High Level Synthesis of ASICs Under Timing and Synchronization Constraints

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   High Level Synthesis of ASICs under Timing and Synchronization Constraints David C. Ku,Giovanni DeMicheli,2013-03-14 Computer aided synthesis of digital circuits from behavioral level specifications offers an effective means to deal with increasing complexity of digital hardware design High Level Synthesis of ASICs Under Timing and Synchronization Constraints addresses both theoretical and practical aspects in the design of a high level synthesis system that transforms a behavioral level description of hardware to a synchronous logic level implementation consisting of logic gates and registers High Level Synthesis of ASICs Under Timing and Synchronization Constraints addresses specific issues in applying high level synthesis techniques to the design of ASICs This complements previous results achieved in synthesis of general purpose and signal processors where data path design is of utmost importance In contrast ASIC designs are often characterized by complex control schemes to support communication and synchronization with the environment The combined design of efficient data path control unit is the major contribution of this book Three requirements are important in modeling ASIC designs concurrency external synchronization and detailed timing constraints The objective of the research work presented here is to develop a hardware model incorporating these requirements as well as synthesis algorithms that operate on this hardware model The contributions of this book address both the theory and the implementation of algorithm for hardware synthesis   *High-Level Synthesis for Real-Time Digital Signal Processing* Jan Vanhoof,Karl Van Rompaey,Ivo Bolsens,Gert Goossens,Hugo De Man,2012-12-06 High Level Synthesis for Real Time Digital Signal Processing is a comprehensive reference work for researchers and practicing ASIC design engineers It focuses on methods for compiling complex low to medium throughput DSP system and on the implementation of these methods in the CATHEDRAL II compiler The emergence of independent silicon foundries the reduced price of silicon real estate and the shortened processing turn around time bring silicon technology within reach of system houses Even for low volumes digital systems on application specific integrated circuits ASICs are becoming an economically meaningful alternative for traditional boards with analogue and digital commodity chips ASICs cover the application region where inefficiencies inherent to general purpose components cannot be tolerated However full custom handcrafted ASIC design is often not affordable in this competitive market Long design times a high development cost for alow production volume the lack of silicon designers and the lack of suited design facilities are inherent difficulties to manual full custom chip design To overcome these drawbacks complex systems have to be integrated in ASICs much faster and without losing too much efficiency in silicon area and operation speed compared to handcrafted chips The gap between system design and silicon design can only be bridged by new design CAD The idea of a silicon compiler translating a behavioural system specification directly into silicon was born from the awareness that the ability to fabricate chips is indeed outrunning the ability to design them At this moment CAD is one order of magnitude behind schedule Conceptual CAD is the keyword to mastering the design complexity in ASIC design and the topic of this book

SPARK: A Parallelizing Approach to the High-Level Synthesis of Digital Circuits Sumit Gupta,Rajesh Gupta,Nikil D. Dutt,Alexandru Nicolau,2007-05-08 Rapid advances in microelectronic integration and the advent of Systems on Chip have fueled the need for high level synthesis i e an automated approach to the synthesis of hardware from behavioral descriptions SPARK A Parallelizing Approach to the High Level Synthesis of Digital Circuits presents a novel approach to the high level synthesis of digital circuits that of parallelizing high level synthesis PHLS This approach uses aggressive code parallelizing and code motion techniques to discover circuit optimization opportunities beyond what is possible with traditional high level synthesis This PHLS approach addresses the problems of the poor quality of synthesis results and the lack of controllability over the transformations applied during the high level synthesis of system descriptions with complex control flows that is with nested conditionals and loops Also described are speculative code motion techniques and dynamic compiler transformations that optimize the circuit quality in terms of cycle time circuit size and interconnect costs We describe the SPARK parallelizing high level synthesis framework in which we have implemented these techniques and demonstrate the utility of SPARK s PHLS approach using designs derived from multimedia and image processing applications We also present a case study of an instruction length decoder derived from the Intel Pentium class of microprocessors This case study serves as an example of a typical microprocessor functional block with complex control flow and demonstrates how our techniques are useful for such designs SPARK A Parallelizing Approach to the High Level Synthesis of Digital Circuits is targeted mainly to embedded system designers and researchers This includes people working on design and design automation The book is useful for researchers and design automation engineers who wish to understand how the main problems hindering the adoption of high level synthesis among designers *Advances in Computers* ,1993-09-14 Advances in Computers

