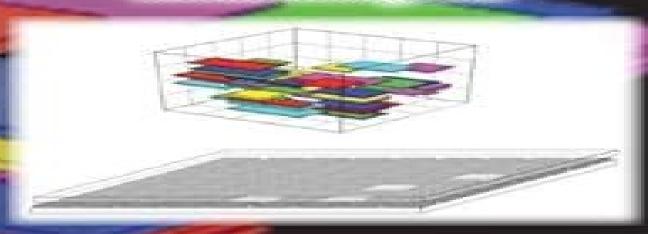# DIGITAL MICROFLUIDIC BIOCHIPS

SYNTHESIS, TESTING, AND RECONFIGURATION TECHNIQUES

Krishnendu Chakrabarty
Fei Su

Digital Microfluidic Biochips Synthesis Testing And Reconfiguration Techniques

Krishnendu Chakrabarty

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Digital Microfluidic Biochips Krishnendu Chakrabarty,2007   *Digital Microfluidic Biochips* Krishnendu Chakrabarty,Fei Su,2006-10-10 Digital Microfluidic Biochips focuses on the automated design and production of microfluidic based biochips for large scale bioassays and safety critical applications Bridging areas of electronic design automation with microfluidic biochip research the authors present a system level design automation framework that addresses key issues in the design analysis and testing of digital microfluidic biochips The book describes a new generation of microfluidic biochips with more complex designs that offer dynamic reconfigurability system scalability system integration and defect tolerance Part I describes a unified design methodology that targets design optimization under resource constraints Part II investigates cost effective testing techniques for digital microfluidic biochips that include test resource optimization and fault detection while running normal bioassays Part III focuses on different reconfiguration based defect tolerance techniques designed to increase the yield and dependability of digital microfluidic biochips Expanding upon results from ongoing research on CAD for biochips at Duke University this book presents new design methodologies that address some of the limitations in current full custom design techniques Digital Microfluidic Biochips is an essential resource for achieving the integration of microfluidic components in the next generation of system on chip and system in package designs   **Synthesis, Testing, and Reconfiguration Techniques for Digital Microfluidic Biochips** Fei Su (Ph. D.),2006   *Digital Microfluidic Biochips* Krishnendu Chakrabarty,Fei Su,2018-10-03 Digital Microfluidic Biochips focuses on the automated design and production of microfluidic based biochips for large scale bioassays and safety critical applications Bridging areas of electronic design automation with microfluidic biochip research the authors present a system level design automation framework that addresses key issues in the design analysis and testing of digital microfluidic biochips The book describes a new generation of microfluidic biochips with more complex designs that offer dynamic reconfigurability system scalability system integration and defect tolerance Part I describes a unified design methodology that targets design optimization under resource constraints Part II investigates cost effective testing techniques for digital microfluidic biochips that include test resource optimization and fault detection while running normal bioassays Part III focuses on different reconfiguration based defect tolerance techniques designed to increase the yield and dependability of digital microfluidic biochips Expanding upon results from ongoing research on CAD for biochips at Duke University this book presents new design methodologies that address some of the limitations in current full custom design techniques Digital Microfluidic Biochips is an essential resource for achieving the integration of microfluidic components in the next generation of system on chip and system in package designs   *VLSI 2010 Annual Symposium* Nikolaos Voros,Amar Mukherjee,Nicolas Sklavos,Konstantinos Masselos,Michael Huebner,2011-09-08 VLSI 2010 Annual Symposium will present extended versions of the best papers presented in ISVLSI 2010 conference The areas covered by the papers will include among others Emerging Trends in VLSI Nanoelectronics

Molecular Biological and Quantum Computing MEMS VLSI Circuits and Systems Field programmable and Reconfigurable Systems System Level Design System on a Chip Design Application Specific Low Power VLSI System Design System Issues in Complexity Low Power Heat Dissipation Power Awareness in VLSI Design Test and Verification Mixed Signal Design and Analysis Electrical Packaging Co Design Physical Design Intellectual property creating and sharing *Computer-Aided Design of Microfluidic Very Large Scale Integration (mVLSI) Biochips* Kai Hu,Krishnendu Chakrabarty,Tsung-Yi Ho,2017-04-05 This book provides a comprehensive overview of flow based microfluidic VLSI The authors describe and solve in a comprehensive and holistic manner practical challenges such as control synthesis wash optimization design for testability and diagnosis of modern flow based microfluidic biochips They introduce practical solutions based on rigorous optimization and formal models The technical contributions presented in this book will not only shorten the product development cycle but also accelerate the adoption and further development of modern flow based microfluidic biochips by facilitating the full exploitation of design complexities that are possible with current fabrication techniques

