Chapter 12 Advanced Mosfet Models World Scientific

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SHANNON VEGA

ESD Protection Device and Circuit Design for Advanced CMOS Technologies Springer Science & Business Media
Presenting a comprehensive overview of the design automation algorithms, tools, and methodologies used to design integrated circuits, the Electronic Design Automation for Integrated Circuits Handbook is available in two volumes. The second volume, EDA for IC Implementation, Circuit Design, and Process Technology, thoroughly examines real-time logic to GDSII (a file format used to transfer data of semiconductor physical layout), analog/mixed signal design, physical verification, and technology CAD (TCAD). Chapters contributed by leading experts authoritatively discuss design for manufacturability at the nanoscale, power supply network design and analysis, design modeling, and much more. Save on the complete set.
Conventional Transistors and Beyond Springer Science & Business Media
This book deals with some emerging semiconductor devices and their applications in terms of electronic circuits. The basic concept plays a key role in development of any new electronic devices and circuits. The implementation of complex integrated circuits becomes easier with understanding of basic concepts of solid-state devices and its circuit behaviour. The book covers the latest trends in development of advanced electronic devices and applications for undergraduate, graduate and post graduate level courses. It combines the right blend of theory and practice to present a simplified and methodical way to develop researchers' understanding of the clarity between theoretical, practical and simulated results in the analysis of solid-state devices, circuit characteristics and other important issues based on their applications. The book also covers the broad applications of electronic devices in biomedical and low power portable smart IOT systems. This book is well organized into 13 chapters. Chapters 1 to 4 cover design of low power FET devices compatible to technology scaling trends meeting required performance enhancement in terms of power, delay and speed. Chapter 5 and 6 are focused on analogue application of CMOS technology. Chapter 7 describes power MOSFET design with advance materials for lowest possible on-resistance resulting into enhance performance. Chapter 8 deals with biomedical application of advance electronic devices introducing new materials and structure. Chapter 9 introduces a neuromorphic model and real-time simulation for the study of biological neuron model in the human body on circuit level. Chapter 10 and 11 presents the applications of sensors growing over a wide range of sensing targets along with advance sensing technology for human-computer interaction. Chapter 12 and 13 describe optoelectronic devices like photodetectors, optical sensors and solar cells etc.
Advanced Compact Modeling of MOSFETs Springer Science & Business Media
This book provides readers with an overview of the design, fabrication, simulation, and reliability of nanoscale semiconductor devices, MEMS, and sensors, as they serve for realizing the next-generation internet of things. The authors focus on how the nanoscale structures interact with the electrical and/or optical performance, how to find optimal solutions to achieve the best outcome, how these apparatus can be designed via models and simulations, how to improve reliability, and what are the possible challenges and roadblocks moving forward.
Materials, Processing, and Devices CRC Press
The editors and authors present a wealth of knowledge regarding the most relevant aspects in the field of MOS transistor modeling. The variety of subjects and the high quality of content of this volume make it a reference document for researchers and users of MOSFET devices and models. The book can be recommended to everyone who is involved in compact model developments, numerical TCAD modeling, parameter extraction, space-level simulation or model standardization. The book will appeal equally to PhD students who want to understand the ins and outs of MOSFETs as well as to modeling designers working in the analog and high-frequency areas.
Multiscale Modelling of Advanced Materials John Wiley & Sons
This book presents the art of advanced MOSFET modeling for integrated circuit simulation and design. It provides the essential mathematical and physical analyses of all the electrical, mechanical and thermal effects in MOS transistors relevant to the operation of integrated circuits. Particular emphasis is placed on how the BSIM model evolved into the first ever industry standard SPICE MOSFET model for circuit simulation and CMOS technology development. The discussion covers the theory and methodology of how a MOSFET model, or semiconductor device models in general, can be implemented to be robust and efficient, turning device physics theory into a production-worthy SPICE simulation model. Special attention is paid to MOSFET characterization and model parameter extraction methodologies, making the book particularly useful for those interested or already engaged in work in the areas of semiconductor devices, compact modeling for SPICE simulation, and integrated circuit design.
Surface-Potential Model Hisim Springer Science & Business Media
This book is the first to explain FinFET modeling for IC simulation and the industry standard – BSIM-CMG - describing the rush in demand for advancing the technology from planar to 3D architecture, as now enabled by the approved industry standard. The book gives a strong foundation on the physics and operation of FinFET, details aspects of the BSIM-CMG model such as surface potential, charge and current calculations, and includes a dedicated chapter on parameter extraction procedures, providing a step-by-step approach for the efficient extraction of model parameters. With this book you will learn: Why you should use FinFET The physics and operation of FinFET Details of the FinFET standard model (BSIM-CMG) Parameter extraction in BSIM-CMG FinFET circuit design and simulation Authored by the lead inventor and developer of FinFET, and developers of the BSIM-CM standard model, providing an experts' insight into the specifications of the standard The first book on the industry-standard FinFET model - BSIM-CMG