System-Level Synthesis Ahmed Amine Jerraya,Jean Mermet,2012-12-06 System Level Synthesis deals with the concurrent design of electronic applications including both hardware and software The issue has become the bottleneck in the design of electronic systems including both hardware and software in several major industrial fields including telecommunications automotive and aerospace engineering The major difficulty with the subject is that it demands contributions from several research fields including system specification system architecture hardware design and software design Most existing book cover well only a few aspects of system level synthesis The present volume presents a comprehensive discussion of all the aspects of system level synthesis Each topic is covered by a contribution written by an international authority on the subject **Accelerator Data-Path Synthesis for High-Throughput Signal Processing Applications** Werner Geurts,Francky Catthoor,Serge Vernalde,Hugo De Man,2011-06-27 Accelerator Data Path Synthesis for High Throughput Signal Processing Applications is the first book to show how to use high level synthesis techniques to cope with the stringent timing requirements of complex high throughput real time signal and data processing The book describes the state of the art in architectural synthesis for complex high throughput real time processing Unlike many other

the Synthesis approach used in this book targets an architecture style or an application domain This approach is thus heavily application driven and this is illustrated in the book by several realistic demonstration examples used throughout Accelerator Data Path Synthesis for High Throughput Signal Processing Applications focuses on domains where application specific high speed solutions are attractive such as significant parts of audio telecom instrumentation speech robotics medical and automotive processing image and video processing TV multi media radar sonar etc Moreover it addresses mainly the steps above the traditional scheduling and allocation tasks which focus on scalar operations and data Accelerator Data Path Synthesis for High Throughput Signal Processing Applications is of interest to researchers senior design engineers and CAD managers both in academia and industry It provides an excellent overview of what capabilities to expect from future practical design tools and includes an extensive bibliography EDA for IC System Design, Verification, and Testing Louis Scheffer,Luciano Lavagno,Grant Martin,2018-10-03 Presenting a comprehensive overview of the design automation algorithms tools and methodologies used to design integrated circuits the Electronic Design Automation for Integrated Circuits Handbook is available in two volumes The first volume EDA for IC System Design Verification and Testing thoroughly examines system level design microarchitectural design logical verification and testing Chapters contributed by leading experts authoritatively discuss processor modeling and design tools using performance metrics to select microprocessor cores for IC designs design and verification languages digital simulation hardware acceleration and emulation and much more Save on the complete set **Advances in Intelligent Systems** S.G. Tzafestas,2013-12-01 Intelligent Systems involve a large class of systems which posses human like capabilities such as learning observation perception interpretation reasoning under uncertainty planning in known and unknown environments decision making and control action The field of intelligent systems is actually a new interdisciplinary field which is the outcome of the interaction cooperation and synergetic merging of classical fields such as system theory control theory artificial intelligence information theory operational research soft computing communications linguistic theory and others Integrated intelligent decision and control systems involve three primary hierarchical levels namely organization coordination and execution levels As we proceed from the be performed organization to the execution level the precision about the jobs to increases and accordingly the intelligence required for these jobs decreases This is in compliance with the principle of increasing precision with decreasing intelligence IPOI known from the management field and theoretically established by Saridis using information theory concepts This book is concerned with intelligent systems and techniques and gives emphasis on the computational and processing issues Control issues are not included here The contributions of the book are presented in four parts as follows *Embedded System Design: Topics, Techniques and Trends* Achim Rettberg,Mauro Zanella,Rainer Domer,Andreas Gerstlauer,Franz Rammig,2010-05-09 Over recent years embedded systems have gained an enormous amount of processing power and functionality Many of the formerly external components can now be integrated into a single System on Chip This