Fault-Tolerant Digital Microfluidic Biochips Paul Pop,Mirela Alistar,Elena Stuart,Jan Madsen,2015-09-07 This book describes for researchers in the fields of compiler technology design and test and electronic design automation the new area of digital microfluidic biochips DMBs and thus offers a new application area for their methods The authors present a routing based model of operation execution along with several associated compilation approaches which progressively relax the assumption that operations execute inside fixed rectangular modules Since operations can experience transient faults during the execution of a bioassay the authors show how to use both offline design time and online runtime recovery strategies The book also presents methods for the synthesis of fault tolerant application specific DMB architectures Presents the current models used for the research on compilation and synthesis techniques of DMBs in a tutorial fashion Includes a set of benchmarks which are presented in great detail and includes the source code of most of the techniques presented including solutions to the basic compilation and synthesis problems Discusses several new research problems in detail using numerous examples *Design and Testing of Digital Microfluidic Biochips* Yang Zhao,Krishnendu Chakrabarty,2012-07-25 This book provides a comprehensive methodology for automated design test and diagnosis and use of robust low cost and manufacturable digital microfluidic systems It focuses on the development of a comprehensive CAD optimization framework for digital microfluidic biochips that unifies different design problems With the increase in system complexity and integration levels biochip designers can utilize the design methods described in this book to evaluate different design alternatives and carry out design space exploration to obtain the best design point **Advancing Computational Intelligence Techniques for Security Systems Design** Uzzal Sharma,Parmanand Astya,Anupam Baliyan,Salah-ddine Krit,Vishal Jain,Mohammad Zubair Khan,2022-08-24 Security systems have become an integral part of the building and large complex setups and intervention of the computational intelligence CI paradigm plays an important role in security system architecture

This book covers both theoretical contributions and practical applications in security system design by applying the Internet of Things IoT and CI It further explains the application of IoT in the design of modern security systems and how IoT blended with computational intel ligence can make any security system improved and realizable Key features Focuses on the computational intelligence techniques of security system design Covers applications and algorithms of discussed computational intelligence techniques Includes convergence based and enterprise integrated security systems with their applications Explains emerging laws policies and tools affecting the landscape of cyber security Discusses application of sensors toward the design of security systems This book will be useful for graduate students and researchers in electrical computer engineering security system design and engineering **Handbook of Nanoscience, Engineering, and Technology, Third Edition** William A. Goddard III,Donald Brenner,Sergey Edward Lyshevski,Gerald J Iafrate,2012-06-12 In his 1959 address There is Plenty of Room at the Bottom Richard P Feynman speculated about manipulating materials atom by atom and challenged the technical community to find ways of manipulating and controlling things on a small scale This visionary challenge has now become a reality with recent advances enabling atomistic level tailoring and control of materials Exemplifying Feynman s vision Handbook of Nanoscience Engineering and Technology Third Edition continues to explore innovative nanoscience engineering and technology areas Along with updating all chapters this third edition extends the coverage of emerging nano areas even further Two entirely new sections on energy and biology cover nanomaterials for energy storage devices photovoltaics DNA devices and assembly digital microfluidic lab on a chip and much more This edition also includes new chapters on nanomagnet logic quantum transport at the nanoscale terahertz emission from Bloch oscillator systems molecular logic electronic optics in graphene and electromagnetic metamaterials With contributions from top scientists and researchers from around the globe this color handbook presents a unified up to date account of the most promising technologies and developments in the nano field It sets the stage for the next revolution of nanoscale manufacturing where scalable technologies are used to manufacture large numbers of devices with complex functionalities

