves as a reference offering an overview of existing research with a particular focus on industrial applications Nano optics is the branch of nanoscience and nanotechnology that deals with interaction of light with nanoscale objects This book explores the materials structure manufacturing techniques and industrial applications of nano optics The applications discussed include healthcare communication astronomy and satellites Explains the major manufacturing techniques for light emitting nanoscale materials Discusses how nanoscale optical materials are being used in a range of industrial applications Assesses the challenges of using nano optics in a mass production context   **Electromagnetics in a Complex World** Innocenzo Pinto,Vincenzo Galdi,Leopold B. Felsen,2012-12-06 This monograph contains the ceremonials and the Proceedings pertaining to the WorkshopjMinisymposium on Electromagnetics in a Complex World Challenges and Perspectives convened at the University of Sannio Ben evento Italy from February 20 21 2003 in connection with the bestowal of an honorary Laurea degree on Professor Leopold B Felsen The symposium was co organized by Professors Innocenzo M Pinto and Vincenzo Galdi in consul tation with Professor Felsen The University of Sannio is a recently installed fast growing university enrolling about 6 500 undergraduate and graduatestu dents in its various programs Law Economics Engineering Sciences The College of Engineering presently comprises 50 faculty members and about 1 500 students The degree bestowal ceremony took place in the morning of February 20 2003 and is documented in English in its entirety here in Part VI of these Proceedings because of the international character of this two day event the program booklet provided for attendees of the degree award ceremony was printed in Italian and English After a brief greeting by Prof Aniello Cimitile the President of the University of Sannio Professor Pinto who had originally proposed Prof Felsen s nomination delivered in Italian a detailed Laudatio a laudatory discourse on the nominee s accomplishments and per sonality This was followed by the nominee s Lectio a retrospective covering his professional life as well as his social and cultural background presented in English in a mixed style laced with humor and comprising prose verses visuals and photographs   **Electromagnetic Theory and Applications for Photonic Crystals** Kiyotoshi Yasumoto,2018-10-03 Photonic technology promises much faster computing massive parallel processing and an evolutionary step in the digital age The search continues for devices that will enable this paradigm and these devices will be based on photonic crystals Modeling is a key process in developing crystals with the desired characteristics and

performance and Electromagnetic Theory and Applications for Photonic Crystals provides the electromagnetic theoretical models that can be effectively applied to modeling photonic crystals and related optical devices The book supplies eight self contained chapters that detail various analytical numerical and computational approaches to the modeling of scattering and guiding problems For each model the chapter begins with a brief introduction detailed formulations of periodic structures and photonic crystals and practical applications to photonic crystal devices Expert contributors discuss the scattering matrix method multipole theory of scattering and propagation model of layered periodic arrays for photonic crystals the multiple multipole program the mode matching method for periodic metallic structures the method of lines the finite difference frequency domain technique and the finite difference time domain technique Based on original research and application efforts Electromagnetic Theory and Applications for Photonic Crystals supplies a broad array of practical tools for analyzing and designing devices that will form the basis for a new age in computing **Computational Methods In Large Scale Simulation** Heow-pueh Lee,Khin-yong Lam,2005-10-26 This volume documents the research carried out by visiting scientists attached to the Institute for Mathematical Sciences IMS at the National University of Singapore and the Institute of High Performance Computing IHPC under the program Advances and Mathematical Issues in Large Scale Simulation From 2002 to 2003 researchers from various countries gathered to initiate interesting and innovative work on various themes related to multiscale simulation and fast algorithms Today modeling and simulation are used extensively to solve complex problems and to reduce the use of experimentation during the design and analysis stage It is important to know the various issues that have to be considered in the successful development of computational methodologies for such work This volume is a compilation of the research by various visiting scientists in the area of modeling and multiscale simulation Each article covers a major project and documents how computational methodology mathematical modeling high performance computing and simulation are combined in a multiscale scheme to solve a variety of complex problems Some of these include the design synthesis processing characterization and manufacture of nanomaterials and nanostructures new algorithms for computational work and grid computing Through the included examples readers can realize the vast potential of computational modeling and large scale simulation for the solution of problems in a variety of disciplines and applications **Theorem Proving in Higher Order Logics** Stefan Berghofer,Tobias Nipkow,Christian Urban,Makarius Wenzel,2009-08-04 This volume constitutes the proceedings of the 22nd International Conference on Theorem Proving in Higher Order Logics TPHOLs 2009 which was held during August 17 20 2009 in Munich Germany TPHOLs covers all aspects of theorem proving in higher order logics as well as related topics in theorem proving and veri cation There were 55 papers submitted to TPHOLs 2009 in the full research c egory each of which was refereed by at least three reviewers selected by the ProgramCommittee Of these submissions 26 researchpapers and 1 proofpearl were accepted for presentation at the conference and publication in this v ume In keeping with longstanding tradition TPHOLs 2009 also o ered a venue for the

