

SystemC Kernel Extensions for Heterogeneous System Modeling

A Framework for Multi-MoC Modeling & Simulation

By
Hiren D. Patel and Sandeep K. Shukla

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Hiren Patel, Sandeep Kumar Shukla



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SystemC Kernel Extensions for Heterogeneous System Modeling Hiren Patel, Sandeep Kumar Shukla, 2006-01-16

SystemC Kernel Extensions for Heterogeneous System Modeling is a result of an almost two year endeavour on our part to understand how SystemC can be made useful for system level modeling at higher levels of abstraction Making it a truly heterogeneous modeling language and platform for hardware software co design as well as complex embedded hardware designs has been our focus in the work reported in this book

SystemC Kernel Extensions for Heterogeneous System Modeling Hiren Patel, Sandeep Kumar Shukla, 2008-11-01 SystemC Kernel Extensions for Heterogeneous System Modeling is a result of an almost two year endeavour on our part to understand how SystemC can be made useful for system level modeling at higher levels of abstraction Making it a truly heterogeneous modeling language and platform for hardware software co design as well as complex embedded hardware designs has been our focus in the work reported in this book

Synthesis of Embedded Software Sandeep Kumar Shukla, Jean-Pierre Talpin, 2010-08-05 Embedded software is ubiquitous today There are millions of lines of embedded code in smart phones and even more in systems responsible for automotive control avionics control weapons control and space missions Some of these are safety critical systems whose correctness timely response and reliability are of paramount importance These requirements pose new challenges to system designers This necessitates that a proper design science based on constructive correctness be developed Correct by construction design and synthesis of embedded software is done in a way so that post development verification is minimized and correct operation of embedded systems is maximized This book presents the state of the art in the design of safety critical embedded software It introduces readers to three major approaches to specification driven embedded software synthesis construction synchronous programming based approaches models of computation based approaches and an approach based on concurrent programming with a co design focused language It is an invaluable reference for practitioners and researchers concerned with improving the product development life cycle

Embedded Systems Specification and Design Languages Eugenio Villar, 2008-05-15 This book is the latest contribution to the Chip Design Languages series and it consists of selected papers presented at the Forum on Specifications and Design Languages FDL 07 in September 2007 The book represents the state of the art in research and practice and it identifies new research directions It highlights the role of specification and modelling languages and presents practical experiences with specification and modelling languages

Model Driven Engineering Languages and Systems Dorina C. Petriu, Nicolas Rouquette, Øystein Haugen, 2010-09-22 The MODELS series of conferences is the premier venue for the exchange of innovative technical ideas and experiences focusing on a very important new technical discipline model driven software and systems engineering The expansion

of this discipline is a direct consequence of the increasing significance and success of model based methods in practice Numerous efforts resulted in the invention of concepts languages and tools for the definition analysis transformation and veri

cation of domain specific modeling languages and general purpose modeling language standards as well as their use for software and systems engineering MODELS 2010 the 13th edition of the conference series took place in Oslo Norway October 3-8 2010 along with numerous satellite workshops symposia and tutorials The conference was fortunate to have three prominent keynote speakers Ole Lehrmann Madsen Aarhus University Denmark Edward A Lee UC Berkeley USA and Pamela Zave AT T Laboratories USA To provide a broader forum for reporting on scientific progress as well as on experience stemming from practical applications of model based methods the 2010 conference accepted submissions in two distinct tracks Foundations and Applications The primary objective of the first track is to present new research results dedicated to advancing the state of the art of the discipline whereas the second aims to provide a realistic and verifiable picture of the current state the practice of model based engineering so that the broader community could be better informed of the capabilities and successes of this relatively young discipline This volume contains the final version of the papers accepted for presentation at the conference from both tracks

Embedded Systems Design Based on Formal Models of Computation Ivan Radojevic, Zoran Salcic, 2011-06-15 Models of Computation for Heterogeneous Embedded Systems presents a model of computation for heterogeneous embedded systems called DFCharts It targets heterogeneous systems by combining finite state machines FSM with synchronous dataflow graphs SDFG FSMs are connected in the same way as in Argos a Statecharts variant with purely synchronous semantics using three operators synchronous parallel refinement and hiding The fourth operator called asynchronous parallel is introduced in DFCharts to connect FSMs with SDFGs In the formal semantics of DFCharts the operation of an SDFG is represented as an FSM Using this representation SDFGs are merged with FSMs so that the behaviour of a complete DFCharts specification can be expressed as a single flat FSM This allows system properties to be verified globally The practical application of DFCharts has been demonstrated by linking it to widely used system level languages Java Esterel and SystemC