Design Automation Methods and Tools for Microfluidics-Based Biochips Jun Zeng,2006-11-08 Design Automation Methods and Tools for Microfluidics Based Biochips deals with all aspects of design automation for microfluidics based biochips Experts have contributed chapters on many aspects of biochip design automation Topics covered include device modeling adaptation of bioassays for on chip implementations numerical methods and simulation tools architectural synthesis scheduling and binding of assay operations physical design and module placement fault modeling and testing and reconfiguration methods Applied Computation and Security Systems Rituparna Chaki,Khalid Saeed,Sankhayan Choudhury,Nabendu Chaki,2014-08-26 This book contains the extended version of the works that have been presented and discussed in the First International Doctoral Symposium on Applied Computation and Security Systems ACSS 2014 held during April 18 20 2014 in Kolkata India The symposium has been jointly organized by the AGH University of Science

Technology Cracow Poland and University of Calcutta India The Volume I of this double volume book contains fourteen high quality book chapters in three different parts Part 1 is on Pattern Recognition and it presents four chapters Part 2 is on Imaging and Healthcare Applications contains four more book chapters The Part 3 of this volume is on Wireless Sensor Networking and it includes as many as six chapters Volume II of the book has three Parts presenting a total of eleven chapters in it Part 4 consists of five excellent chapters on Software Engineering ranging from cloud service design to transactional memory Part 5 in Volume II is on Cryptography with two book chapters in it Part 6 of this volume is on Computer Aided Design with four chapters in it We strongly believe that the twenty five chapters in these two volumes of Applied Computation and Security Systems will be appreciated by all its readers **Transactions on Computational Science XXXV** Marina L. Gavrilova,C. J. Kenneth Tan,Khalid Saeed,Nabendu Chaki,2020-02-17 The LNCS journal Transactions on Computational Science reflects recent developments in the field of Computational Science conceiving the field not as a mere ancillary science but rather as an innovative approach supporting many other scientific disciplines The journal focuses on original high quality research in the realm of computational science in parallel and distributed environments encompassing the facilitating theoretical foundations and the applications of large scale computations and massive data processing It addresses researchers and practitioners in areas ranging from aerospace to biochemistry from electronics to geosciences from mathematics to software architecture presenting verifiable computational methods findings and solutions and enabling industrial users to apply techniques of leading edge large scale high performance computational methods This the 35th issue of the Transactions on Computational Science focusses on signal processing and security in distributed systems The topics covered include classification of visual attention levels using microsaccades analysis of textual content using Eyegaze automatic car accident detection and passenger counting face recognition secure data fusion in IoT business compliance using goal models and microfluidic executions *Cyber Physical Systems* Anupam Baliyan,Kuldeep Singh Kaswan,Naresh Kumar,Kamal Upreti,Ramani Kannan,2023-01-11 Cyber Physical System CPS is an integration of computation networking and physical processes the combination of several systems ofdifferent nature whose main purpose is tocontrol a physical process and through feedback adapt itself to new conditions in real time Cyber Physical System Concepts and Applications includes an in depth coverage of the latestmodels and theories that unify perspectives It expresses the interacting dynamics of the computational and physical components of asystem in a dynamic environment Covers automatic application of software countermeasures against physical attacks and impact of cyber physical system on industry 4 0 Explains how formal models provide mathematical abstractions to manage the complexity of a system design Offers a rigorous and comprehensive introduction to the principles of design specification modelling and analysis of cyber physicalsystems Discusses the multiple domains where Cyber Physical system has a vital impact and provides knowledge about different models thatprovide mathematical abstractions tomanage the complexity of a system design Provides the

rapidly expanding field of cyber physical systems with a Long needed foundational text by an established authority This book is primarily aimed at advanced undergraduates graduates of computer science Engineers will also find this book useful

