Circuit And Numerical Modeling Of Electrostatic Discharge

Circuit simulation is essential in integrated circuit design, and the accuracy of circuit simulation depends on the accuracy of the transistor model. BSIM3v3 (BSIM for Berkeley Short-channel IGFET Model) has been selected as the first MOSFET model for standardization by the Compact Model Council, a consortium of leading companies in semiconductor and design tools. In the next few years, many fabless and integrated semiconductor companies are expected to switch from dozens of other MOSFET models to BSIM3. This will require many device engineers and most circuit designers to learn the basics of BSIM3. MOSFET Modeling & BSIM3 User's Guide explains the detailed physical effects that are important in modeling MOSFETs, and presents the derivations of compact model expressions so that users can understand the physical meaning of the model equations and parameters. It is the first book devoted to BSIM3. It treats the BSIM3 model in detail as used in digital, analog and RF circuit design. It covers the complete set of models, i.e., I-V model, capacitance model, noise model, parasitics model, substrate current model, temperature effect model and non

quasi-static model. MOSFET Modeling & BSIM3 User's Guide not only addresses the device modeling issues but also provides a user's guide to the device or circuit design engineers who use the BSIM3 model in digital/analog circuit design, RF modeling, statistical modeling, and technology prediction. This book is written for circuit designers and device engineers, as well as device scientists worldwide. It is also suitable as a reference for graduate courses and courses in circuit design or device modelling. Furthermore, it can be used as a textbook for industry courses devoted to BSIM3. MOSFET Modeling & BSIM3 User's Guide is comprehensive and practical. It is balanced between the background information and advanced discussion of BSIM3. It is helpful to experts and students alike.
The heat transfer and analysis on laser beam, evaporator coils, shell-and-tube condenser, two phase flow, nanofluids, complex fluids, and on phase change are significant issues in a design of wide range of industrial processes and devices. This book includes 25 advanced and revised contributions, and it covers mainly (1) numerical modeling of heat transfer, (2) two phase flow, (3) nanofluids, and (4) phase change. The first section introduces numerical modeling of heat transfer on particles in binary gas-solid fluidization bed, solidification phenomena, thermal approaches to laser damage, and temperature and velocity distribution. The second section covers density wave instability phenomena, gas and spray-

water quenching, spray cooling, wettability effect, liquid film thickness, and thermosyphon loop. The third section includes nanofluids for heat transfer, nanofluids in minichannels, potential and engineering strategies on nanofluids, and heat transfer at nanoscale. The forth section presents time-dependent melting and deformation processes of phase change material (PCM), thermal energy storage tanks using PCM, phase change in deep CO_2 injector, and thermal storage device of solar hot water system. The advanced idea and information described here will be fruitful for the readers to find a sustainable solution in an industrialized society.

Microelectronics are certainly one of the key-technologies of our time. They are a key factor of technological and economic progress. They effect the fields of automation, information and communication, leading to the development of new applications and markets. Attention should be focused on three areas of development: • process and production technology, • test technology, • design technology. Clearly, because of the development of new application fields, the skill ~f design ing integrated circuits should not be limited to a few, highly specialized experts Rather, this ability should be made available to all system aDd design engineers as a new application technology - just like nrogramrning technology for software. For this reason, design procedures havt: to be

developed which, supported by appropriate CAD systems, provide the desIgn englIl~I' with tools for representaltop effective instruments for design and reliable ·tools for verificatibn, ensuring simpre, proper and easily controllable interfaces for the manufacturing and test processes. Such CAD systems are called standard design systems. They open the way to fast and safe design of integrated circuits. First, this book demonstrates basic principles with an example of the Siemens design system VENUS, gives a general introduction to the method of designing integrated circuits, familiarizes the reader with basic semiconductor and circuit tech nologies, shows the various methods of layout design, and presents necessary con cepts and strategies of test technology.
In this volume, we have put together papers spanning a broad range — from the area of modeling of strain and misfit dislocation densities, microwave absorption characteristics of nanocomposites, to X-ray diffraction studies.Specific topics in this volume include:In summary, papers selected in this volume cover various aspects of high performance logic and circuits for high-speed electronic systems.
The U.S. Department of Energy’s Generation IV Program has identified six advanced reactor technologies to be investigated for possible deployment in both energy and process heat generation. Most of these reactor concepts, such as the Very-High-Temperature Reactor (VHTR) and the Molten Salt Reactor (MSR),