Metamodeling-driven IP Reuse for SoC Integration and Microprocessor Design Deepak A. Mathaikutty, Sandeep Shukla, 2009 This cutting edge resource offers you an in depth understanding of metamodeling approaches for the reuse of intellectual properties IPs in the form of reusable design or verification components The book covers the essential issues associated with fast and effective integration of reusable design components into a system on a chip SoC to achieve faster design turn around time Moreover it addresses key factors related to the use of reusable verification IPs for a write once use many times verification strategy another effective approach that can attain a faster product design cycle

Languages for Embedded Systems and their Applications Martin Radetzki, 2009-05-24 Embedded systems take over complex control and data processing tasks in diverse application fields such as automotive avionics consumer products and telecommunications They are the primary driver for improving overall system safety efficiency and comfort The demand for further improvement in these aspects can only be satisfied by designing embedded systems of increasing complexity which in turn necessitates the development of new system design methodologies

based on specification design and verification languages The objective of the book at hand is to provide researchers and designers with an overview of current research trends results and application experiences in computer languages for embedded systems The book builds upon the most relevant contributions to the 2008 conference Forum on Design Languages FDL the premier international conference specializing in this field These contributions have been selected based on the results of reviews provided by leading experts from research and industry In many cases the authors have improved their original work by adding breadth depth or explanation

ESL Models and their Application Brian Bailey, Grant Martin, 2009-12-15 This book arises from experience the authors have gained from years of work as industry practitioners in the field of Electronic System Level design ESL At the heart of all things related to Electronic Design Automation EDA the core issue is one of models what are the models used for what should the models contain and how should they be written and distributed Issues such as interoperability and tool transportability become central factors that may decide which ones are successful and those that cannot get sufficient traction in the industry to survive Through a set of real examples taken from recent industry experience this book will distill the state of the art in terms of System Level Design models and provide practical guidance to readers that can be put into use This book is an invaluable tool that will aid readers in their own designs reduce risk in development projects expand the scope of design projects and improve developmental processes and project planning

Innovations in Embedded and Real-Time Systems Engineering for Communication Virtanen, Seppo, 2012-04-30 This book has collected the latest research within the field of real time systems engineering and will serve as a vital reference compendium for practitioners and academics Provided by publisher

Ingredients for Successful System Level Design Methodology Hiren D. Patel, Sandeep Kumar Shukla, 2008-06-06 ESL or Electronic System Level is a buzz word these days in the electronic design automation EDA industry in design houses and in the academia Even though numerous trade magazine articles have been written quite a few books have been published that have attempted to define ESL it is still not clear what exactly it entails However what seems clear to every one is that the Register Transfer Level RTL languages are not adequate any more to be the design entry point for today's and tomorrow's complex electronic system design There are multiple reasons for such thoughts First the continued progression of the miniaturization of the silicon technology has led to the ability of putting almost a billion transistors on a single chip Second applications are becoming more and more complex and integrated with communication control ubiquitous and pervasive computing and hence the need for ever faster ever more reliable and more robust electronic systems is pushing designers towards a productivity demand that is not sustainable without a fundamental change in the design methodologies Also the hardware and software functionalities are getting interchangeable and ability to model and design both in the same manner is gaining importance Given this context we assume that any methodology that allows us to model an entire electronic system from a system perspective rather than just hardware with discrete event or cycle based semantics is an ESL methodology of some kind