tendency has resulted in a dramatic reduction in the size and cost of embedded systems As a unique technology the design of embedded systems is an essential element of many innovations Embedded System Design Topics Techniques and Trends presents the technical program of the International Embedded Systems Symposium IESS 2007 held in Irvine California IESS is a unique forum to present novel ideas exchange timely research results and discuss the state of the art and future trends in the field of embedded systems Contributors and participants from both industry and academia take active part in this symposium The IESS conference is organized by the Computer Systems Technology committee TC10 of the International Federation for Information Processing IFIP Timley topics techniques and trends in embedded system design are covered by the chapters in this book including design methodology specification and modeling embedded software and hardware synthesis networks on chip distributed and networked systems and system verification and validation Particular emphaisis is paid to automotive and medical applications A set of actual case studies and special aspects in embedded system design are included as well   Hardware Implementation of Intelligent Systems Horia-Nicolai Teodorescu,Abraham Kandel,2013-11-11 Intelligent systems are now being used more commonly than in the past These involve cognitive evolving and artificial life robotic and decision making systems to name a few Due to the tremendous speed of development on both fundamental and technological levels it is virtually impossible to offer an up to date yet comprehensive overview of this field Nevertheless the need for a volume presenting recent developments and trends in this domain is huge and the demand for such a volume is continually increasing in industrial and academic engineering 1 communities Although there are a few volumes devoted to similar issues none offer a comprehensive coverage of the field moreover they risk rapidly becoming obsolete The editors of this volume cannot pretend to fill such a large gap However it is the editors intention to fill a significant part of this gap A comprehensive coverage of the field should include topics such as neural networks fuzzy systems neuro fuzzy systems genetic algorithms evolvable hardware cellular automata based systems and various types of artificial life system implementations including autonomous robots In this volume we have focused on the first five topics listed above The volume is composed of four parts each part being divided into chapters with the exception of part 4 In Part 1 the topics of Evolvable Hardware and GAs are addressed In Chapter 1 Automated Design Synthesis and Partitioning for Adaptive Reconfigurable Hardware Ranga Vemuri and co authors present state of the art adaptive architectures their classification and their applications   Models in System Design Jean-Michel Bergé,Oz Levia,Jacques Rouillard,2012-12-06 Models in System Design tracks the general trend in electronics in terms of size complexity and difficulty of maintenance System design is by nature combined with prototyping mixed domain design and verification and it is no surprise that today s modeling and models are used in various levels of system design and verification In order to deal with constraints induced by volume and complexity new methods and techniques have been defined Models in System Design provides an overview of the latest modeling techniques for use by system designers The first part of the book considers system level design discussing such

issues as abstraction performance and trade offs There is also a section on automating system design The second part of the book deals with some of the newest aspects of embedded system design These include co verification and prototyping Finally the book includes a section on the use of the MCSE methodology for hardware software co design Models in System Design will help designers and researchers to understand these latest techniques in system design and as such will be of interest to all involved in embedded system design   *Co-Synthesis of Hardware and Software for Digital Embedded Systems* Rajesh Kumar Gupta,2012-12-06 Co Synthesis of Hardware and Software for Digital Embedded Systems with a Foreword written by Giovanni De Micheli presents techniques that are useful in building complex embedded systems These techniques provide a competitive advantage over purely hardware or software implementations of time constrained embedded systems Recent advances in chip level synthesis have made it possible to synthesize application specific circuits under strict timing constraints This work advances the state of the art by formulating the problem of system synthesis using both application specific as well as reprogrammable components such as off the shelf processors Timing constraints are used to determine what part of the system functionality must be delegated to dedicated application specific hardware while the rest is delegated to software that runs on the processor This co synthesis of hardware and software from behavioral specifications makes it possible to realize real time embedded systems using off the shelf parts and a relatively small amount of application specific circuitry that can be mapped to semi custom VLSI such as gate arrays The ability to perform detailed analysis of timing performance provides the opportunity of improving the system definition by creating better phototypes Co Synthesis of Hardware and Software for Digital Embedded Systems is of interest to CAD researchers and developers who want to branch off into the expanding field of hardware software co design as well as to digital system designers who are interested in the present power and limitations of CAD techniques and their likely evolution   **Design Automation for Timing-Driven Layout Synthesis** S. Sapatnekar,Sung-Mo (Steve) Kang,2012-12-06 Moore s law Noy77 which predicted that the number of devices in tegrated on a chip would be doubled every two years was accurate for a number of years Only recently has the level of integration be gun to slow down somewhat due to the physical limits of integration technology Advances in silicon technology have allowed Ie design ers to integrate more than a few million transistors on a chip even a whole system of moderate complexity can now be implemented on a single chip To keep pace with the increasing complexity in very large scale integrated VLSI circuits the productivity of chip designers would have to increase at the same rate as the level of integration Without such an increase in productivity the design of complex systems might not be achievable within a reasonable time frame The rapidly increasing complexity of VLSI circuits has made de 1 2 INTRODUCTION sign automation an absolute necessity since the required increase in productivity can only be accomplished with the use of sophisticated design tools Such tools also enable designers to perform trade off analyses of different logic implementations and to make well informed design decisions   <u>Application-Driven Architecture Synthesis</u> Francky Catthoor,Lars-Gunnar