operate at high temperatures and/or pressures, requiring intermediate heat exchangers (IHXs) to transfer heat from the primary loop to secondary and tertiary loops. The VHTR has a design core outlet temperature of up to 1000 °C, and thus a robust high temperature IHX is required for full VHTR technology maturity. One such candidate for the IHX in these advanced reactors is the printed circuit heat exchanger (PCHE). The PCHE has an extremely high effectiveness and compactness, and the fabrication methods lead to great robustness as well. In this study, numerical simulations using a commercial code, COMSOL Multiphysics, were investigated and compared to the experimental results obtained from straight channel PCHE testing at the High-Temperature Helium test Facility (HTHF) at The Ohio State University (OSU). A post-machining analysis was completed for the frontal face geometry of the PCHE flow channels, and the results were compared to the nominal geometric values. The actual channel diameter was found to be 2.04±0.12 mm, compared to the nominal value of 2.0 mm, and the actual channel height was found to be 0.9±0.11 mm, compared to the nominal value of 1.0 mm. These new values were tested in the numerical model geometry as well as the nominal values. Three model were created for numerical investigation of the experimental results; a two-channel model, a two-plate model and a full-geometry model. A grid sensitivity

study was completed for the two-channel model using a laminar flow model. Results were obtained for the two-channel model and was compared to the results obtained in the experiment. The heat transfer characteristics were over predicted in the numerical results, while the numerical pressure drops predicted the experimental values well. Preliminary results using a coarsened mesh were obtained for the two-plate and full-geometry model. A methodology for calculations of local friction factor and Nusselt number effects from numerical data is presented, and the resulting analyses are discussed. The globally calculated values are compared to the locally calculated values. The global and locally calculated results do not always match, explained by numerical errors related to the use of differentials for first ordered mesh cell elements.
Numerical Simulation - from Theory to Industry is the edited book containing 25 chapters and divided into four parts. Part 1 is devoted to the background and novel advances of numerical simulation; second part contains simulation applications in the macro- and micro-electrodynamics. Part 3 includes contributions related to fluid dynamics in the natural environment and scientific applications; the last, fourth part is dedicated to simulation in the industrial areas, such as power engineering, metallurgy and building. Recent numerical techniques, as well as software the most accurate and advanced in treating the

physical phenomena, are applied in order to explain the investigated processes in terms of numbers. Since the numerical simulation plays a key role in both theoretical and industrial research, this book related to simulation of many physical processes, will be useful for the pure research scientists, applied mathematicians, industrial engineers, and post-graduate students.
In Optoelectronic Integrated Circuit Design and Device Modeling, Professor Jianjun Gao introduces the fundamentals and modeling techniques of optoelectronic devices used in high-speed optical transmission systems. Gao covers electronic circuit elements such as FET, HBT, MOSFET, as well as design techniques for advanced optical transmitter and receiver front-end circuits. The book includes an overview of optical communication systems and computer-aided optoelectronic IC design before going over the basic concept of laser diodes. This is followed by modeling and parameter extraction techniques of lasers and photodiodes. Gao covers high-speed electronic semiconductor devices, optical transmitter design, and optical receiver design in the final three chapters. Addresses a gap within the rapidly growing area of transmitter and receiver modeling in OEICs Explains diode physics before device modeling, helping readers understand their equivalent circuit models Provides comprehensive explanations for E/O and O/E conversions done with laser and

photodiodes Covers an extensive range of devices for high-speed applications Accessible for students new to microwaves Presentation slides available for instructor use This book is primarily aimed at practicing engineers, researchers, and post-graduates in the areas of RF, microwaves, IC design, photonics and lasers, and solid state devices. The book is also a strong supplement for senior undergraduates taking courses in RF and microwaves. Lecture materials for instructors available at www.wiley.com/go/gao