Applications of Specification and Design Languages for SoCs

A. Vachoux,2006-10-06 This book includes a selection of the best contributions to the Forum on Specification and Design Languages held in 2005 FDL 05 It provides detailed insights into recent works dealing with a large spectrum of issues in system on chip design All the chapters have been carefully revised and extended to offer up to date information They also provide seeds for further researches and developments in the field of heterogeneous systems on chip design **Embedded Systems** Kiyofumi Tanaka,2012-03-02 Nowadays embedded systems the computer systems that are embedded in various kinds of devices and play an important role of specific control functions have permitted various aspects of industry Therefore we can hardly discuss our life and society from now onwards without referring to embedded systems For wide ranging embedded systems to continue their growth a number of high quality fundamental and applied researches are indispensable This book contains 19 excellent chapters and addresses a wide spectrum of research topics on embedded systems including basic researches theoretical studies and practical work Embedded systems can be made only after fusing miscellaneous technologies together Various technologies condensed in this book will be helpful to researchers and engineers around the world System-on-Chip Bashir M. Al-Hashimi,2006-01-31 This book highlights both the key achievements of electronic systems design targeting SoC implementation style and the future challenges presented by the continuing scaling of CMOS technology **Languages, Design Methods, and Tools for Electronic System Design** Frank Oppenheimer,Julio Luis Medina Pasaje,2015-12-11 This book brings together a selection of the best papers from the seventeenth edition of the Forum on specification and Design Languages Conference FDL which took place on October 14 16 2014 in Munich Germany FDL is a well established international forum devoted to dissemination of research results practical experiences and new ideas in the application of specification design and verification languages to the design modeling and verification of integrated circuits complex hardware software embedded systems and mixed technology systems **Enhanced Virtual Prototyping for Heterogeneous Systems** Muhammad Hassan,Daniel Große,Rolf Drechsler,2022-09-01 This book describes a comprehensive combination of methodologies that strongly enhance the modern Virtual Prototype VP based verification flow for heterogeneous systems on chip SOCs In particular the book combines verification and analysis aspects across various stages of the VP based verification flow providing a new perspective on verification by leveraging advanced techniques like metamorphic testing data flow testing and information flow testing In addition the book puts a strong emphasis on advanced coverage driven methodologies to verify the functional behavior of the SOC as well as ensure its security Provides an extensive introduction to the modern VP based verification flow for heterogeneous SOCs Introduces a novel metamorphic testing technique for heterogeneous SOCs which does not require reference models Includes automated advanced data flow coverage driven methodologies tailored for SystemC AMS based VPs Describes enhanced functional coverage driven methodologies to verify various functional behaviors of RF amplifiers **Smart Systems Integration and Simulation** Nicola Bombieri,Massimo Poncino,Graziano Pravadelli,2016-02-17 This book presents new methods and tools for the

integration and simulation of smart devices The design approach described in this book explicitly accounts for integration of Smart Systems components and subsystems as a specific constraint It includes methodologies and EDA tools to enable multi disciplinary and multi scale modeling and design simulation of multi domain systems subsystems and components at all levels of abstraction system integration and exploration for optimization of functional and non functional metrics By covering theoretical and practical aspects of smart device design this book targets people who are working and studying on hardware software modelling component integration and simulation under different positions system integrators designers developers researchers teachers students etc In particular it is a good introduction to people who have interest in managing heterogeneous components in an efficient and effective way on different domains and different abstraction levels People active in smart device development can understand both the current status of practice and future research directions Provides a comprehensive overview of smart systems design focusing on design challenges and cutting edge solutions Enables development of a co simulation and co design environment that accounts for the peculiarities of the basic subsystems and components to be integrated Describes development of modeling and design techniques methods and tools that enable multi domain simulation and optimization at various levels of abstraction and across different technological domains

Model-Based Design for Embedded Systems Gabriela Nicolescu, Pieter J. Mosterman, 2018-09-03 The demands of increasingly complex embedded systems and associated performance computations have resulted in the development of heterogeneous computing architectures that often integrate several types of processors analog and digital electronic components and mechanical and optical components all on a single chip As a result now the most prominent challenge for the design automation community is to efficiently plan for such heterogeneity and to fully exploit its capabilities A compilation of work from internationally renowned authors *Model Based Design for Embedded Systems* elaborates on related practices and addresses the main facets of heterogeneous model based design for embedded systems including the current state of the art important challenges and the latest trends Focusing on computational models as the core design artifact this book presents the cutting edge results that have helped establish model based design and continue to expand its parameters The book is organized into three sections Real Time and Performance Analysis in Heterogeneous Embedded Systems Design Tools and Methodology for Multiprocessor System on Chip and Design Tools and Methodology for Multidomain Embedded Systems The respective contributors share their considerable expertise on the automation of design refinement and how to relate properties throughout this refinement while enabling analytic and synthetic qualities They focus on multi core methodological issues real time analysis and modeling and validation taking into account how optical electronic and mechanical components often interface Model based design is emerging as a solution to bridge the gap between the availability of computational capabilities and our inability to make full use of them yet This approach enables teams to start the design process using a high level model that is gradually refined through abstraction levels to ultimately yield a prototype

When executed well model based design encourages enhanced performance and quicker time to market for a product. Illustrating a broad and diverse spectrum of applications such as in the automotive aerospace health care consumer electronics this volume provides designers with practical readily adaptable modeling solutions for their own practice.

