

Workshop on Compact Modeling
The 5th International Conference on Modeling and Simulation of Microsystems

(San Juan, Puerto Rico, USA. April 23-25, 2002)

As the mainstream MOS technology is scaled into the very-deep-submicron (VDSM) era, development of a truly physical and predictive MOSFET compact model (CM) for circuit simulation that covers geometry, bias, temperature, DC, AC, RF, and noise characteristics becomes a major challenge. There exist a large number of CM development efforts that address the new challenges in theoretical models as well as industrial applications. It would be beneficial to bring together researchers and CM developers to share their ideas and insights on the current needs and future trends in CM development in the context of VDSM technology and circuit as well as system-on-chip (SOC) design.

Workshop on Compact Modeling (WCM) is one of the first of its kind in bringing people in the CM field together. The objective is to create a truly open forum for discussion among experts in the field as well as feedback from technology developers and circuit designers. It consists of a 2-day *Invited-Speaker Session*, an *Evening Panel Session*, and a *Tutorial Session*. Regular papers are also solicited to follow the above sessions in the *Contributed-Paper Session*. The topics are centered at bulk-Si and SOI MOSFET compact models for circuit simulation to address the following issues:

- Physics-based I-V model formulations
- Scalable AC/RF/noise models
- Predictive models with process correlation
- Statistical modeling with compact models
- Compact model with higher-order (atomic-level) effects
- Parameter extraction
- Global vs local optimization
- Equivalent circuit generation from numerical simulation
- Compact solution from surface-potential-based models
- Benchmark tests and model comparisons
- Compact models for SOI MOSFETs
- Interconnect modeling in CMOS technology
- Role of CM in bridging technology development, TCAD, and circuit design
- Trends and needs in compact models in the VDSM era

Invited-Speaker Session

There are 23 invited speakers from all over the world (10 countries) to present their work and their views on compact modeling. They are listed below:

WCM-1: Tuesday, April 23, 10:30 – 12:00

Session chair: *Xing Zhou, Nanyang Technological University, Singapore*

- Challenges of Modeling VLSI Interconnects in the DSM Era
Narain Arora, Simplex Solutions, USA
- Detailed Comparison of the SP, EKV, and BSIM3 Models
Peter Bendix, LSI Logic, USA
- Standardization and Validation of Compact Models
Britt Brooks, Texas Instruments, USA

WCM-2: Tuesday, April 23, 14:00 – 15:30

Session chair: *Jerry Fossum, University of Florida, USA*

- Advanced Surface-Potential-Based Model (SP)
Gennady Gildenblat, Pennsylvania State University, USA
- Engineering BSIM for the Nano-Technology Era and Beyond
Mansun Chan, Hong Kong University of Science and Technology, Hong Kong
- The Foundations of the EKV MOS Transistor Charge-Based Model
Christian Enz, Swiss Center for Electronics and Microtechnology, Switzerland

WCM-3: Tuesday, April 23, 16:00 – 18:00

Session chair: *Serge Luryi, State University of New York at Stony Brook, USA*

- The EKV Compact MOS Transistor Model Version 3: Accounting for Deep-Submicron Aspects
Matthias Bucher, National Technical University of Athens, Greece
- RF Applications of MOS Model 11
Dirk Klaassen, Philips Research Laboratories, The Netherlands
- HiSIM: Self-Consistent Surface-Potential MOS-Model Valid Down to Sub-100nm Technologies
Mitiko Miura-Mattausch, Hiroshima University, Japan
- Starting Over: g_{ms}/I_d -based MOSFET Modeling as a Basis for Modernized Analog Design Methodologies
Daniel Foty, Gilgamesh Associates, USA

WCM-4: Wednesday, April 24, 8:30 – 10:00

Session chair: *Narain Arora, Simplex Solutions, USA*

- A Unified Process-Based Compact Model for Scaled PD/SOI and Bulk-Si MOSFETs
Jerry Fossum, University of Florida, USA
- Measurements and Modeling of Mobility in Ultra-Thin SOI
Marco Mastrapasqua, Agere Systems, USA
- RF MOS Noise Parameter Extraction and Modeling
Jamal Deen, McMaster University, Canada

WCM-5: Wednesday, April 24, 10:30 – 12:00

Session chair: *Christian Enz, CSEM SA, Switzerland*

- RF CMOS Modeling and Parameter Extraction Approaches Taking Charge Conservation into Account
Kwyro Lee, Korea Advanced Institute of Science and Technology, Korea
- Automatic Generation of RF Compact Models from Device Simulation
Serge Luryi and Andrea Pacelli, State University of New York at Stony Brook, USA
Part I: Motivation and methodology (by *Serge Luryi*)
Part II: Implementation and applications (by *Andrea Pacelli*)

