

Field-Programmable Custom Computing Machines – A Taxonomy –

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Abstract. The ability for providing a hardware platform which can be customized on a per-application basis under software control has established *Reconfigurable Computing (RC)* as a new computing paradigm. A machine employing the RC paradigm is referred to as a *Field-Programmable Custom Computing Machine (FCCM)*. So far, the FCCMs have been classified according to implementation criteria. For the previous classifications do not reveal the entire meaning of the RC paradigm, we propose to classify the FCCMs according to architectural criteria. To analyze the phenomena inside FCCMs, we introduce a formalism based on microcode, in which any custom operation performed by a field-programmed computing facility is executed as a microprogram with two basic stages: SET CONFIGURATION and EXECUTE CUSTOM OPERATION. Based on the SET/EXECUTE formalism, we then propose an architectural-based taxonomy of FCCMs.

1 Introduction

The ability of providing a hardware platform which can be transformed under software control has established *Reconfigurable Computing (RC)* [28], [42], [29] as a new computing paradigm in the last ten years. According to this paradigm, the main idea in improving the performance of a computing machine is to define custom computing resources on a per-application basis, and to dynamically configure them onto a *Field-Programmable Gate Array (FPGA)* [11]. As a general view, a computing machine working under the new RC paradigm typically includes a *General-Purpose Processor (GPP)* which is augmented with an FPGA. The basic idea is to exploit both the GPP flexibility to achieve medium performance for a large class of applications, and FPGA capability to implement application-specific computations. Such a hybrid is referred to as a *Field-Programmable Custom Computing Machine (FCCM)* [7], [16].

Various FCCMs have been proposed in the last decade. Former attempts in classifying FCCMs used implementation criteria [15], [31], [26], [47], [23], [38]. As the user observes only the architecture of a computing machine [4], the previous classifications do not seize well the implications of the new RC paradigm as perceived

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FCCM 2004 Jeffrey M. Arnold, Kenneth L. Pocek, 2004-01-01 FCCM presents recent work on the use of reconfigurable logic as computing elements The proceedings focuses on topics such as device architecture system architecture compilation and programming tools run time environments nano technology and applications [Handbook of FPGA Design Security](#) Ted Huffmire, Cynthia Irvine, Thuy D. Nguyen, Timothy Levin, Ryan Kastner, Timothy Sherwood, 2010-06-18 The purpose of this book is to provide a practical approach to managing security in FPGA designs for researchers and practitioners in the electronic design automation EDA and FPGA communities including corporations industrial and government research labs and academics This book combines theoretical underpinnings with a practical design approach and worked examples for combating real world threats To address the spectrum of lifecycle and operational threats against FPGA systems a holistic view of FPGA security is presented from formal top level specification to low level policy enforcement mechanisms which integrates recent advances in the fields of computer security theory languages compilers and hardware The net effect is a diverse set of static and runtime techniques that working in cooperation facilitate the composition of robust dependable and trustworthy systems using commodity components We wish to acknowledge the many people who helped us ensure the success of our work on reconfigurable hardware security In particular we wish to thank Andrei Paun and Jason Smith of Louisiana Tech University for providing us with a Linux compatible version of Grail We also wish to thank those who gave us comments on drafts of this book including Marco Platzner of the University of Paderborn and Ali Irturk and Jason Oberg of the University of California San Diego This research was funded in part by National Science Foundation Grant CNS 0524771 and NSF Career Grant CCF 0448654 **High-Performance Computing Using FPGAs** Wim Vanderbauwhede, Khaled Benkrid, 2013-08-23 High Performance Computing using FPGA covers the area of high performance reconfigurable computing HPRC This book provides an overview of architectures tools and applications for High Performance Reconfigurable Computing HPRC FPGAs offer very high I/O bandwidth and fine grained custom and flexible parallelism and with the ever increasing computational needs coupled with the frequency power wall the increasing maturity and capabilities of FPGAs and the advent of multicore processors which has caused the acceptance of parallel computational models The Part on architectures will introduce different FPGA based HPC platforms attached co-processor HPRC architectures such as the CHREC's Novo G and EPCC's Maxwell systems tightly coupled HPRC architectures e.g. the Convey hybrid core computer reconfigurably networked HPRC architectures e.g. the QPACE system and standalone HPRC architectures such as EPFL's CONFETTI system The Part on Tools will focus on high level programming approaches for HPRC with chapters on C to Gate tools such as Impulse C AutoESL Handel C MORA C Graphical tools MATLAB Simulink NI LabVIEW Domain specific languages languages for heterogeneous computing for example OpenCL Microsoft's Kiwi and Alchemy projects The part on Applications will present case from several application domains where HPRC has been used successfully such as