Nanotechnology for Telecommunications Sohail Anwar, M. Yasin Akhtar Raja, Salahuddin Qazi, Mohammad Ilyas, 2017-12-19 With its unique promise to revolutionize science engineering technology and other fields nanotechnology continues to profoundly impact associated materials components and systems particularly those used in telecommunications. These developments are leading to easier convergence of related technologies massive storage data compact storage devices and higher performance computing. Nanotechnology for Telecommunications presents vital technical scientific information to help readers grasp issues and challenges associated with nanoscale telecommunication system development and commercialization and then avail themselves of the many opportunities to be gleaned. This book provides technical information and research ideas regarding the use of nanotechnology in telecommunications and information processing reflecting the continuing trend toward the use of optoelectronics. Nanotech will eventually lead to a technology cluster that offers a complete range of functionalities for systems used in domains including information energy construction environmental and biomedical. Describing current and future developments that hold promise for significant innovations in telecommunications this book is organized to provide a progressive understanding of topics including Background information on nanoscience and nanotechnology Specific applications of nanotechnology in telecommunications Nanostructured optoelectronic materials MEMS NEMS and their applications in communication systems Quantum dot Cellular Automata QCA and its applications in telecommunication systems How nonohmic nonlinear behavior affects both digital and analog signal processing Concepts regarding quantum switching and its applications in quantum networks The scale of the physical systems that use nanoscale electronic devices is still large and that presents serious challenges to the establishment of interconnections between nanoscale devices and the outside world. Also addressing consequent social implications of nanotech this book reviews a broad range of the nano concepts and their influence on every aspect of telecommunications. It describes the different levels of interconnections in systems and details the standardized assembly process for a broad spectrum of micro nano bio fiber optic and optoelectronic components and functions. This book is a powerful tool for understanding how to harness the power of nanotech through integration of materials processes devices and applications.

Formal Methods and Models for System Design Rajesh Gupta, Paul Le Guernic, Sandeep Kumar Shukla, Jean-Pierre Talpin, 2004-06-30 Perhaps nothing characterizes the inherent heterogeneity in embedded systems than the ability to choose between hardware and software implementations of a given system function. Indeed most embedded systems at their core represent a careful division and design of hardware and software parts of the system. To do this task effectively models and methods are necessary functionality to capture application behavior needs and system implementation.

constraints Formal modeling can be valuable in addressing these tasks As with most engineering domains co design practice defines the state of the it seeks to add new capabilities in system conceptualization mod art though eling optimization and implementation These advances particularly those related to synthesis and verification tasks directly depend upon formal understanding of system behavior and performance measures Current practice in system modeling relies upon exploiting high level programming frameworks such as SystemC Esterel to capture design at increasingly higher levels of abstraction and attempts to reduce the system implementation task While raising the abstraction levels for design and verification tasks to be really useful these approaches must also provide for reuse adaptation of the existing intellectual property IP blocks

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Table of Contents Systemc Kernel Extensions For Heterogenous System Modeling

1. Understanding the eBook Systemc Kernel Extensions For Heterogenous System Modeling
 - The Rise of Digital Reading Systemc Kernel Extensions For Heterogenous System Modeling
 - Advantages of eBooks Over Traditional Books
2. Identifying Systemc Kernel Extensions For Heterogenous System Modeling
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Systemc Kernel Extensions For Heterogenous System Modeling
 - User-Friendly Interface
4. Exploring eBook Recommendations from Systemc Kernel Extensions For Heterogenous System Modeling

- Personalized Recommendations
- Systemc Kernel Extensions For Heterogenous System Modeling User Reviews and Ratings
- Systemc Kernel Extensions For Heterogenous System Modeling and Bestseller Lists
- 5. Accessing Systemc Kernel Extensions For Heterogenous System Modeling Free and Paid eBooks
 - Systemc Kernel Extensions For Heterogenous System Modeling Public Domain eBooks
 - Systemc Kernel Extensions For Heterogenous System Modeling eBook Subscription Services
 - Systemc Kernel Extensions For Heterogenous System Modeling Budget-Friendly Options
- 6. Navigating Systemc Kernel Extensions For Heterogenous System Modeling eBook Formats
 - ePub, PDF, MOBI, and More
 - Systemc Kernel Extensions For Heterogenous System Modeling Compatibility with Devices
 - Systemc Kernel Extensions For Heterogenous System Modeling Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Systemc Kernel Extensions For Heterogenous System Modeling
 - Highlighting and Note-Taking Systemc Kernel Extensions For Heterogenous System Modeling
 - Interactive Elements Systemc Kernel Extensions For Heterogenous System Modeling
- 8. Staying Engaged with Systemc Kernel Extensions For Heterogenous System Modeling
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Systemc Kernel Extensions For Heterogenous System Modeling
- 9. Balancing eBooks and Physical Books Systemc Kernel Extensions For Heterogenous System Modeling
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Systemc Kernel Extensions For Heterogenous System Modeling
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Systemc Kernel Extensions For Heterogenous System Modeling
 - Setting Reading Goals Systemc Kernel Extensions For Heterogenous System Modeling
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Systemc Kernel Extensions For Heterogenous System Modeling

- Fact-Checking eBook Content of Systemc Kernel Extensions For Heterogenous System Modeling
- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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