Semiconductor optical amplifiers (SOAs) have been extensively used in a wealth of telecom and datacom applications as a powerful building block that features large optical gain, all-optical gating function, fast response, and ease of integration with other functional semiconductor devices. As fabrication technologies are steadily maturing toward enhanced yield, SOAs are foreseen to play a pivotal role in complex photonics integrated circuits (PICs) of the near future. From a design standpoint, accurate numerical modeling of SOA devices is required toward optimizing PICs response from a system perspective, while enhanced circuit complexity calls for efficient solvers. In this book chapter, we present established experimentally validated SOA numerical modeling techniques and a gain parameterization procedure applicable to a wide range of SOA devices. Moreover, we describe multigrid concepts and implicit schemes that have been only recently presented to SOA modeling, enabling adaptive time stepping at the SOA output, with dense sampling at transient phenomena during the gain recovery and scarce sampling during the steady-state response. Overall, a holistic simulation methodology approach along with recent research trends are described, aiming to form the basis of further developments in SOA modeling. Magnets are widely used in industry, medical, scientific instruments, and electrical equipment. They are the basic tools for scientific research and electromagnetic devices. Numerical methods for the magnetic field analysis combined with mathematical optimization from practical applications of the magnets have been widely studied in recent years. It is necessary for professional researchers, engineers, and students to study these numerical methods for the complex magnet structure design instead of using traditional "trial-and-error" methods. Those working in this field will find this book useful as a reference to help reduce costs and obtain good magnetic field quality. Presents a clear introduction to magnet technology, followed by basic theories, numerical analysis, and practical applications Emphasizes the latest developments in magnet design, including MRI systems Provides comprehensive numerical techniques that provide solutions to practical problems Introduces the latest computation techniques for optimizing and characterizing the magnetostatic structure design Well organized and adaptable by researchers, engineers, lecturers, and students Appendix available on the Wiley Companion Website As a comprehensive treatment of the topic, Practical Design of Magnetostatic Structure Using Numerical Simulation is ideal for researchers in the field of magnets and their applications, materials scientists, structural engineers, and graduate students in electrical engineering. The book will also better equip mechanical engineers and aerospace engineers.

The book represents a basic support for a master course in electromagnetism oriented to numerical simulation. The main goal of the book is that the reader knows the boundary-value problems of partial differential equations that should be solved in order to perform computer simulation of electromagnetic processes. Moreover it includes a part devoted to electric circuit theory based on ordinary differential equations. The book is mainly oriented to electric engineering applications, going from the general to the specific, namely, from the full Maxwell's equations to the particular cases of electrostatics, direct current, magnetostatics and eddy currents models. Apart from standard exercises related to analytical calculus, the book includes some others oriented to real-life applications solved with MaxFEM free simulation software.

Numerical simulation and modelling are witnessing a resurgence. Designing systems with integrated wireless components, mixed-signal blocks and nanoscale, multi-GHz "digital" circuits is requiring extensive low-level modelling and simulation. Analysis and design in non-electronic domains, notably in systems biology, are also relying increasingly on numerical computation. Chapters 2-8 of this monograph provide an introduction to the fundamentals of numerical simulation, and to the basics of modelling electronic circuits and biochemical reactions. The focus is on a minimal set of concepts that will enable the reader to further explore the field independently. Differential-algebraic equation models of electronic circuits and biochemical reactions, together with basic numerical techniques - quiescent, transient and linear frequency domain analyses, as well as sensitivity and noise analyses - for solving these differential equations are developed. Downloadable MATLAB implementations are provided. The last two chapters provide an introduction to computational methods for nonlinear periodic steady states and multi-time PDE formulations, followed by an overview of model order reduction (MOR) and, at the end, a glimpse of some applications of oscillator MOR - in circuits (PLLs), biochemical reaction-diffusion systems and nanoelectronics.

