

# Preface

This book in the *Lecture Notes in Electrical Engineering* (LNEE) series presents the most innovative contributions to the Forum on specification and Design Languages (FDL) 2013, which took place in September 2013 at the Université Pierre et Marie Curie (UPMC), Paris, France. These contributions were selected by leading experts from research and industry. Their authors improved the originally presented work based on the feedback received during the conference and recent results.

The increasing integration and complexity of electronic system design requires a constant evolution of the used languages and associated design methods and tools. The FDL is a well-established international forum devoted to the dissemination of research results, practical experiences, and new ideas in this domain. Addressed are in particular the application of specification, design, and verification languages to the modeling, design, and verification of integrated circuits, complex hardware/software embedded systems, and mixed-technology systems. The thus made possible new modeling and specification concepts push the development of new design and verification methodologies to the system level thus providing means for model-driven design of complex information processing systems in a variety of application domains.

This book presents the newest results in five thematic areas:

Part I “Applications of Formal Methods for Specification and Verification”:

The efficient design space exploration and system verification calls for the use of formal methods to raise the confidence in the taken design decisions and thus accelerate the time to market. Chapter 1 tackles energy component selection and proposes a heuristic algorithm to solve this NP-hard problem. Chapter 2 presents a refinement-based design approach for Systems-on-Chip, supported by model checking technology.

Part II “Embedded Analog and Mixed-Signal System Verification”: Tackling this task with classic approaches based on SPICE simulation and visual waveform

inspection has reached its limits with today's more and more complex AMS systems. While waiting for a much anticipated revolution in this field, assertion-based approaches are very promising. Two are presented in Chaps. 3 and 4.

Part III “Embedded Analog and Mixed-Signal System Design”: Efficient modeling and simulation approaches for analog and mixed-signal systems are at the heart of the design process. Chapter 5 proposes a model to describe the nonlinear behavior of memresistors and presents its implementation in VHDL-AMS. Chapter 6 presents a way to generate homogeneous (SystemC AMS or C++) code for heterogeneous systems by using a formal intermediate representation.

Part IV “Digital Hardware/Software Embedded System Design”: SystemC needs to continuously evolve through core library extensions and new methodology-specific libraries to offer modeling capabilities and simulation performance that keep up with the user needs. Chapter 7 proposes the concept of combining SystemC events with TLM transactions so as to simplify and systematize synchronization in TLM models. Chapter 8 shows how predictable platforms can be characterized to form a basis for virtual prototyping of real-time systems.

Efficient simulation, static analysis, and model transformation are key techniques to enable design validation and design space exploration. Chapter 9 combines simulation with analytical techniques to provide estimates that guide the design space exploration of real-time systems. Chapter 10 introduces model transformations and validation methods that open an automated path from algorithm design to ESL design. Chapter 11 supports software allocation in networked automotive system platforms. Chapter 12 shows a method for switching between models of different abstraction levels and its application to trade-off speed and accuracy in network-on-chip simulation.

Part V “Model-Driven Engineering for Embedded Systems Design”: The increasing complexity of embedded software requires the application of modern software engineering approaches like model-based software development enabled by standard modeling languages and associated tools. Chapter 13 presents the use of MARTE and its real-time modes specification for the development of cross-layer self-adaptive real-time embedded systems. Chapter 14 investigates the difficult task of design space exploration for the allocation of UML composite structures in the modeling of distributed systems. Chapter 15 explores the use of MARTE on an autonomous robot use case for the application of MAST schedulability analysis tools for model-based performance analysis.

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