Electromagnetic Optimization by Genetic Algorithms

Edited by

Yahya Rahmat-Samii and Eric Michielssen

$$\nabla \cdot D = \rho$$

$$\nabla \times E = -\frac{\partial B}{\partial t}$$

$$\nabla \cdot B = 0$$

$$\nabla \times H = J + \frac{\partial D}{\partial t}$$

Electromagnetic Optimization By Genetic Algorithms

Nemai Chandra Karmakar,Prasanna Kalansuriya,Rubayet E. Azim,Randka Koswatta

Electromagnetic Optimization By Genetic Algorithms:

Electromagnetic Optimization by Genetic Algorithms Yahya Rahmat-Samii,Eric Michielssen,1999-07-23 Authoritative coverage of a revolutionary technique for overcoming problems in electromagnetic design Genetic algorithms are stochastic search procedures modeled on the Darwinian concepts of natural selection and evolution The machinery of genetic algorithms utilizes an optimization methodology that allows a global search of the cost surface via statistical random processes dictated by the Darwinian evolutionary concept These easily programmed and readily implemented procedures robustly locate extrema of highly multimodal functions and therefore are particularly well suited to finding solutions to a broad range of electromagnetic optimization problems Electromagnetic Optimization by Genetic Algorithms is the first book devoted exclusively to the application of genetic algorithms to electromagnetic device design Compiled by two highly competent and well respected members of the electromagnetics community this book describes numerous applications of genetic algorithms to the design and optimization of various low and high frequency electromagnetic components Special features include Introduction by David E Goldberg A Meditation on the Application of Genetic Algorithms Design of linear and planar arrays using genetic algorithms Application of genetic algorithms to the design of broadband wire and integrated antennas Genetic algorithm driven design of dielectric gratings and frequency selective surfaces Synthesis of magnetostatic devices using genetic algorithms Application of genetic algorithms to multiobjective electromagnetic backscattering optimization A comprehensive list of the up to date references applicable to electromagnetic design problems Supplemented with more than 250 illustrations Electromagnetic Optimization by Genetic Algorithms is a powerful resource for electrical engineers interested in modern electromagnetic designs and an indispensable reference for university researchers

Genetic Algorithms in Electromagnetics Randy L. Haupt,Douglas H. Werner,2007-04-27 A thorough and insightful introduction to using genetic algorithms to optimize electromagnetic systems Genetic Algorithms in Electromagnetics focuses on optimizing the objective function when a computer algorithm analytical model or experimental result describes the performance of an electromagnetic system It offers expert guidance to optimizing electromagnetic systems using genetic algorithms GA which have proven to be tenacious in finding optimal results where traditional techniques fail Genetic Algorithms in Electromagnetics begins with an introduction to optimization and several commonly used numerical optimization routines and goes on to feature Introductions to GA in both binary and continuous variable forms complete with examples of MATLAB r commands Two step by step examples of optimizing antenna arrays as well as a comprehensive overview of applications of GA to antenna array design problems Coverage of GA as an adaptive algorithm including adaptive and smart arrays as well as adaptive reflectors and crossed dipoles Explanations of the optimization of several different wire antennas starting with the famous crooked monopole How to optimize horn reflector and microstrip patch antennas which require significantly more computing power than wire antennas Coverage of GA optimization of scattering including

scattering from frequency selective surfaces and electromagnetic band gap materials Ideas on operator and parameter selection for a GA Detailed explanations of particle swarm optimization and multiple objective optimization An appendix of MATLAB code for experimentation   *The Application of Advanced Operator Genetic Algorithms to Electromagnetic Optimization Problems* Daniel Seth Weile,1999   *Real-World Applications of Genetic Algorithms* Olympia Roeva,2012-03-07 The book addresses some of the most recent issues with the theoretical and methodological aspects of evolutionary multi objective optimization problems and the various design challenges using different hybrid intelligent approaches Multi objective optimization has been available for about two decades and its application in real world problems is continuously increasing Furthermore many applications function more effectively using a hybrid systems approach The book presents hybrid techniques based on Artificial Neural Network Fuzzy Sets Automata Theory other metaheuristic or classical algorithms etc The book examines various examples of algorithms in different real world application domains as graph growing problem speech synthesis traveling salesman problem scheduling problems antenna design genes design modeling of chemical and biochemical processes etc   **Differential Evolution in Electromagnetics** Anyong Qing,Ching Kwang Lee,2010-05-28 Differential evolution has proven itself a very simple while very powerful stochastic global optimizer It has been applied to solve problems in many scientific and engineering fields This book focuses on applications of differential evolution in electromagnetics to showcase its achievement and capability in solving synthesis and design problems in electromagnetics Topics covered in this book include A comprehensive up to date literature survey on differential evolution A systematic description of differential evolution A topical review on applications of differential evolution in electromagnetics Five new application examplesThis book is ideal for electromagnetic researchers and people in differential evolution community It is also a valuable reference book for researchers and students in the optimization or electrical and electronic engineering field In addition managers and engineers in relevant fields will find it a helpful introductory guide