The third Conference on Mathematical Models and Numerical Simulation in Electronic Industry brought together researchers in mathematics, electrical

engineering and scientists working in industry. The contributions to this volume try to bridge the gap between basic and applied mathematics, research in electrical engineering and the needs of industry.
A comprehensive text, combining all important concepts and topics of Electrical Machines and featuring exhaustive simulation models based on MATLAB/Simulink Electrical Machine Fundamentals with Numerical Simulation using MATLAB/Simulink provides readers with a basic understanding of all key concepts related to electrical machines (including working principles, equivalent circuit, and analysis). It elaborates the fundamentals and offers numerical problems for students to work through. Uniquely, this text includes simulation models of every type of machine described in the book, enabling students to design and analyse machines on their own. Unlike other books on the subject, this book meets all the needs of students in electrical machine courses. It balances analytical treatment, physical explanation, and hands-on examples and models with a range of difficulty levels. The authors present complex ideas in simple, easy-to-understand language, allowing students in all engineering disciplines to build a solid foundation in the principles of electrical machines. This book: Includes clear elaboration of fundamental concepts in the area of electrical machines, using simple language for optimal and enhanced learning Provides

wide coverage of topics, aligning with the electrical machines syllabi of most international universities Contains extensive numerical problems and offers MATLAB/Simulink simulation models for the covered machine types Describes MATLAB/Simulink modelling procedure and introduces the modelling environment to novices Covers magnetic circuits, transformers, rotating machines, DC machines, electric vehicle motors, multiphase machine concept, winding design and details, finite element analysis, and more Electrical Machine Fundamentals with Numerical Simulation using MATLAB/Simulink is a well-balanced textbook perfect for undergraduate students in all engineering majors. Additionally, its comprehensive treatment of electrical machines makes it suitable as a reference for researchers in the field.

Today's most commonly used circuit models increasingly tend to lose their validity in circuit simulation due to rapid technological developments, miniaturization and increased complexity of integrated circuits. The starting point of this thesis was to tackle these challenges by refining the critical parts of the circuit by combining circuit simulation directly with distributed device models. The approach set out in this thesis couples partial differential equations for electromagnetic devices - modeled by Maxwell's equations -, to differential-algebraic equations, which describe basic circuit elements including memristors and the circuit's topology. First, Maxwell's equations are spatially discretized and a potential formulation is derived, the coupled system is then formulated as a differential-algebraic equation with a properly stated leading term and analyzed. Topological and modeling conditions are presented to guarantee the tractability index of these differential-algebraic equations to be no greater than two. Finally, local solvability, perturbation results and an algorithm to calculate consistent initializations are derived for a general class of differential-algebraic equations with a properly stated leading term having tractability index-2.

Simulation based on mathematical models plays a major role in computer aided design of integrated circuits (ICs). Decreasing structure sizes, increasing packing densities and driving frequencies require the use of refined mathematical models, and to take into account secondary, parasitic effects. This leads to very high dimensional problems which nowadays require simulation times too large for the short time-to-market demands in industry. Modern Model Order Reduction (MOR) techniques present a way out of this dilemma in providing surrogate models which keep the main characteristics of the device while requiring a significantly lower simulation time than the full model. With Model Reduction for Circuit Simulation we survey the state of the art in the challenging research field of MOR for ICs, and also address its future research directions. Special emphasis is taken on aspects stemming from miniturisations to the nano scale. Contributions cover complexity reduction using e.g., balanced truncation, Krylov-techniques or POD approaches. For semiconductor applications a focus is on generalising current techniques to differential-algebraic equations, on including design parameters, on preserving stability, and on including nonlinearity by means of piecewise linearisations along solution trajectories (TPWL) and interpolation techniques for nonlinear parts. Furthermore the influence of interconnects and power grids on the physical properties of the device is considered, and also top-down system design approaches in which detailed block descriptions are combined with behavioral models. Further topics consider MOR and the combination of approaches from optimisation and statistics, and the inclusion of PDE models with emphasis on MOR for the resulting partial differential algebraic systems. The methods which currently are being developed have also relevance in other application areas such as mechanical multibody systems, and systems arising in chemistry and to biology. The current number of books in the area of MOR for ICs is very limited, so that this volume helps to fill a gap in providing the state of the art material, and to stimulate further research in this area of MOR. Model Reduction for Circuit Simulation also reflects and documents the vivid interaction between three active research projects in this area, namely the EU-