Process Variations and Probabilistic Integrated Circuit Design Springer Science & Business Media
The essentials of analog circuit design with a unique all-region MOSFET modeling approach.
Principles, Techniques and Applications Springer Science & Business Media
This volume provides a timely description of the latest compact MOS transistor models for circuit simulation. The first generation BSIM3 and BSIM4 models that have dominated circuit simulation in the last decade are no longer capable of characterizing all the important features of modern sub-100nm MOS transistors. This book discusses the second generation MOS transistor models that are now in urgent demand and being brought into the initial phase of manufacturing applications. It considers how the models are to include the complete drift-diffusion theory using the surface potential variable in the MOS transistor channel in order to give one characterization equation.
Advanced Nanoelectronics CRC Press
The primary aim of this book is to discuss various aspects of nanoscale device design and their applications including transport mechanism, modeling, and circuit applications. . Provides a platform for modeling and analysis of state-of-the-art devices in nanoscale regime, reviews issues related to optimizing the sub-nanometer device performance and addresses simulation aspect and/or fabrication process of devices Also, includes design problems at the end of each chapter
Intelligent Nanomaterials Springer Science & Business Media
Compact Models for Integrated Circuit Design: Conventional Transistors and Beyond provides a modern treatise on compact models for circuit computer-aided design (CAD). Written by an author with more than 25 years of industry experience in semiconductor processes, devices, and circuit CAD, and more than 10 years of academic experience in teaching compact modeling courses, this first-of-its-kind book on compact SPICE models for very-large-scale-integrated (VLSI) chip design offers a balanced presentation of compact modeling crucial for addressing current modeling challenges and understanding new models for emerging devices. Starting from basic semiconductor physics and covering state-of-the-art device regimes from conventional micron to nanometer, this text: Presents industry standard models for bipolar-junction transistors (BJTs), metal-oxide-semiconductor (MOS) field-effect-transistors (FETs), FinFETs, and tunnel field-effect transistors (TFETs), along with statistical MOS models Discusses the major issue of process variability, which severely impacts device and circuit performance in advanced technologies and requires statistical compact models Promotes further research of the evolution and development of compact models for VLSI circuit design and analysis Supplies fundamental and practical knowledge necessary for efficient integrated circuit (IC) design using nanoscale devices Includes exercise problems at the end of each chapter and extensive references at the end of the book Compact Models for Integrated Circuit Design: Conventional Transistors and Beyond is intended for senior undergraduate and graduate courses in electrical and electronics engineering as well as for researchers and practitioners working in the area of electron devices. However, even those unfamiliar with semiconductor physics gain a solid grasp of compact modeling concepts from this book.
Structured Analog CMOS Design CRC Press
This book facilitates the VLSI-interested individuals with not only in-depth knowledge, but also the broad aspects of it by explaining its applications in different fields, including image processing and biomedical. The deep understanding of basic concepts gives you the power to develop a new application aspect, which is very well taken care of in this book by using simple language in explaining the concepts. In the VLSI world, the importance of hardware description languages cannot be ignored, as the designing of such dense and complex circuits is not possible without them. Both Verilog and VHDL languages are used here for designing. The current needs of high-performance integrated circuits (ICs) including low power devices and new emerging materials, which can play a very important role in achieving new functionalities, are the most interesting part of the book. The testing of VLSI circuits becomes more crucial than the designing of the circuits in this nanometer technology era. The role of fault simulation algorithms is very well explained, and its implementation using Verilog is the key aspect of this book. This book is well organized into 20 chapters. Chapter 1 emphasizes on uses of FPGA on various image processing and biomedical applications. Then, the descriptions enlighten the basic understanding of digital design from the perspective of HDL in Chapters 2–5. The performance enhancement with alternate material or geometry for silicon-based FET designs is focused in Chapters 6 and 7. Chapters 8 and 9 describe the study of bimolecular interactions with biosensing FETs. Chapters 10–13 deal with advanced FET structures available in various shapes, materials such as nanowire, HFET, and their comparison in terms of device performance metrics calculation. Chapters 14–18 describe different application-specific VLSI design techniques and challenges for analog and digital circuit designs. Chapter 19 explains the VLSI testability issues with the description of simulation and its categorization into logic and fault simulation for test pattern generation using Verilog HDL. Chapter 20 deals with a secured VLSI design with hardware obfuscation by hiding the IC's structure and function, which makes it much more difficult to reverse engineer.
Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology Springer Science & Business Media
Uncertainty in key parameters within a chip and between different chips in the deep sub micron area plays a more and more important role. As a

