

Hao Yu · Yuhao Wang

Design Exploration of Emerging Nano-scale Non- volatile Memory

 Springer

Design Exploration Of Emerging Nano Scale Non Volatile Memory

Writam Banerjee



Design Exploration Of Emerging Nano Scale Non Volatile Memory:

Design Exploration of Emerging Nano-scale Non-volatile Memory Hao Yu, Yuhao Wang, 2014-04-18 This book presents the latest techniques for characterization modeling and design for nano scale non volatile memory NVM devices Coverage focuses on fundamental NVM device fabrication and characterization internal state identification of memristic dynamics with physics modeling NVM circuit design and hybrid NVM memory system design space optimization The authors discuss design methodologies for nano scale NVM devices from a circuits systems perspective including the general foundations for the fundamental memristic dynamics in NVM devices Coverage includes physical modeling as well as the development of a platform to explore novel hybrid CMOS and NVM circuit and system design Offers readers a systematic and comprehensive treatment of emerging nano scale non volatile memory NVM devices Focuses on the internal state of NVM memristic dynamics novel NVM readout and memory cell circuit design and hybrid NVM memory system optimization Provides both theoretical analysis and practical examples to illustrate design methodologies Illustrates design and analysis for recent developments in spin torque transfer domain wall racetrack and memristors *Mem-elements for Neuromorphic Circuits with Artificial Intelligence Applications* Christos Volos, Viet-Thanh Pham, 2021-06-17 Mem elements for Neuromorphic Circuits with Artificial Intelligence Applications illustrates recent advances in the field of mem elements memristor memcapacitor meminductor and their applications in nonlinear dynamical systems computer science analog and digital systems and in neuromorphic circuits and artificial intelligence The book is mainly devoted to recent results critical aspects and perspectives of ongoing research on relevant topics all involving networks of mem elements devices in diverse applications Sections contribute to the discussion of memristive materials and transport mechanisms presenting various types of physical structures that can be fabricated to realize mem elements in integrated circuits and device modeling As the last decade has seen an increasing interest in recent advances in mem elements and their applications in neuromorphic circuits and artificial intelligence this book will attract researchers in various fields Covers a broad range of interdisciplinary topics between mathematics circuits realizations and practical applications related to nonlinear dynamical systems nanotechnology analog and digital systems computer science and artificial intelligence Presents recent advances in the field of mem elements memristor memcapacitor meminductor Includes interesting applications of mem elements in nonlinear dynamical systems analog and digital systems neuromorphic circuits computer science and artificial intelligence **Next Generation Spin Torque Memories** Brajesh Kumar Kaushik, Shivam Verma, Anant Aravind Kulkarni, Sanjay Prajapati, 2017-04-07 This book offers detailed insights into spin transfer torque STT based devices circuits and memories Starting with the basic concepts and device physics it then addresses advanced STT applications and discusses the outlook for this cutting edge technology It also describes the architectures performance parameters fabrication and the prospects of STT based devices Further moving from the device to the system perspective it presents a non volatile computing

architecture composed of STT based magneto resistive and all spin logic devices and demonstrates that efficient STT based magneto resistive and all spin logic devices can turn the dream of instant on off non volatile computing into reality

Emerging Computing: From Devices to Systems Mohamed M. Sabry Aly, Anupam Chattopadhyay, 2022-07-11 The book covers a range of topics dealing with emerging computing technologies which are being developed in response to challenges faced due to scaling CMOS technologies It provides a sneak peek into the capabilities unleashed by these technologies across the complete system stack with contributions by experts discussing device technology circuit architecture and design automation flows Presenting a gradual progression of the individual sub domains and the open research and adoption challenges this book will be of interest to industry and academic researchers technocrats and policymakers Chapters Innovative Memory Architectures Using Functionality Enhanced Devices and Intelligent Edge Biomedical Sensors in the Internet of Things IoT Era are available open access under a Creative Commons Attribution 4.0 International License via link [springer.com](https://www.springer.com)

Energy-Efficient Communication Processors Robert Fasthuber, Francky Catthoor, Praveen Raghavan, Frederik Naessens, 2013-05-29 This book describes a new design approach for energy efficient Domain Specific Instruction set Processor DSIP architectures for the wireless baseband domain The innovative techniques presented enable co design of algorithms architectures and technology for efficient implementation of the most advanced technologies To demonstrate the feasibility of the author's design approach case studies are included for crucial functionality of advanced wireless systems with increased computational performance flexibility and reusability Designers using this approach will benefit from reduced development product costs and greater scalability to future process technology nodes

Deep Learning Classifiers with Memristive Networks Alex Pappachen James, 2019-04-08 This book introduces readers to the fundamentals of deep neural network architectures with a special emphasis on memristor circuits and systems At first the book offers an overview of neuro memristive systems including memristor devices models and theory as well as an introduction to deep learning neural networks such as multi layer networks convolution neural networks hierarchical temporal memory and long short term memories and deep neuro fuzzy networks It then focuses on the design of these neural networks using memristor crossbar architectures in detail The book integrates the theory with various applications of neuro memristive circuits and systems It provides an introductory tutorial on a range of issues in the design evaluation techniques and implementations of different deep neural network architectures with memristors

