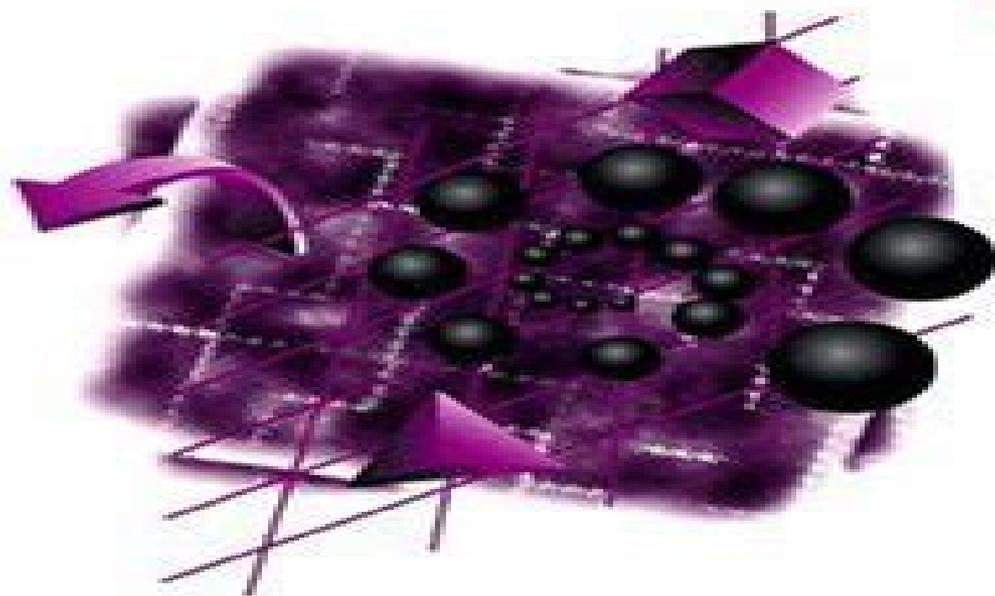


MOSFET MODELING WITH SPICE



Principles

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and

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Practice

Daniel Foty

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Christopher A. Freymuth



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MOSFET Modeling with SPICE Daniel Foty,1997 This book will help CMOS circuit designers make the best possible use of SPICE models and will prepare them for new models that may soon be introduced Introduces SPICE modeling and its use in CMOS circuit design Presents the formalism of model building and the semiconductor physics of MOS structures Covers each important SPICE model showing how to choose the appropriate model Discusses the popular HSPICE Level 28 as well as Levels 1 3 BSIM 1 3 and MOS Model 9 Presents techniques for accounting for systematic process variations Describes new model candidates including the Power Lane Model the PCIM Model and the EKV Model Includes extensive examples throughout Practicing engineers and scientists in the semiconductor industry engineering faculty and students *Device Modeling for Analog and RF CMOS Circuit Design* Trond Ytterdal, Yuhua Cheng, Tor A. Fjeldly, 2003-08-01 Bridges the gap between device modelling and analog circuit design Includes dedicated software enabling actual circuit design Covers the three significant models BSIM3 Model 9 and EKV Presents practical guidance on device development and circuit implementation The authors offer a combination of extensive academic and industrial experience Mosfet Modeling for VLSI Simulation Narain Arora, 2007 **MOSFET Models for VLSI Circuit Simulation** Narain D. Arora, 2012-12-06 Metal Oxide Semiconductor MOS transistors are the basic building block of MOS integrated circuits I C Very Large Scale Integrated VLSI circuits using MOS technology have emerged as the dominant technology in the semiconductor industry Over the past decade the complexity of MOS IC s has increased at an astonishing rate This is realized mainly through the reduction of MOS transistor dimensions in addition to the improvements in processing Today VLSI circuits with over 3 million transistors on a chip with effective or electrical channel lengths of 0.5 microns are in volume production Designing such complex chips is virtually impossible without simulation tools which help to predict circuit behavior before actual circuits are fabricated However the utility of simulators as a tool for the design and analysis of circuits depends on the adequacy of the device models used in the simulator This problem is further aggravated by the technology trend towards smaller and smaller device dimensions which increases the complexity of the models There is extensive literature available on modeling these short channel devices However there is a lot of confusion too Often it is not clear what model to use and which model parameter values are important and how to determine them After working over 15 years in the field of semiconductor device modeling I have felt the need for a book which can fill the gap between the theory and the practice of MOS transistor modeling This book is an attempt in that direction **MOSFET Models for VLSI Circuit Simulation** Narain Arora, 1993-01-01 The book has 12 chapters Starting from the overview of various aspects of device modeling for circuit simulators a brief but complete review of semiconductor device physics and pn junction theory required for understanding MOSFET models is covered The MOS transistor characteristics as applied to current MOS technologies are then discussed First the theory of MOS capacitors that is essential for understanding of MOS transistor models are discussed This is followed by different types of MOSFET