Svensson,2012-12-06 Application Driven Architecture Synthesis describes the state of the art of architectural synthesis for complex real time processing In order to deal with the stringent timing requirements and the intricacies of complex real time signal and data processing target architecture styles and target application domains have been adopted to make the synthesis approach feasible These approaches are also heavily application driven which is illustrated by many realistic demonstrations used as examples in the book The focus is on domains where application specific solutions are attractive such as significant parts of audio telecom instrumentation speech robotics medical and automotive processing image and video processing TV multi media radar sonar Application Driven Architecture Synthesis is of interest to both academics and senior design engineers and CAD managers in industry It provides an excellent overview of what capabilities to expect from future practical design tools and includes an extensive bibliography **Algorithms for Synthesis and Testing of Asynchronous Circuits** Luciano Lavagno,Alberto L. Sangiovanni-Vincentelli,2012-12-06 Since the second half of the 1980s asynchronous circuits have been the subject of a great deal of research following a period of relative oblivion The lack of interest in asynchronous techniques was motivated by the progressive shift towards synchronous design techniques that had much more structure and were much easier to verify and synthesize System design requirements made it impossible to eliminate totally the use of asynchronous circuits Given the objective difficulty encountered by designers the asynchronous components of electronic systems such as interfaces became a serious bottleneck in the design process The use of new models and some theoretical breakthroughs made it possible to develop asynchronous design techniques that were reliable and effective This book describes a variety of mathematical models and of algorithms that form the backbone and the body of a new design methodology for asyn chronous design The book is intended for asynchronous hardware designers for computer aided tool experts and for digital designers interested in ex ploring the possibility of designing asynchronous circuits It requires a solid mathematical background in discrete event systems and algorithms While the book has not been written as a textbook nevertheless it could be used as a reference book in an advanced course in logic synthesis or asynchronous design **Circuit Synthesis with VHDL** Roland Airiau,Jean-Michel Bergé,Vincent Olive,2012-12-06 One of the main applications of VHDL is the synthesis of electronic circuits Circuit Synthesis with VHDL is an introduction to the use of VHDL logic RTL synthesis tools in circuit design The modeling styles proposed are independent of specific market tools and focus on constructs widely recognized as synthesizable by synthesis tools A statement of the prerequisites for synthesis is followed by a short introduction to the VHDL concepts used in synthesis Circuit Synthesis with VHDL presents two possible approaches to synthesis the first starts with VHDL features and derives hardware counterparts the second starts from a given hardware component and derives several description styles The book also describes how to introduce the synthesis design cycle into existing design methodologies and the standard synthesis environment Circuit Synthesis with VHDL concludes with a case study providing a realistic example of the design flow from behavioral description down to the synthesized level Circuit