   Handbook of Antennas in Wireless Communications Lal Chand Godara,2018-10-03 The move toward worldwide wireless communications continues at a remarkable pace and the antenna element of the technology is crucial to its success With contributions from more than 30 international experts the Handbook of Antennas in Wireless Communications brings together all of the latest research and results to provide engineering professionals and students with a one stop reference on the theory technologies and applications for indoor hand held mobile and satellite systems Beginning with an introduction to wireless communications systems it offers an in depth treatment of propagation prediction and fading channels It then explores antenna technology with discussion of antenna design methods and the various antennas in current use or development for base stations hand held devices satellite communications and shaping beams The discussions then move to smart antennas and phased array technology including details on array theory and beamforming techniques Space diversity direction of arrival estimation source tracking and blind source separation methods are addressed as are the implementation

of smart antennas and the results of field trials of systems using smart antennas implemented Finally the hot media topic of the safety of mobile phones receives due attention including details of how the human body interacts with the electromagnetic fields of these devices Its logical development and extensive range of diagrams figures and photographs make this handbook easy to follow and provide a clear understanding of design techniques and the performance of finished products Its unique comprehensive coverage written by top experts in their fields promises to make the Handbook of Antennas in Wireless Communications the standard reference for the field   Proceedings of 2nd International Conference on Micro-Electronics, Electromagnetics and Telecommunications Suresh Chandra Satapathy,Vikrant Bhateja,P. Satish Rama Chowdary,V.V.S.S. Sameer Chakravarthy,Jaume Anguera,2017-09-06 The book is a collection of best papers presented in the Second International Conference on Microelectronics Electromagnetics and Telecommunication ICMEET 2016 an international colloquium which aims to bring together academic scientists researchers and research scholars to discuss the recent developments and future trends in the fields of microelectronics electromagnetics and telecommunication Microelectronics research investigates semiconductor materials and device physics for developing electronic devices and integrated circuits with data energy efficient performance in terms of speed power consumption and functionality The book discusses various topics like analog digital and mixed signal circuits bio medical circuits and systems RF circuit design microwave and millimeter wave circuits green circuits and systems analog and digital signal processing nano electronics and giga scale systems VLSI circuits and systems SoC and NoC MEMS and NEMS VLSI digital signal processing wireless communications cognitive radio and data communication   **The Finite Element Method for Electromagnetic Modeling** Gérard Meunier,2010-01-05 Written by specialists of modeling in electromagnetism this book provides a comprehensive review of the finite element method for low frequency applications Fundamentals of the method as well as new advances in the field are described in detail Chapters 1 to 4 present general 2D and 3D static and dynamic formulations by the use of scalar and vector unknowns and adapted interpolations for the fields nodal edge face or volume Chapter 5 is dedicated to the presentation of different macroscopic behavior laws of materials and their implementation in a finite element context anisotropy and hysteretic properties for magnetic sheets iron losses non linear permanent magnets and superconductors More specific formulations are then proposed the modeling of thin regions when finite elements become misfit Chapter 6 infinite domains by using geometrical transformations Chapter 7 the coupling of 2D and 3D formulations with circuit equations Chapter 8 taking into account the movement particularly in the presence of Eddy currents Chapter 9 and an original approach for the treatment of geometrical symmetries when the sources are not symmetric Chapter 10 Chapters 11 to 13 are devoted to coupled problems magneto thermal coupling for induction heating magneto mechanical coupling by introducing the notion of strong and weak coupling and magneto hydrodynamical coupling focusing on electromagnetic instabilities in fluid conductors Chapter 14 presents different meshing methods in the context of electromagnetism presence

of air and introduces self adaptive mesh refinement procedures Optimization techniques are then covered in Chapter 15 with the adaptation of deterministic and probabilistic methods to the numerical finite element environment Chapter 16 presents a variational approach of electromagnetism showing how Maxwell equations are derived from thermodynamic principles