models such as threshold voltage DC steady state AC and reliability models and the corresponding model parameter determination The diode and MOSFET models as implemented in Berkeley SPICE are also covered Finally the statistical variation of model parameters due to process variations are discussed BSIM4 and MOSFET Modeling for IC Simulation Weidong Liu,Chenming Hu,2011 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 *MOSFET Modeling & BSIM3 User's Guide* Yuhua Cheng,Chenming Hu,2007-05-08 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 *Mosfet Modeling For Circuit Analysis And Design* Carlos Galup-montoro,Marcio Cherem Schneider,2007-02-27 This is the first book dedicated to the next generation of MOSFET models Addressed to circuit designers with an in depth treatment that

appeals to device specialists the book presents a fresh view of compact modeling having completely abandoned the regional modeling approach Both an overview of the basic physics theory required to build compact MOSFET models and a unified treatment of inversion charge and surface potential models are provided The needs of digital analog and RF designers as regards the availability of simple equations for circuit designs are taken into account Compact expressions for hand analysis or for automatic synthesis valid in all operating regions are presented throughout the book All the main expressions for computer simulation used in the new generation compact models are derived Since designers in advanced technologies are increasingly concerned with fluctuations the modeling of fluctuations is strongly emphasized A unified approach for both space matching and time noise fluctuations is introduced

MOSFET Models for SPICE Simulation William Liu,2001-02-21
An expert guide to understanding and making optimum use of BSIM Used by more chip designers worldwide than any other comparable model the Berkeley Short Channel IGFET Model BSIM has over the past few years established itself as the de facto standard MOSFET SPICE model for circuit simulation and CMOS technology development Yet until now there have been no independent expert guides or tutorials to supplement the various BSIM manuals currently available Written by a noted expert in the field this book fills that gap in the literature by providing a comprehensive guide to understanding and making optimal use of BSIM3 and BSIM4 Drawing upon his extensive experience designing with BSIM William Liu provides a brief history of the model discusses the various advantages of BSIM over other models and explores the reasons why BSIM3 has been adopted by the majority of circuit manufacturers He then provides engineers with the detailed practical information and guidance they need to master all of BSIM s features He Summarizes key BSIM3 components Represents the BSIM3 model with equivalent circuits for various operating conditions Provides a comprehensive glossary of modeling terminology Lists alphabetically BSIM3 parameters along with their meanings and relevant equations Explores BSIM3 s flaws and provides improvement suggestions Describes all of BSIM4 s improvements and new features Provides useful SPICE files which are available online at the Wiley ftp site

High Frequency MOSFET Modeling for Circuit Simulation Suet Fong Tin,1998

Physics And Modeling Of Mosfets, The: Surface-potential Model Hisim Tatsuya Ezaki,Hans Jurgen Mattausch,Mitiko Miura-mattausch,2008-06-03 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

Power MOSFET Model for SPICE Hsian-Pei Yee,1988

The Physics and Modeling of Mosfets Mitiko Miura-Mattausch,2008
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

FET Modeling for Circuit Simulation Dileep A.

