

Preface

Circuit design based on numerical simulation relies heavily on mathematical methods. As a result, relations have long since been established between the microelectronics industry and university groups specializing in simulations for semiconductor processes and devices, electromagnetics and electronic circuits. State-of-the-art methods from the fields of applied and numerical analysis, as well as newly developed dedicated algorithms, have facilitated the large-scale use of simulations, thereby enabling the industry to reach its current high state of the art.

Designing complex integrated circuits calls for adequate simulation and optimization tools. The current design approach involves simulations and optimizations in different physical domains (device, circuit, thermal, electromagnetic) and in electrical engineering disciplines (logic, timing, power, crosstalk, signal integrity, system functionality). The physical aspects are essential to characterizing circuit behavior from an electrical engineering and system-oriented standpoint.

Accordingly, the main scientific objectives of the COMSON (COupled Multi-scale Simulation and Optimization in Nanoelectronics) project were as follows:

- To develop new descriptive models that take these mutual dependencies into account
- To combine these models with existing circuit descriptions in new simulation strategies
- To develop new optimization techniques that will accommodate new designs

COMSON was a Marie Curie Research Training Network supported by the European Commission in the programme Structuring the European Research Area, part of the EU's Sixth Framework Research Programme. The project was initiated by the three major European semiconductor companies – Infineon Technologies AG, later replaced by its spin-off Qimonda AG of Neubiberg, Germany; Koninklijke Philips N.V., later replaced by its spin-off NXP Semiconductors Netherlands N.V. of Eindhoven, the Netherlands; and STMicroelectronics of Catania, Italy – who worked in cooperation with five European academic partners in Applied Mathematics and Electrical Engineering with considerable experience in the simulation and optimization of integrated circuits – the University of Wuppertal, Germany

(coordinator); Eindhoven University of Technology, the Netherlands; University of Catania, Italy; University of Calabria, Italy; and University Politehnica of Bucharest, Romania. The rationale behind the project and this book was described as follows:

Performing the step from micro- to nanoelectronics, the semiconductor industry is confronted with very high levels of integration, introducing coupling effects that were not observed before. Currently, the complexity of this problem is beyond the capabilities of any industrial software and design environment. Furthermore, in the near future, researchers must understand all aspects of the problems faced by industry.

To meet these new scientific and training challenges, the COMSON project on “COupled Multiscale Simulation and Optimization in Nanoelectronics” merges the know-how of the three major European semiconductor companies with the combined expertise of university groups specialized in developing adequate mathematical models, numerical schemes, and e-learning facilities, covering all relevant fields of interest. In COMSON, academia and industry join their efforts to realize a common Demonstrator Platform: on the one hand, to test mathematical methods and approaches, so as to assess whether they are capable of addressing the industry’s problems; on the other hand, to adequately educate young researchers by providing hands-on experience with state-of-the-art problems, and beyond.

The editor thanks his colleagues for their valued contributions in the different chapters of this handbook: Roland Pulch of Greifswald, Germany (PDAE modelling); Andreas Bartel of Wuppertal, Germany, and Sebastian Schöps of Darmstadt, Germany (dynamic iteration); E.J.W. ter Maten of Eindhoven, the Netherlands (MOR); Salvatore Rinaudo of Catania, Italy (optimization); Georg Denk of Munich, Germany (demonstrator platform); and Giuseppe Ali of Cosenza, Italy (e-learning).

Wuppertal, Germany
September 2014

Michael Günther

Coupled Multiscale Simulation and Optimization in
Nanoelectronics

Günther, M. (Ed.)

2015, XVII, 565 p. 201 illus., 80 illus. in color.,

Hardcover

ISBN: 978-3-662-46671-1