Computational Electromagnetics Raj Mittra,2013-08-20 Emerging Topics in Computational Electromagnetics in Computational Electromagnetics presents advances in Computational Electromagnetics This book is designed to fill the existing gap in current CEM literature that only cover the conventional numerical techniques for solving traditional EM problems The book examines new algorithms and applications of these algorithms for solving problems of current interest that are not readily amenable to efficient treatment by using the existing techniques The authors discuss solution techniques for problems arising in nanotechnology bioEM metamaterials as well as multiscale problems They present techniques that utilize recent advances in computer technology such as parallel architectures and the increasing need to solve large and complex problems in a time efficient manner by using highly scalable algorithms **Electromagnetic Fields** Jean G. Van Bladel,2007-06-04 Professor Jean Van Bladel an eminent researcher and educator in fundamental electromagnetic theory and its application in electrical engineering has updated and expanded his definitive text and reference on electromagnetic fields to twice its original content This new edition incorporates the latest methods theory formulations and applications that relate to today s technologies With an emphasis on basic principles and a focus on electromagnetic formulation and analysis Electromagnetic Fields Second Edition includes detailed discussions of electrostatic fields potential theory propagation in waveguides and unbounded space scattering by obstacles penetration through apertures and field behavior at high and low frequencies **Electromagnetic Simulation Techniques Based on the FDTD Method** W. Yu,2009-09-15 Bridges the gap between FDTD theory and the implementation of practical simulation techniques This is the first publication that guides readers step by step through the implementation of electromagnetic simulation techniques based on FDTD methods These simulation techniques serve as an essential bridge between FDTD methods and their applications Moreover the book helps readers better understand the underlying logic of FDTD methods so that they can design FDTD projects using either commercial electromagnetic software packages or their own codes in order to solve practical engineering problems The book begins with two chapters that introduce the basic concepts of the 3 D Cartesian FDTD method followed by discussions of advanced FDTD methods such as conformal techniques dispersive media circuit elements and near to far field transformation Next the book Presents basic concepts of parallel processing techniques and systems including parallel FDTD techniques and systems Explores simulation techniques based on FDTD methods Illustrates practical simulation techniques using engineering applications Introduces advanced simulation techniques Each chapter concludes with references to help readers investigate particular topics in greater depth Each chapter also includes problem sets that challenge readers to put their new FDTD and simulation skills into practice By bridging the gap between FDTD theory and practical simulation techniques this

publication is an invaluable guide for students and engineers who need to solve a wide range of design problems in RF antenna and microwave engineering **Advances in Differential Evolution** Uday K. Chakraborty,2008-09-08 Differential evolution is arguably one of the hottest topics in today s computational intelligence research This book seeks to present a comprehensive study of the state of the art in this technology and also directions for future research The fourteen chapters of this book have been written by leading experts in the area The first seven chapters focus on algorithm design while the last seven describe real world applications Chapter 1 introduces the basic differential evolution DE algorithm and presents a broad overview of the field Chapter 2 presents a new rotationally invariant DE algorithm The role of self adaptive control parameters in DE is investigated in Chapter 3 Chapters 4 and 5 address constrained optimization the former develops suitable stopping conditions for the DE run and the latter presents an improved DE algorithm for problems with very small feasible regions A novel DE algorithm based on the concept of opposite points is the topic of Chapter 6 Chapter 7 provides a survey of multi objective differential evolution algorithms A review of the major application areas of differential evolution is presented in Chapter 8 Chapter 9 discusses the application of differential evolution in two important areas of applied electromagnetics Chapters 10 and 11 focus on applications of hybrid DE algorithms to problems in power system optimization Chapter 12 applies the DE algorithm to computer chess The use of DE to solve a problem in bioprocess engineering is discussed in Chapter 13 Chapter 14 describes the application of hybrid differential evolution to a problem in control engineering **Computational Electromagnetics and Its Applications** Thomas G. Campbell,Roy A. Nicolaides,Manuel D. Salas,2012-12-06 This volume contains the proceedings of the first ICASE LaRC Work shop on Computational Electromagnetics and Its Applications conducted by the Institute for Computer Applications in Science and Engineering and NASA Langley Research Center We had several goals in mind when we decided jointly with the Elec tromagnetics Research Branch to organize this workshop on Computa tional Electromagnetics CEM Among our goals were a desire to obtain an overview of the current state of CEM covering both algorithms and ap plications and their effect on NASA s activities in this area In addition we wanted to provide an attractive setting for computational scientists with expertise in other fields especially computational fluid dynamics CFD to observe the algorithms and tools of CEM at work Our expectation was that scientists from both fields would discover mutually beneficial inter connections and relationships Another goal was to learn of progress in solution algorithms for electromagnetic optimization and design problems such problems make extensive use of field solvers and computational effi ciency is at a premium To achieve these goals we assembled the renowned group of speakers from academia and industry whose talks are contained in this volume The papers are printed in the same order in which the talks were pre sented at the meeting The first paper is an overview of work currently being performed in the Electromagnetic Research Branch at the Langley Research Center Bio-inspired Computing: Theories and Applications Linqiang Pan,Jing Liang,Boyang Qu,2020-04-01 This two volume set CCIS 1159 and CCIS 1160 constitutes