Marie Curie Action ToK project O-MOORE-NICE (members in Belgium, The Netherlands and Germany), the EU-Marie Curie Action RTN-project COMSON (members in The Netherlands, Italy, Germany, and Romania), and the German federal project System reduction in nano-electronics (SyreNe).

Soft errors are a multifaceted issue at the crossroads of applied physics and engineering sciences. Soft errors are by nature multiscale and multiphysics problems that combine not only nuclear and semiconductor physics, material sciences, circuit design, and chip architecture and operation, but also cosmic-ray physics, natural radioactivity issues, particle detection, and related instrumentation. Soft Errors: From Particles to Circuits addresses the problem of soft errors in digital integrated circuits subjected to the terrestrial natural radiation environment—one of the most important primary limits for modern digital electronic reliability. Covering the fundamentals of soft errors as well as engineering considerations and technological aspects, this robust text: Discusses the basics of the natural radiation environment, particle interactions with matter, and soft-error mechanisms Details instrumentation developments in the fields of environment characterization, particle detection, and real-time and accelerated tests Describes the latest computational developments, modeling, and simulation strategies for the soft error-rate estimation in digital circuits Explores trends for future technological nodes and emerging devices Soft Errors: From Particles to Circuits presents the state of the art of this complex subject, providing comprehensive knowledge of the complete chain of the physics of soft errors. The book makes an ideal text for introductory graduate-level courses, offers academic researchers a specialized overview, and serves as a practical guide for semiconductor industry engineers or application engineers.

This book demonstrates applications and case studies performed by experts for professionals and students in the field of technology, engineering, materials, decision making management and other industries in which mathematical modelling plays a role. Each chapter discusses an example and these are ranging from well-known standards to novelty applications. Models are developed and analysed in details, authors carefully consider the procedure for constructing a mathematical replacement of phenomenon under consideration. For most of the cases this leads to the partial differential equations, for the solution of which numerical methods are necessary to use. The term Model is mainly understood as an ensemble of equations which describe the variables and interrelations of a physical system or process. Developments in computer technology and related software have provided numerous tools of increasing power for specialists in mathematical modelling. One finds a variety of these used to obtain the numerical results of the book.

The number of transistors in integrated circuits doubles every two years, as stipulated by Moore’s law, and this has been the driving force for the huge development of the microelectronics industry in the past 50 years – currently advanced to the nanometric scale. This e-book is dedicated to electronic noises and parasites, accounting for issues involving substrate coupling and interconnections, in the perspective of the 3D integration: a second track for enhancing integration, also compatible with Moore’s law. This reference explains the modeling of 3D circuits without delving into the latest advances, but highlights crucial problems, for instance electro-thermo-mechanical problems, which could be addressed through 3D modeling. The book also explains electromagnetic interferences , at different modeling levels (device and circuit) oriented towards 3D integration technologies. It also covers substrate noise, such as disturbances of digital blocks, power bounces, phase noise in oscillators, both at the device level, such as carriers or field fluctuations, and circuit levels. The entanglement between interconnect and substrate is also discussed. This e-book serves as a reference for advanced graduates or researchers in the field of micro and nano electronics interested in topics relevant to electromagnetic interference or the ‘noise’ domain, at device or circuit and system levels

Nowadays mathematical modeling and numerical simulations play an important role in life and natural science. Numerous researchers are working in developing different methods and techniques to help understand the behavior of very complex systems, from the brain activity with real importance in medicine to the turbulent flows with important applications in physics and engineering. This book presents an overview of some models, methods, and numerical computations that are useful for the applied research scientists and mathematicians, fluid tech engineers, and postgraduate students.