WCM-6: Wednesday, April 24, 14:00 – 15:30

Session chair: *Jamal Deen, McMaster University, Canada*

- Xsim: A Compact Model for Bridging Technology Developers and Circuit Designers
Xing Zhou, Nanyang Technological University, Singapore
- Unified Statistical Modeling for Circuit Simulation
Colin McAndrew, Motorola, USA
- The Role of TCAD in Compact Modeling
Michael Duane, Applied Materials, USA

WCM-7: Wednesday, April 24, 15:40 – 17:40

Session chair: Dirk Klaassen, Philips Research Laboratories, The Netherlands

- Interconnect Modeling for High Speed Digital Circuits - the Role of RLC Coupling
Roberto Suaya, Mentor Graphics, France
- How to Build an SOI MOSFET Compact Model without Violating the Laws of Physics
Josef Watts, IBM, USA
- Simulation Study of Non-Quasi Static Behaviour of MOS Transistors (contributed)
D. V. Kumar, M. B. Patil, and V. R. Rao, Indian Institute of Technology - Bombay, India

WCM-8: Thursday, April 25, 9:30 – 11:00

Session chair: Albert Kordesch, Silterra Malaysia

- Present Status and Future Direction of BSIM SOI Model for High-Performance/Low-Power/RF Application
Samuel Fung, IBM, USA
- A New Analytical Model of Channel Hot Electron (CHE) and Channel Initiated Secondary Electron (CHISEL) Current Suitable for Compact Modeling (contributed)
L. Larcher and P. Pavan, Università di Modena e Reggio Emilia, Italy
- Compact Model for Manufacturing Design and Fluctuation Study (contributed)
K. Y. Lim and X. Zhou, Chartered Semiconductor Manufacturing Ltd., Singapore
- Physically-Based Approach to Deep-Submicron MOSFET Compact Model Parameter Extraction (contributed)
S. B. Chiah, X. Zhou, K. Y. Lim, A. See, and L. Chan, Nanyang Technological University, Singapore

Evening Panel Session on Trends and Needs in Compact Models in the SOC Era

An evening panel discussion on the general topics of compact modeling is organized. The topic is on the trends and needs of compact models from the perspectives of the model developers, device physicists, technology developers, CAD vendors, and circuit designers.

Date/Time: Tuesday, April 23, 19:00 – 21:00

Moderator: Narain Arora, Simplex Solutions, USA

Panelists:

- Peter Bendix, LSI Logic, USA
- Britt Brooks, Texas Instruments, USA
- Mansun Chan, Hong Kong University of Science and Technology, Hong Kong
- Christian Enz, Swiss Center for Electronics and Microtechnology, Switzerland
- Daniel Foty, Gilgamesh Associates, USA
- Gennady Gildenblat, Pennsylvania State University, USA
- Dirk Klaassen, Philips Research Laboratories, The Netherlands
- Mitiko Miura-Mattausch, Hiroshima University, Japan

Agenda

A) 19:00 – 19:45:

5-min presentation for each panelist for the individual personal views on the topic: “Trends and Needs in Compact Models in the SOC Era”

B) 19:45 – 20:30:

Panel discussion on the selected 8 topics (average ~10min/topic). Panelists are to provide their views on the pros and cons, supporting or opposing arguments for the following topic categories:

1. Compact model standardization vs. diversity
2. Compact model quality: definitions and priorities
3. Compact model applications in circuit design and technology development
4. Compact model parameter extraction vs. optimization
5. Compact model predictability and scalability
6. Compact model accuracy and efficiency tradeoff
7. RF/parasitic/interconnect models vs. intrinsic transistor compact models
8. Physically based vs. largely empirical compact models

C) 20:30 – 21:00:

Q/A session for the audience

Tutorial Session

Five tutorials are offered by the invitees on special topics, which are arranged in series with the Invited-Speaker Session for the general audience. Details about the tutorials will be available at the MSM2002 website.

Thursday, April 25, 11:00 – 18:15

- Model Equations of the Self-Consistent Surface-Potential MOS-Model HiSIM
Mitiko Miura-Mattausch, Hiroshima University, Japan
- Submicron Circuit Design with BSIM3/4
Mansun Chan, Hong Kong University of Science and Technology, Hong Kong
- MOS Transistor Modeling for RF IC Design
Christian Enz, Swiss Center for Electronics and Microtechnology, Switzerland
- MOS Modeling, Design Quality, and Modern Analog Design
Daniel Foty, Gilgamesh Associates, USA
- An Introduction to MOS Model 11
Dirk Klaassen, Philips Research Laboratories, The Netherlands

Websites:

<http://www.cr.org/MSM2002/program/index.html#WCM>

<http://www.cr.org/publications/MSM2002/toc.html#13>

<http://nsti.org/procs/MSM2002/13>