the proceedings of the 14th International Conference on Bio inspired Computing Theories and Applications BIC TA 2019 held in Zhengzhou China in November 2019 The 121 full papers presented in both volumes were selected from 197 submissions The papers are organized according to the topical headings evolutionary computation and swarm intelligence bioinformatics and systems biology complex networks DNA and molecular computing neural networks and articial intelligence **Phased Arrays for Radio Astronomy, Remote Sensing, and Satellite Communications** Karl F. Warnick,Rob Maaskant,Marianna V. Ivashina,David B. Davidson,Brian D. Jeffs,2018-07-26 Discover a modern approach to the analysis modeling and design of high sensitivity phased arrays Network theory numerical methods and computational electromagnetic simulation techniques are uniquely combined to enable full system analysis and design optimization Beamforming and array signal processing theory are integrated into the treatment from the start Digital signal processing methods such as polyphase filtering and RFI mitigation are described along with technologies for real time hardware implementation Key concepts from interferometric imaging used in radio telescopes are also considered A basic development of theory and modeling techniques is accompanied by problem sets that guide readers in developing modeling codes that retain the simplicity of the classical array factor method while incorporating mutual coupling effects and interactions between elements Combining current research trends with pedagogical material suitable for a first year graduate course this is an invaluable resource for students teachers researchers and practicing RF microwave and antenna design engineers   Implanted Antennas in Medical Wireless Communications Yahya Rahmat-Samii,Jaehoon Kim,2006-12-01 One of the main objectives of this lecture is to summarize the results of recent research activities of the authors on the subject of implanted antennas for medical wireless communication systems It is anticipated that ever sophisticated medical devices will be implanted inside the human body for medical telemetry and telemedicine To establish effective and efficient wireless links with these devices it is pivotal to give special attention to the antenna designs that are required to be low profile small safe and cost effective In this book it is demonstrated how advanced electromagnetic numerical techniques can be utilized to design these antennas inside as realistic human body environment as possible Also it is shown how simplified models can assist the initial designs of these antennas in an efficient manner   *Compact Multifunctional Antennas for Wireless Systems* Eng Hock Lim,Kwok Wa Leung,2012-04-17 Offers an up to date description of modern multifunctional antenna systems and microwave components Compact multifunctional antennas are of great interest in the field of antennas and wireless communication systems but there are few if any books available that fully explore the multifunctional concept Divided into six chapters Compact Multifunctional Antennas for Wireless Systems encompasses both the active and passive multifunctional antennas and components for microwave systems It provides a systematic valuable reference for antenna microwave researchers and designers Beginning with such novel passive components as antenna filters antenna packaging covers and balun filters the book discusses various miniaturization techniques for the multifunctional antenna systems In addition to amplifying and