presentation of emerging trends where researchers invited discussion by means of a brief introductory talk and then discussed their work at a poster session A supplementary proceedings volume was published as a 2009 technical report of the Technische Universit at Munc hen The organizers are grateful to David Basin John Harrison and Wolfram Schulte for agreeing to give invited talks We also invited four tool devel ers to give tutorials about their systems The following speakers kindly accepted our invitation and we are grateful to them John Harrison HOL Light Adam Naumowicz Mizar Ulf Norell Agda and Carsten Schur mann Twelf **Ultrafast Laser Nanostructuring** Razvan Stoian,Jörn Bonse,2023-04-06 Bringing together contributions from leading experts in the field this book reviews laser processing concepts that allow the structuring of material beyond optical limits and methods that facilitate direct observation of the underlying mechanisms by exploring direct structuring and self organization phenomena The capacity to nanostructure material using ultrafast lasers lays the groundwork for the next generation of flexible and precise material processing tools Rapid access to scales of 100 nm and below in two and three dimensions becomes a factor of paramount importance to engineer materials and to design innovative functions To reflect the dynamic nature of the field at all levels from basic science to applications the book is divided into three parts Fundamental Processes Concepts of Extreme Nanostructuring and Applications each of which is comprehensively covered This book will be a useful resource for graduate students and researchers in laser processing materials engineering and nanoscience Optical Metamaterials: Qualitative Models Arkadi Chipouline,Franko Küppers,2018-12-28 This textbook bridges the gap between university courses on electrodynamics and the knowledge needed to successfully address the problem of electrodynamics of metamaterials It appeals to both experimentalists and theoreticians who are interested in the physical basics of metamaterials and plasmonics Focusing on qualitative fundamental treatment as opposed to quantitative numerical treatment it covers the phenomena of artificial magnetization at high frequencies and discusses homogenization procedures and the basics of quantum dynamics in detail By considering different phenomena it creates a self consistent qualitative picture to explain most observable phenomena This allows readers to develop a better understanding of the concepts and helps to create a conceptual approach which is especially important in educational contexts This clearly written book includes problems and solutions for each chapter which can be used for seminars and homework as well as qualitative models that are helpful to students *Next Generation of Photovoltaics* Ana Cristobal,Antonio Martí Vega,Antonio Luque López,2012-02-14 This book presents new concepts for a next generation of PV Among these concepts are Multijunction solar cells multiple excitation solar cells or how to take benefit of high energy photons for the creation of more than one electron hole pair intermediate band solar cells or how to take advantage of below band gap energy photons and related technologies for quantum dots nitrides thin films advanced light management approaches plasmonics Written by world class experts in next generation photovoltaics this book is an essential reference guide accessible to both beginners and experts working with solar cell technology The book deeply analyzes the current state of the art of the new photovoltaic approaches and outlines

the implementation paths of these advanced devices Topics addressed range from the fundamentals to the description of state of the art of the new types of solar cells

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