The goal of putting `systems on a chip' has been a difficult challenge that is only recently being met. Since the world is `analog', putting systems on a chip requires putting analog interfaces on the same chip as digital processing functions. Since some processing functions are accomplished more efficiently in analog circuitry, chips with a large amount of analog and digital circuitry are being designed. Whether a small amount of analog circuitry is combined with varying amounts of digital circuitry or the other way around, the problem encountered in marrying analog and digital circuitry are the same but with different scope. Some of the most prevalent problems are chip/package capacitive and inductive coupling, ringing on the RLC tuned circuits that form the chip/package power supply rails and off-chip drivers and receivers, coupling between circuits through the chip substrate bulk, and radiated emissions from the chip/package interconnects. To aggravate the problems of designers who have to deal with the complexity of mixed-signal coupling there is a lack of verification techniques to simulate the problem. In addition to considering RLC models for the various chip/package/board level parasitics, mixed-signal circuit designers must also model coupling through the common substrate when simulating ICs to obtain an accurate estimate of coupled noise in their designs. Unfortunately, accurate simulation of substrate coupling has only recently begun to receive attention, and techniques for the same are not widely known. Simulation Techniques and Solutions for Mixed-Signal Coupling in Integrated Circuits addresses two major issues of the mixed-signal coupling problem -- how to simulate it and how to overcome it. It identifies some of the problems that will be encountered, gives examples of actual hardware experiences, offers simulation techniques, and suggests possible solutions. Readers of this book should come away with a clear directive to simulate their design for interactions prior to building the design, versus a `build it and see' mentality.

Scattering-based numerical methods are increasingly applied to the numerical simulation of distributed time-dependent physical systems. These methods, which possess excellent stability and stability verification properties, have appeared in various guises as the transmission line matrix (TLM) method, multidimensional wave digital (MDWD) filtering and digital waveguide (DWN) methods. This text provides a unified framework for all of these techniques and addresses the question of how they are related to more standard numerical simulation techniques. Covering circuit/scattering models in electromagnetics, transmission line modelling, elastic dynamics, as well as time-varying and nonlinear systems, this book highlights the general applicability of this technique across a variety of disciplines, as well as the inter-relationships between simulation techniques and digital filter design. provides a comprehensive overview of scattering-based numerical integration methods. reviews the basics of classical electrical network theory, wave digital filters, and digital waveguide networks. discusses applications for time-varying and nonlinear systems. includes an extensive bibliography containing over 250 references. Mixing theory and application with numerical simulation results, this book will be suitable for both experts and readers with a limited background in signal processing and numerical techniques.

Information technologies have changed people's lives to a great extent, and now it is almost impossible to imagine any activity that does not depend on computers in some way. Since the invention of first computer systems, people have been trying to avail computers in order to solve complex problems in various areas. Traditional methods of calculation have been replaced by computer programs that have the ability to predict the behavior of structures under different loading conditions. There are eight chapters in this book that deal with: optimal control of thermal pollution emitted by power plants, finite difference solution of conjugate heat transfer in double pipe with trapezoidal fins, photovoltaic system integrated into the buildings, possibilities of modeling Petri nets and their extensions, etc. Computational science is one of the rapidly growing multidisciplinary fields. The high-performance computing capabilities are utilized to solve and understand complex problems. This book offers a detailed exposition of the numerical methods that are used in engineering and science. The chapters are arranged in such a way that the readers will be able to select the topics appropriate to their interest and need. The text features a broad array of applications of computational methods to science and technology. This book would be an interesting supplement for the practicing engineers, scientists, and graduate students.

Modelling and computations in electromagnetics is a quite fast-growing research area. The recent interest in this field is caused by the increased demand for designing complex microwave components, modeling electromagnetic materials, and rapid increase in computational power for calculation of complex electromagnetic problems. The first part of this book is devoted to the advances in the analysis techniques such as method of moments, finite-difference time-domain method, boundary perturbation theory, Fourier analysis, mode-matching method, and analysis based on circuit theory. These techniques are considered with regard to several challenging technological applications such as those related to electrically large devices, scattering in layered structures, photonic crystals, and artificial materials. The second part of the book deals with waveguides, transmission lines and transitions. This includes microstrip lines (MSL), slot waveguides, substrate integrated waveguides (SIW), vertical transmission lines in multilayer media as well as MSL to SIW and MSL to slot line transitions.