Divekar,2012-12-06 Circuit simulation is widely used for the design of circuits both discrete and integrated Device modeling is an important aspect of circuit simulation since it is the link between the physical device and the simulated device Currently available circuit simulation programs provide a variety of built in models Many circuit designers use these built in models whereas some incorporate new models in the circuit simulation programs Understanding device modeling with particular emphasis on circuit simulation will be helpful in utilizing the built in models more efficiently as well as in implementing new models SPICE is used as a vehicle since it is the most widely used circuit simulation program However some issues are addressed which are not directly applicable to SPICE but are applicable to circuit simulation in general These discussions are useful for modifying SPICE and for understanding other simulation programs The generic version 2G 6 is used as a reference for SPICE although numerous different versions exist with different modifications This book describes field effect transistor models commonly used in a variety of circuit simulation programs Understanding of the basic device physics and some familiarity with device modeling is assumed Derivation of the model equations is not included SPICE is a circuit simulation program available from EECS Industrial Support Office 461 Cory Hall University of California Berkeley CA 94720 Acknowledgements I wish to express my gratitude to Valid Logic Systems Inc *A Study of Spice Parameter Extraction for MOSFET Modeling with Emphasis on Small Geometry Effects in MOSFETS* Christopher Anthony Freymuth,1985

Compact MOSFET Models for VLSI Design A. B. Bhattacharyya,2009-04-13 Practicing designers students and educators in the semiconductor field face an ever expanding portfolio of MOSFET models In Compact MOSFET Models for VLSI Design A B Bhattacharyya presents a unified perspective on the topic allowing the practitioner to view and interpret device phenomena concurrently using different modeling strategies Readers will learn to link device physics with model parameters helping to close the gap between device understanding and its use for optimal circuit performance Bhattacharyya also lays bare the core physical concepts that will drive the future of VLSI development allowing readers to stay ahead of the curve despite the relentless evolution of new models Adopts a unified approach to guide students through the confusing array of MOSFET models Links MOS physics to device models to prepare practitioners for real world design activities Helps fabless designers bridge the gap with off site foundries Features rich coverage of quantum mechanical related phenomena Si Ge strained Silicon substrate non classical structures such as Double Gate MOSFETs Presents topics that will prepare readers for long term developments in the field Includes solutions in every chapter Can be tailored for use among students

and professionals of many levels Comes with MATLAB code downloads for independent practice and advanced study This book is essential for students specializing in VLSI Design and indispensable for design professionals in the microelectronics and VLSI industries Written to serve a number of experience levels it can be used either as a course textbook or practitioner's reference Access the MATLAB code solution manual and lecture materials at the companion website www.wiley.com/go/bhattacharyya SPICE Parameter Extraction for MOSFET Modeling in Analog Circuit Design Wen Lu,1998 **Fet Modeling for Circuit Simulation** Dileep A Divekar,1988-03-31 **~Ae study of spice parameter extraction for MOSFET modeling with emphasis on small geometry effects in MOSFETS** Christopher A. Freymuth,1987

Technology Computer Aided Design Chandan Kumar Sarkar,2018-09-03 Responding to recent developments and a growing VLSI circuit manufacturing market Technology Computer Aided Design Simulation for VLSI MOSFET examines advanced MOSFET processes and devices through TCAD numerical simulations The book provides a balanced summary of TCAD and MOSFET basic concepts equations physics and new technologies related to TCAD and MOSFET A firm grasp of these concepts allows for the design of better models thus streamlining the design process saving time and money This book places emphasis on the importance of modeling and simulations of VLSI MOS transistors and TCAD software Providing background concepts involved in the TCAD simulation of MOSFET devices it presents concepts in a simplified manner frequently using comparisons to everyday life experiences The book then explains concepts in depth with required mathematics and program code This book also details the classical semiconductor physics for understanding the principle of operations for VLSI MOS transistors illustrates recent developments in the area of MOSFET and other electronic devices and analyzes the evolution of the role of modeling and simulation of MOSFET It also provides exposure to the two most commercially popular TCAD simulation tools Silvaco and Sentaurus Emphasizes the need for TCAD simulation to be included within VLSI design flow for nano scale integrated circuits Introduces the advantages of TCAD simulations for device and process technology characterization Presents the fundamental physics and mathematics incorporated in the TCAD tools Includes popular commercial TCAD simulation tools Silvaco and Sentaurus Provides characterization of performances of VLSI MOSFETs through TCAD tools Offers familiarization to compact modeling for VLSI circuit simulation R D cost and time for electronic product development is drastically reduced by taking advantage of TCAD tools making it indispensable for modern VLSI device technologies They provide a means to characterize the MOS transistors and improve the VLSI circuit simulation procedure The comprehensive information and systematic approach to design characterization fabrication and computation of VLSI MOS transistor through TCAD tools presented in this book provides a thorough foundation for the development of models that simplify the design verification process and make it cost effective

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