result, manufacturing process spreads need to be considered during the design process. Quantitative methodology is needed to ensure faultless functionality, despite existing process variations within given bounds, during product development. This book presents the technological, physical, and mathematical fundamentals for a design paradigm shift, from a deterministic process to a probability-orientated design process for microelectronic circuits. Readers will learn to evaluate the different sources of variations in the design flow in order to establish different design variants, while applying appropriate methods and tools to evaluate and optimize their design.

CRC Press

This book consists of four chapters to address at different modeling levels for different nanoscale MOS structures (Single- and Multi-Gate MOSFETs). The collection of these chapters in the book are attempted to provide a comprehensive coverage on the different levels of electrostatics and transport modeling for these devices, and relationships between them. In particular, the issue of quantum transport approaches, analytical predictive 2D/3D modeling and design-oriented compact modeling. It should be of interests to researchers working on modeling at any level, to provide them with a clear explanation of theapproaches used and the links with modeling techniques for either higher or lower levels. Contents:Monte-Carlo Simulation of Ultra-Thin Film Silicon-on-Insulator MOSFETs (F Gámiz, C Sampedro, L Donetti and A Godoy)Analytical Models and Electrical Characterisation of Advanced MOSFETs in the Quasi-Ballistic Regime (R Clerc and G Ghibaudo)Physics Based Analytical Modeling of Nanoscale Multigate MOSFETs (T A Fjeldly and U Monga)Compact Modeling of Double and Tri-Gate MOSFETs (B Iñiguez, R Ritzenthaler and F Lime) Readership: Scientists, engineers, research leaders, and even investors interested in microelectronics, nanoelectronics, and optoelectronics. It is also recommended to graduate students working in these fields. Key Features:This book is part of the Selected Topics in Electronics and Systems edited by Sorin Cristoloveanu (Grenoble INP – Minatec, France) and Michael Shur (Rensselaer Polytechnic Institute, USA)Nanoscale Electron Devices started with a big bang but over the years there are still many challenges unsolved which prevent it from becoming mainstream. This book reignites the interests on research works on different modeling levels for nanoscale semiconductor devices, in particular different nanoscale MOS structures (Single- and Multi-Gate MOSFETs)The book is well written, and targeting at graduate students, faculty and researchers working in MOSFETsKeywords:Workshops on Frontiers in Electronics â WOFE;Carbon Nanotubes;Microelectronics;Nanoelectronics;MOSFETs

Strain-Induced Effects in Advanced MOSFETs Springer

This book provides a comprehensive reference for everything that has to do with digital circuits. The author focuses equally on all levels of abstraction. He tells a bottom-up story from the physics level to the finished product level. The aim is to provide a full account of the experience of designing, fabricating, understanding, and testing a microchip. The content is structured to be very accessible and self-contained, allowing readers with diverse backgrounds to read as much or as little of the book as needed. Beyond a basic foundation of mathematics and physics, the book makes no assumptions about prior knowledge. This allows someone new to the field to read the book from the beginning. It also means that someone using the book as a reference will be able to answer their questions without referring to any external sources.