Synthesis with VHDL is essential reading for all students researchers design engineers and managers working with VHDL in a synthesis environment   System Synthesis with VHDL Petru Eles,Krzysztof Kuchcinski,Zebo Peng,2013-03-14 Embedded systems are usually composed of several interacting components such as custom or application specific processors ASICs memory blocks and the associated communication infrastructure The development of tools to support the design of such systems requires a further step from high level synthesis towards a higher abstraction level The lack of design tools accepting a system level specification of a complete system which may include both hardware and software components is one of the major bottlenecks in the design of embedded systems Thus more and more research efforts have been spent on issues related to system level synthesis This book addresses the two most active research areas of design automation today high level synthesis and system level synthesis In particular a transformational approach to synthesis from VHDL specifications is described System Synthesis with VHDL provides a coherent view of system synthesis which includes the high level and the system level synthesis tasks VHDL is used as a specification language and several issues concerning the use of VHDL for high level and system level synthesis are discussed These include aspects from the compilation of VHDL into an internal design representation to the synthesis of systems specified as interacting VHDL processes The book emphasizes the use of a transformational approach to system synthesis A Petri net based design representation is rigorously defined and used throughout the book as a basic vehicle for illustration of transformations and other design concepts Iterative improvement heuristics such as tabu search simulated annealing and genetic algorithms are discussed and illustrated as strategies which are used to guide the optimization process in a transformation based design environment Advanced topics including hardware software partitioning test synthesis and low power synthesis are discussed from the perspective of a transformational approach to system synthesis System Synthesis with VHDL can be used for advanced undergraduate or graduate courses in the area of design automation and more specifically of high level and system level synthesis At the same time the book is intended for CAD developers and researchers as well as industrial designers of digital systems who are interested in new algorithms and techniques supporting modern design tools and methodologies   **Job Scheduling Strategies for Parallel Processing** Dror G. Feitelson,Larry Rudolph,1998-08-05 This book constitutes the thoroughly refereed post workshop proceedings of the 4th International Workshop on Job Scheduling Strategies for Parallel Processing held during IPPS SPDP 98 in Orlando Florida USA in March 1998 The 13 revised full papers presented have gone through an iterated reviewing process and give a report on the state of the art in the area   **Hot-Carrier Reliability of MOS VLSI Circuits** Yusuf Leblebici,Sung-Mo (Steve) Kang,2012-12-06 As the complexity and the density of VLSI chips increase with shrinking design rules the evaluation of long term reliability of MOS VLSI circuits is becoming an important problem The assessment and improvement of reliability on the circuit level should be based on both the failure mode analysis and the basic understanding of the physical failure mechanisms observed in integrated circuits Hot carrier induced degrada tion of

MOS transistor characteristics is one of the primary mechanisms affecting the long term reliability of MOS VLSI circuits It is likely to become even more important in future generation chips since the down ward scaling of transistor dimensions without proportional scaling of the operating voltage aggravates this problem A thorough understanding of the physical mechanisms leading to hot carrier related degradation of MOS transistors is a prerequisite for accurate circuit reliability evaluation It is also being recognized that important reliability concerns other than the post manufacture reliability qualification need to be addressed rigorously early in the design phase The development and use of accurate reliability simulation tools are therefore crucial for early assessment and improvement of circuit reliability Once the long term reliability of the circuit is estimated through simulation the results can be compared with predetermined reliability specifications or limits If the predicted reliability does not satisfy the requirements appropriate design modifications may be carried out to improve the resistance of the devices to degradation **Motion Analysis and Image Sequence Processing** M. Ibrahim Sezan,Reginald L. Lagendijk,2012-12-06 An image or video sequence is a series of two dimensional 2 D images sequen tially ordered in time Image sequences can be acquired for instance by video motion picture X ray or acoustic cameras or they can be synthetically gen erated by sequentially ordering 2 D still images as in computer graphics and animation The use of image sequences in areas such as entertainment visual communications multimedia education medicine surveillance remote control and scientific research is constantly growing as the use of television and video systems are becoming more and more common The boosted interest in digital video for both consumer and professional products along with the availability of fast processors and memory at reasonable costs has been a major driving force behind this growth Before we elaborate on the two major terms that appear in the title of this book namely motion analysis and image sequence processing we like to place them in their proper contexts within the range of possible operations that involve image sequences In this book we choose to classify these operations into three major categories namely i image sequence processing ii image sequence analysis and iii visualization The interrelationship among these three categories is pictorially described in Figure 1 below in the form of an image sequence triangle

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