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Partial Reconfiguration on FPGAs Dirk Koch, 2012-07-25 This is the first book to focus on designing run time reconfigurable systems on FPGAs in order to gain resource and power efficiency as well as to improve speed Case studies in partial reconfiguration guide readers through the FPGA jungle straight toward a working system The discussion of partial reconfiguration is comprehensive and practical with models introduced together with methods to implement efficiently the corresponding systems Coverage includes concepts for partial module integration and corresponding communication architectures floorplanning of the on FPGA resources physical implementation aspects starting from constraining primitive placement and routing all the way down to the bitstream required to configure the FPGA and verification of reconfigurable systems

Reconfigurable and Adaptive Computing Nadia Nedjah, Chao Wang, 2018-10-09 Reconfigurable computing techniques and adaptive systems are some of the most promising architectures for microprocessors Reconfigurable and Adaptive Computing Theory and Applications explores the latest research activities on hardware architecture for reconfigurable and adaptive computing systems The first section of the book covers reconfigurable systems The book presents a software and hardware codesign flow for coarse grained systems on chip a video watermarking algorithm for the H 264 standard a solution for regular expressions matching systems and a novel field programmable gate array FPGA based acceleration solution with MapReduce framework on multiple hardware accelerators The second section discusses network on chip including an implementation of a multiprocessor system on chip platform with shared memory access end to end quality of service metrics modeling based on a multi application environment in network on chip and a 3D ant colony routing 3D ACR for network on chip with three different 3D topologies The final section addresses the methodology of system codesign The book introduces a new software hardware codesign flow for embedded systems that models both processors and intellectual property cores as services It also proposes an efficient algorithm for dependent task software hardware codesign with the greedy partitioning and insert scheduling method GPISM by task graph

Dynamic Reconfigurable Architectures and Transparent Optimization Techniques Antonio Carlos Schneider Beck Fl., Luigi Carro, 2010-03-10 Dynamic Reconfigurable Architectures and Transparent Optimization Techniques presents a detailed study on new techniques to cope with the aforementioned limitations First characteristics of reconfigurable systems are discussed in details and a large number of case studies is shown Then a detailed analysis of several benchmarks demonstrates that such architectures need to attack a diverse range of applications with very different behaviours besides supporting code compatibility This requires the use of dynamic optimization techniques such as Binary Translation and Trace reuse Finally works that combine both reconfigurable systems and dynamic techniques are discussed and a quantitative analysis of one them the DIM architecture is presented

Reconfigurable Computing Scott Hauck, André DeHon, 2010-07-26 Reconfigurable Computing marks a revolutionary and hot topic that bridges the gap between the separate worlds of