Micro-Electrode-Dot-Array Digital Microfluidic Biochips Zipeng Li,Krishnendu Chakrabarty,Tsung-Yi Ho,Chen-Yi Lee,2018-12-14 This book provides an insightful guide to the design testing and optimization of micro electrode dot array MEDA digital microfluidic biochips The authors focus on the characteristics specific for MEDA biochips e g real time sensing and advanced microfluidic operations like lamination mixing and droplet shape morphing Readers will be enabled to enhance the automated design and use of MEDA and to develop a set of solutions to facilitate the full exploitation of design complexities that are possible with standard CMOS fabrication techniques The book provides the first set of design automation and test techniques for MEDA biochips The methods described in this book have been validated using fabricated MEDA biochips in the laboratory Readers will benefit from an in depth look at the MEDA platform and how to combine microfluidics with software e g applying biomolecular protocols to software controlled and cyberphysical microfluidic biochips **Digital Microfluidic Biochips** Krishnendu Chakrabarty,Tao Xu,2010-05-03 Microfluidics based biochips combine electronics with biochemistry providing access to new application areas in a wide variety of fields Continued technological innovations are essential to assuring the future role of these chips in functional diversification in biotech pharmaceuticals and other industries Revolutionary guidance on design opti *Applied Algorithms* Prosenjit Gupta,Christos Zaroliagis,2014-01-08 This book constitutes the refereed proceedings of the First International Conference on Applied Algorithms ICAA 2014 held in Kolkata India in January 2014 ICAA is a new conference series with a mission to provide a quality forum for researchers working in applied algorithms Papers presenting original contributions related to the design analysis implementation and experimental evaluation of efficient algorithms and data structures for problems with relevant real world applications were sought ideally bridging the gap between academia and industry The 21 revised full papers presented together with 7 short papers were carefully reviewed and selected from 122 submissions Proceedings of the 10th Ph.D. Retreat of the HPI Research School on Service-oriented Systems Engineering Meinel, Christoph , Plattner, Hasso , Döllner, Jürgen , Weske, Mathias , Polze, Andreas , Hirschfeld, Robert , Naumann, Felix , Giese, Holger , Baudisch, Patrick , Friedrich, Tobias , Müller, Emmanuel ,2018-01-17 Design and Implementation of service oriented architectures imposes a huge number of research questions from the fields of software engineering system analysis and modeling adaptability and application integration Component orientation and web services are two approaches for design and realization of complex web based system Both approaches allow for dynamic application adaptation as well as integration of enterprise application Commonly used technologies such as J2EE and NET form de facto standards for the realization of complex distributed systems Evolution of component systems has lead to web services and service based architectures This has been manifested in a multitude of industry standards and initiatives such as XML WSDL UDDI SOAP etc All these achievements lead to a new

and promising paradigm in IT systems engineering which proposes to design complex software solutions as collaboration of contractually defined software services Service Oriented Systems Engineering represents a symbiosis of best practices in object orientation component based development distributed computing and business process management It provides integration of business and IT concerns The annual Ph D Retreat of the Research School provides each member the opportunity to present his her current state of their research and to give an outline of a prospective Ph D thesis Due to the interdisciplinary structure of the research school this technical report covers a wide range of topics These include but are not limited to Human Computer Interaction and Computer Vision as Service Service oriented Geovisualization Systems Algorithm Engineering for Service oriented Systems Modeling and Verification of Self adaptive Service oriented Systems Tools and Methods for Software Engineering in Service oriented Systems Security Engineering of Service based IT Systems Service oriented Information Systems Evolutionary Transition of Enterprise Applications to Service Orientation Operating System Abstractions for Service oriented Computing and Services Specification Composition and Enactment **Applied Computing for Software and Smart Systems** Rituparna Chaki,Nabendu Chaki,Agostino Cortesi,Khalid Saeed,2023-12-26 This book features a collection of high quality research papers presented at the 10th International Symposium on Applied Computing for Software and Smart systems ACSS 2023 to be held during September 15 16 2023 in Kolkata India The book presents innovative works by undergraduate graduate students as well as Ph D scholars The emphasis of the workshop is on software and smart systems and research outcomes on other relevant areas pertaining to advancement of computing **Hardware/Software Co-Design and Optimization for Cyberphysical Integration in Digital Microfluidic Biochips** Yan Luo,Krishnendu Chakrabarty,Tsung-Yi Ho,2014-08-06 This book describes a comprehensive framework for hardware software co design optimization and use of robust low cost and cyberphysical digital microfluidic systems Readers with a background in electronic design automation will find this book to be a valuable reference for leveraging conventional VLSI CAD techniques for emerging technologies e g biochips or bioMEMS Readers from the circuit system design community will benefit from methods presented to extend design and testing techniques from microelectronics to mixed technology microsystems For readers from the microfluidics domain this book presents a new design and development strategy for cyberphysical microfluidics based biochips suitable for large scale bioassay applications Takes a transformative cyberphysical approach towards achieving closed loop and sensor feedback driven biochip operation under program control Presents a physically aware system reconfiguration technique that uses sensor data at intermediate checkpoints to dynamically reconfigure biochips Enables readers to simplify the structure of biochips while facilitating the general purpose use of digital microfluidic biochips for a wider range of applications

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