The book comprises contributions by some of the most respected scientists in the field of mathematical modeling and numerical simulation of the human cardiocirculatory system. It covers a wide range of topics, from the assimilation of clinical data to the development of mathematical and computational models, including with parameters, as well as their efficient numerical solution, and both in-vivo and in-vitro validation. It also considers applications of relevant clinical interest. This book is intended for graduate students and researchers in the field of bioengineering, applied mathematics, computer, computational and data science, and medicine wishing to become involved in the highly fascinating task of modeling the cardiovascular system.

Increasing complexity combined with decreasing geometrical sizes in electric circuit design lead to high dimensional dynamical models to be considered by EDA tools. Model order reduction (MOR) has become a popular strategy to decrease the problem's size while preserving its crucial properties. MOR shall achieve accurate statements on a circuit's behavior within an affordable amount of computational time. Just recently, MOR techniques are designed to consider the differential algebraic nature of the underlying models. We present an approach based on an e-embedding, i.e., a strategy applied in the construction of numerical integration schemes for differential algebraic equations (DAEs). The system of DAEs is transformed into an artificial system of ordinary differential equations (ODEs), since MOR schemes for ODEs can be applied now. We construct, analyze and test different strategies with respect to the usage of the parameter e that transforms the DAEs into ODEs. Moreover, accurate mathematical models for MOS-devices introduce highly nonlinear equations. As the packing density of devices is growing in circuit design, huge nonlinear systems appear in practice. It follows an increasing demand for reduced order modeling of nonlinear problems. In the thesis, we also review the status of existing techniques for nonlinear MOR by investigating the performance of the schemes applied in circuit simulation.

Presented here is an alternative methodology to the development of transmission line

models for multi-conductor interconnects in high speed integrated circuits. The methodology starts with the assumption that per unit length (p.u.l.) transmission line parameters 0?4 i.e. p.u.l. resistance R, inductance L, capacitance C, and conductance G 0?4 have been extracted using a two-dimensional RLCG extractor. The methodology relies upon a rational fitting algorithm called VECTFIT to express the parameters as a rational function expression, a form suitable for equivalent circuit generation using a commercial circuit simulator like HSPICE. The methodology has been numerically verified and implemented in the form of some select interconnecting scenarios for typical on-chip applications. The new methodology has also been compared with the previous methodology for robustness, accuracy and computational efficacy.
Since the 1990s five books onApplications of Computational Mechanics in Geotechnical Engineering have been published. Innovative Numerical Modelling in Geomechanics is the 6th and final book in this series, and contains papers written by leading experts on computational mechanics. The book treats highly relevant topics in the field of geotechnic
"This dissertation discusses four topics relevant to power integrity and design, numerical modeling, and characterization and modeling of MEMS switches"--Abstract, leaf iv.
Autonomous and nonautonomous Chua's circuits are of special significance in the study of chaotic system modeling, chaos-based science and engineering applications.

Since hardware and software-based design and implementation approaches can be applied to Chua's circuits, these circuits are also excellent educative models for studying and experimenting nonlinear dynamics and chaos.This book not only presents a collection of the author's published papers on design, simulation and implementation of Chua's circuits, it also provides a systematic approach to practising chaotic dynamics.