hardware and software design the key feature of reconfigurable computing is its groundbreaking ability to perform computations in hardware to increase performance while retaining the flexibility of a software solution Reconfigurable computers serve as affordable fast and accurate tools for developing designs ranging from single chip architectures to multi chip and embedded systems Scott Hauck and Andre DeHon have assembled a group of the key experts in the fields of both hardware and software computing to provide an introduction to the entire range of issues relating to reconfigurable computing FPGAs field programmable gate arrays act as the computing vehicles to implement this powerful technology Readers will be guided into adopting a completely new way of handling existing design concerns and be able to make use of the vast opportunities possible with reconfigurable logic in this rapidly evolving field Designed for both hardware and software programmers Views of reconfigurable programming beyond standard programming languages Broad set of case studies demonstrating how to use FPGAs in novel and efficient ways International Conference on Applications and Techniques in Cyber Security and Intelligence ATCI 2018 Jemal Abawajy, Kim-Kwang Raymond Choo, Rafiqul Islam, Zheng Xu, Mohammed Atiquzzaman, 2018-11-05 The book highlights innovative ideas cutting edge findings and novel techniques methods and applications touching on all aspects of technology and intelligence in smart city management and services Above all it explores developments and applications that are of practical use and value for Cyber Intelligence related methods which are frequently used in the context of city management and services **Information Security Theory and Practices. Smart Devices, Convergence and Next Generation Networks** José A. Onieva, Damien Sauveron, Serge Chaumette, Dieter Gollmann, Konstantinos Markantonakis, 2008-05-07 With the rapid development of information technologies and the transition to next generation networks computer systems and in particular embedded systems are becoming more and more mobile and ubiquitous They also strongly interact with the physical world Ensuring the security of these complex and resource constrained systems is a really challenging research topic Therefore this Workshop in Information Security Theory and Practices was organized to bring together researchers and practitioners in related areas and to encourage cooperation between the research and the industrial communities This was the second edition of WISTP after the first event in Heraklion Greece in 2007 This year again we had a significant number of high quality submissions coming from many different countries These submissions reflected the major topics of the conference i.e smart devices convergence and next generation networks Submissions were reviewed by at least three reviewers in most cases by four and at least by five for the papers involving Program Committee members This long and rigorous process could be achieved thanks to the hard work of the Program Committee members and additional reviewers listed in the following pages This led to the selection of high quality papers that made up the workshop program and are published in these proceedings A number of posters and short papers were also selected for presentation at the conference The process was very selective and we would like to thank all those authors who submitted contributions that could not be selected *Handbook on Securing Cyber-Physical Critical Infrastructure* Sajal K

Das,Krishna Kant,Nan Zhang,2012-01-25 The worldwide reach of the Internet allows malicious cyber criminals to coordinate and launch attacks on both cyber and cyber physical infrastructure from anywhere in the world This purpose of this handbook is to introduce the theoretical foundations and practical solution techniques for securing critical cyber and physical infrastructures as well as their underlying computing and communication architectures and systems Examples of such infrastructures include utility networks e g electrical power grids ground transportation systems automotives roads bridges and tunnels airports and air traffic control systems wired and wireless communication and sensor networks systems for storing and distributing water and food supplies medical and healthcare delivery systems as well as financial banking and commercial transaction assets The handbook focus mostly on the scientific foundations and engineering techniques while also addressing the proper integration of policies and access control mechanisms for example how human developed policies can be properly enforced by an automated system Addresses the technical challenges facing design of secure infrastructures by providing examples of problems and solutions from a wide variety of internal and external attack scenarios Includes contributions from leading researchers and practitioners in relevant application areas such as smart power grid intelligent transportation systems healthcare industry and so on Loaded with examples of real world problems and pathways to solutions utilizing specific tools and techniques described in detail throughout

FCCM 2004 Jeffrey Arnold,Kenneth L. Pocek,2004 FCCM presents recent work on the use of reconfigurable logic as computing elements The proceedings focuses on topics such as device architecture system architecture compilation and programming tools run time environments nano technology and applications

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FPGA ... ,2007 **Conference Proceedings** ,2006

Proceedings of Technical Papers ,2005 **Proceedings of the ... ACM Great Lakes Symposium on VLSI** ,2007

IEEE Symposium on FPGAs for Custom Computing Machines Kenneth L. Pocek,Jeffrey M. Arnold,1996 Contains papers from the April 1996 symposium reporting on research in device architectures applications compilers and related software support Topics include using MORRPH in an industrial machine vision system a software development system for FPGA based data acquisition systems a reconfigura

VLSI Circuits and Systems ,2005 **BORPH: an Operating System for FPGA-based Reconfigurable Computers** Hayden Kwok-Hay So,2007

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In a world driven by information and connectivity, the power of words has are more evident than ever. They have the capacity to inspire, provoke, and ignite change. Such could be the essence of the book **Proceedings Ieee Symposium On Field Programmable Custom Computing Machines 12th 2004**, a literary masterpiece that delves deep into the significance of words and their affect our lives. Published by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we shall explore the book is key themes, examine its writing style, and analyze its overall effect on readers.

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