oscillating antennas the book also covers design considerations for frequency and pattern reconfigurable antennas The last chapter is dedicated to the field of solar cell integrated antennas Inside readers will find comprehensive chapters on Compact Multifunctional Antennas in Microwave Wireless Systems Multifunctional Passive Integrated Antennas and Components Reconfigurable Antennas Receiving Amplifying Antennas Oscillating Antennas Solar cell integrated Antennas Aimed at professional engineers and researchers designing compact antennas for wireless applications Compact Multifunctional Antennas for Wireless Systems will prove to be an invaluable tool **Chipless Radio Frequency Identification Reader Signal Processing** Nemai Chandra Karmakar,Prasanna Kalansuriya,Rubayet E. Azim,Randka Koswatta,2016-03-17 Presents a comprehensive overview and analysis of the recent developments in signal processing for Chipless Radio Frequency Identification Systems This book presents the recent research results on Radio Frequency Identification RFID and provides smart signal processing methods for detection signal integrity multiple access and localization tracking and collision avoidance in Chipless RFID systems The book is divided into two sections The first section discusses techniques for detection and denoising in Chipless RFID systems These techniques include signal space representation detection of frequency signatures using UWB impulse radio interrogation time domain analysis singularity expansion method for data extraction and noise reduction and filtering techniques The second section covers collision and error correction protocols multi tag identification through time frequency analysis FMCW radar based collision detection and multi access for Chipless RFID tags as we as localization and tag tracking Describes the use of UWB impulse radio interrogation to remotely estimate the frequency signature of Chipless RFID tags using the backscatter principle Reviews the collision problem in both chipped and Chipless RFID systems and summarizes the prevailing anti collision algorithms to address the problem Proposes state of the art multi access and signal integrity protocols to improve the efficacy of the system in multiple tag reading scenarios Features an industry approach to the integration of various systems of the Chipless RFID reader integration of physical layers middleware and enterprise software Chipless Radio Frequency Identification Reader Signal Processing is primarily written for researchers in the field of RF sensors but can serve as supplementary reading for graduate students and professors in electrical engineering and wireless communications *Radio Propagation and Adaptive Antennas for Wireless Communication Networks* Nathan Blaunstein,Christos G. Christodoulou,2014-05-05 Radio Propagation and Adaptive Antennas for Wireless Communication Networks 2nd Edition presents a comprehensive overview of wireless communication system design including the latest updates to considerations of over the terrain atmospheric and ionospheric communication channels New features include the latest experimentally verified stochastic approach based on several multi parametric models all new chapters on wireless network fundamentals advanced technologies and current and modern multiple access networks and helpful problem sets at the conclusion of each chapter to enhance clarity The volume s emphasis remains on a thorough examination of the role of obstructions on the corresponding

propagation phenomena that influence the transmission of radio signals through line of sight LOS and non line of sight NLOS propagation conditions along the radio path between the transmitter and the receiver antennas and how adaptive antennas used at the link terminals can be used to minimize the deleterious effects of such obstructions With its focus on 3G 4G MIMO and the latest wireless technologies Radio Propagation and Adaptive Antennas for Wireless Communication Networks represents an invaluable resource to topics critical to the design of contemporary wireless communication systems Explores novel wireless networks beyond 3G and advanced 4G technologies such as MIMO via propagation phenomena and the fundamentals of adapted antenna usage Explains how adaptive antennas can improve GoS and QoS for any wireless channel with specific examples and applications in land aircraft and satellite communications Introduces new stochastic approach based on several multi parametric models describing various terrestrial scenarios which have been experimentally verified in different environmental conditions New chapters on fundamentals of wireless networks cellular and non cellular multiple access networks new applications of adaptive antennas for positioning and localization of subscribers Includes the addition of problem sets at the end of chapters describing fundamental aspects of wireless communication and antennas *Microwave Noncontact Motion Sensing and Analysis* Changzhi Li,Jenshan Lin,2013-11-11 An authoritative guide to the theory technologies and state of the art applications in microwave noncontact sensing and analysis Engineering researchers have recently developed exciting advances in microwave noncontact sensing and analysis with new applications in fields ranging from medicine to structural engineering manufacturing to transportation This book provides an authoritative look at the current state of the art in the field Drawing upon their years of experience in both cutting edge research and industry applications the authors address microwave radar for both noncontact vital sign detection and mechanical movement measurement They explore key advances in everyday applications of microwave and Doppler radar especially in the areas of radio frequency technologies microelectronic fabrication processes and signal processing hardware and algorithms Microwave Noncontact Motion Sensing and Analysis Reviews the theory and technical basics from electromagnetic propagation to signal processing Discusses all major types of motion sensing radar including Doppler pulse and FMCW Explores important advances in detection and analysis techniques Uses numerous case studies to illustrate current applications in an array of fields Provides integrated coverage of human vital sign detection through wall radar and Doppler vibrometry Offers a well informed look at emerging technologies and the shape of things to come An important resource for engineers and researchers with a professional interest in micro wave sensing technology Microwave Noncontact Motion Sensing and Analysis is also a source of insight and guidance for professionals in healthcare transportation safety the military and law enforcement

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