Mixed Analog-digital VLSI Devices and Technology The Electrochemical Society

Modern, large-scale analog integrated circuits (ICs) are essentially composed of metal-oxide semiconductor (MOS) transistors and their interconnections. As technology scales down to deep sub-micron dimensions and supply voltage decreases to reduce power consumption, these complex analog circuits are even more dependent on the exact behavior of each transistor. High-performance analog circuit design requires a very detailed model of the transistor, describing accurately its static and dynamic behaviors, its noise and matching limitations and its temperature variations. The charge-based EKV (Enz-Krummenacher-Vittoz) MOS transistor model for IC design has been developed to provide a clear understanding of the device properties, without the use of complicated equations. All the static, dynamic, noise, non-quasi-static models are completely described in terms of the inversion charge at the source and at the drain taking advantage of the symmetry of the device. Thanks to its hierarchical structure, the model offers several coherent description levels, from basic hand calculation equations to complete computer simulation model. It is also compact, with a minimum number of process-dependant device parameters. Written by its developers, this book provides a comprehensive treatment of the EKV charge-based model of the MOS transistor for the design and simulation of low-power analog and RF ICs. Clearly split into three parts, the authors systematically examine: the basic long-channel intrinsic charge-based model, including all the fundamental aspects of the EKV MOST model such as the basic large-signal static model, the noise model, and a discussion of temperature effects and matching properties; the extended charge-based model, presenting important information for understanding the operation of deep-submicron devices; the high-frequency model, setting out a complete MOS transistor model required for designing RF CMOS integrated circuits. Practising engineers and circuit designers in the semiconductor device and electronics systems industry will find this book a valuable guide to the modelling of MOS transistors for integrated circuits. It is also a useful reference for advanced students in electrical and computer engineering.

Advanced Silicon & Semiconducting Silicon-Alloy Based Materials & Devices World Scientific

Mosfet Modeling for Circuit Analysis and DesignStrain-Induced Effects in Advanced MOSFETsSpringer Science & Business Media

The EKV Model for Low-Power and RF IC Design World Scientific

From the reviews: "... this is a well produced book, written in a easy to read style, and will also be a very useful primer for someone starting out the field [...], and a useful source of reference for experienced users ..." Microelectronics Journal

CMOS Analog Design Using All-Region MOSFET Modeling Springer Nature

Improve your circuit-design potential with this expert guide to the devices and technology used in mixed analog-digital VLSI chips for such high-volume applications as hard-disk drives, wireless telephones, and consumer electronics. The book provides you with a critical understanding of device models, fabrication technology, and layout as they apply to mixed analog-digital circuits.You will learn about the many device-modeling requirements for analog work, as well as the pitfalls in models used today for computer simulators such as Spice. Also included is information on fabrication technologies developed specifically for mixed-signal VLSI chips, plus guidance on the layout of mixed analog-digital chips for a high degree of analog-device matching and minimum digital-to-analog interference.This reference book features an intuitive introduction to MOSFET operation that will enable you to view with insight any MOSFET model ? besides thorough discussions on valuable large-signal and small-signal models.Filled with practical information, this first-of-its-kind book will help you grasp the nuances of mixed-signal VLSI-device models and layout that are crucial to the design of high-performance chips.

Outlook and Challenges of Nano Devices, Sensors, and MEMS Springer Science & Business Media

This hands-on guide contains a fresh approach to efficient and insight-driven integrated circuit design in nanoscale-CMOS. With downloadable MATLAB code and over forty detailed worked examples, this is essential reading for professional engineers, researchers, and graduate students in analog circuit design.

Transistor Level Modeling for Analog/RF IC Design CRC Press

Strain is used to boost performance of MOSFETs. Modeling of strain effects on transport is an important task of modern simulation tools required for device design. The book covers all relevant modeling approaches used to describe strain in silicon. The subband structure in stressed semiconductor films is investigated in devices using analytical k.p and numerical pseudopotential methods. A rigorous overview of transport modeling in strained devices is given.