A Definitive text on developing circuit simulators Circuit Simulation gives a clear description of the numerical techniques and algorithms that are part of modern circuit simulators, with a focus on the most commonly used simulation modes: DC analysis and transient analysis. Tested in a graduate course on circuit simulation at the University of Toronto, this unique text provides the reader with sufficient detail and mathematical rigor to write his/her own basic circuit simulator. There is detailed coverage throughout of the mathematical and numerical techniques that are the basis for the various simulation topics, which facilitates a complete understanding of practical simulation techniques. In addition, Circuit Simulation: Explores a number of modern techniques from numerical analysis that are not synthesized anywhere else Covers network equation formulation in detail, with an emphasis on modified nodal analysis Gives a comprehensive treatment of the most relevant aspects of linear and nonlinear system solution techniques States all theorems without proof in order to maintain the focus on the end-goal of providing coverage of practical simulation methods Provides ample references for further study Enables newcomers to circuit simulation to understand the material in a concrete and holistic manner With problem sets and computer projects at the end of every chapter, Circuit Simulation is ideally suited for a graduate course on this topic. It is also a practical reference for design engineers and computer-aided design practitioners, as well as researchers and developers in both industry and academia.

Numerical Modeling of High Voltage Circuit Breaker Arcs and Their Interraction with the Power SystemDevelopment of a Hybrid 3D Numerical Modeling Technique for Analyzing Printed Circuit Models with Attached WiresAn Equivalent Circuit Model Approach to Numerical Modeling of Semiconductor DevicesLinear and Nonlinear Model Order Reduction for Numerical Simulation of Electric CircuitsLogos Verlag Berlin GmbH

Demystifying Numerical Models: Step-by Step Modeling of Engineering Systems is the perfect guide on the analytic concepts of engineering components and systems. In simplified terms, the book focuses on engineering characteristics and behaviors using numerical methods. Readers will learn how the computational aspects of engineering analysis can be applied to develop various engineering systems to a level that is fit for implementation. Provides numerical examples and graphical representations of complex mathematical models Includes downloadable spreadsheets of the numerical tools discussed that allow the reader to gain a hands-on understanding of how they work Explains the engineering foundations behind the increasingly widespread and complex numerical models

This book provides a comprehensive study of the research outcomes on memristor emulator circuits and includes various analog applications as examples. The authors describe in detail how to design different types of memristor emulators, using active and passive components for different applications. Most of the emulator circuits presented in this book are new and are the outcomes of the authors' recent research. Coverage also includes the latest technological advances in memristor and memristor emulators. Readers will benefit from an understanding of the fundamental concepts and potential applications related to memristors, since these emulator circuits can be built in the laboratory using inexpensive, off-the-shelf circuit components. Introduces readers to memristor emulator circuit design, using regular off-the-shelf circuit components; Describes analog applications of memristors that can be verified by the proposed emulator circuits; Includes a brief overview of the updated mathematical models of the memristor device, with different material implementations; Equips readers to understand the three fingerprints of memristors, which make them unique, compared to the three known, passive elements (resistor, inductor and capacitor).

This book offers broad, detailed coverage of theoretical developments in induction and direct resistance heating and presents new material on the solution of problems in the application of such heating. The physical basis of induction and conduction heating processes is explained and electromagnetic phenomena in direct resistance and induction heating of flat workpieces and cylindrical bodies are examined in depth. The calculation of electrical and energetic characteristics of induction and conduction heating systems is then thoroughly reviewed. The final two chapters consider analytical solutions and numerical modeling of problems in the application of induction and direct resistance heating, providing industrial engineers with the knowledge needed in order to use numerical tools in the modern design of installations. Other engineers, scientists and technologists will find the book to be an invaluable reference that will assist in the efficient utilization of electrical energy.

This book presents for the first time a unified treatment of the physical processes, mathematical models and numerical techniques for circuit, device and process simulation. At the macroscopic level linear and nonlinear circuit elements are introduced to yield a mathematical model of an integrated circuit. Numerical techniques used to solve this coupled system of ODEs are described. Microscopically, current flow within a transistor is modeled using the drift-diffusion and hydrodynamic PDE systems. Finite difference and finite element methods for spatial discretizations are treated, as are grid generation and refinement, upwinding, and multilevel schemes. At the fabrication level, physical processes such as diffusion, oxidation, and crystal growth are modeled using reaction-diffusion-convection equations. These models require multistep integration techniques and Krylov projection methods for successful implementation. Exercises, programming assignments, and an extensive bibliography are included to reinforce and extend the treatment.