Fundamentals of Tunnel Field-Effect Transistors Sneha Saurabh, Mamidala Jagadeesh Kumar, 2016-10-26 During the last decade there has been a great deal of interest in TFETs To the best of authors knowledge no book on TFETs currently exists The proposed book provides readers with fundamental understanding of the TFETs It explains the interesting characteristics of the TFETs pointing to their strengths and weaknesses and describes the novel techniques that can be employed to overcome these weaknesses and improve their characteristics Different tradeoffs that can be made in designing TFETs have also been highlighted Further the

book provides simulation example files of TFETs that could be run using a commercial device simulator

CMOSET 2013: Abstracts CMOS Emerging Technologies Research, **Advances in Neuromorphic Hardware Exploiting Emerging Nanoscale Devices** Manan Suri, 2017-01-21 This book covers all major aspects of cutting edge research in the field of neuromorphic hardware engineering involving emerging nanoscale devices Special emphasis is given to leading works in hybrid low power CMOS Nanodevice design The book offers readers a bidirectional top down and bottom up perspective on designing efficient bio inspired hardware At the nanodevice level it focuses on various flavors of emerging resistive memory RRAM technology At the algorithm level it addresses optimized implementations of supervised and stochastic learning paradigms such as spike time dependent plasticity STDP long term potentiation LTP long term depression LTD extreme learning machines ELM and early adoptions of restricted Boltzmann machines RBM to name a few The contributions discuss system level power energy parasitic trade offs and complex real world applications The book is suited for both advanced researchers and students interested in the field

Nanocrystals in Nonvolatile Memory Writam Banerjee, 2018-10-09 In recent years utilization of the abundant advantages of quantum physics quantum dots quantum wires quantum wells and nanocrystals has attracted considerable scientific attention in the field of nonvolatile memory Nanocrystals are the driving element that have brought the nonvolatile flash memory technology to a distinguished height However new approaches are still required to strengthen this technology for future applications This book details the methods of fabrication of nanocrystals and their application in baseline nonvolatile memory and emerging nonvolatile memory technologies The chapters have been written by renowned experts of the field and will provide an in depth understanding of these technologies The book is a valuable tool for research and development sectors associated with electronics semiconductors nanotechnology material sciences solid state memories and electronic devices

Neuromorphic Circuits for Nanoscale Devices Pinaki Mazumder, Yalcin Yilmaz, Idongesit Ebong, 2022-09-01 Nanoscale devices attracted significant research effort from the industry and academia due to their operation principals being based on different physical properties which provide advantages in the design of certain classes of circuits over conventional CMOS transistors Neuromorphic Circuits for Nanoscale Devices contains recent research papers presented in various international conferences and journals to provide insight into how the operational principles of the nanoscale devices can be utilized for the design of neuromorphic circuits for various applications of non volatile memory neural network training learning and image processing The topics discussed in the book include Nanoscale Crossbar Memory Design Q Learning and Value Iteration using Nanoscale Devices Image Processing and Computer Vision Applications for Nanoscale Devices Nanoscale Devices based Cellular Nonlinear Neural Networks

Nanocrystals in Nonvolatile Memory Writam Banerjee, 2018 In recent years utilization of the abundant advantages of quantum physics quantum dots quantum wires quantum wells and nanocrystals has attracted considerable scientific attention in the field of nonvolatile memory Nanocrystals are the driving element that have brought the nonvolatile

flash memory technology to a distinguished height However new approaches are still required to strengthen this technology for future applications This book details the methods of fabrication of nanocrystals and their application in baseline nonvolatile memory and emerging nonvolatile memory technologies The chapters have been written by renowned experts of the field and will provide an in depth understanding of these technologies The book is a valuable tool for research and development sectors associated with electronics semiconductors nanotechnology material sciences solid state memories and electronic devices

Nanoscale Memristor Device and Circuits Design Balwinder Raj,Ahmed Hemani,Abusaleh M. Jabir,Saurabh Khandelwal,2023-11-08 Nanoscale Memristor Device and Circuits Design provides theoretical frameworks including i the background of memristors ii physics of memristor and their modeling iii memristive device applications and iv circuit design for security and authentication The book focuses on a broad aspect of realization of these applications as low cost and reliable devices This is an important reference that will help materials scientists and engineers understand the production and applications of nanoscale memristor devices A memristor is a two terminal memory nanoscale device that stores information in terms of high low resistance It can retain information even when the power source is removed i e non volatile In contrast to MOS Transistors MOST which are the building blocks of all modern mobile and computing devices memristors are relatively immune to radiation as well as parasitic effects such as capacitance and can be much more reliable This is extremely attractive for critical safety applications such as nuclear and aerospace where radiation can cause failure in MOST based systems Outlines the major principles of circuit design for nanoelectronic applications Explores major applications including memristor based memories sensors solar cells or memristor based hardware and software security applications Assesses the major challenges to manufacturing nanoscale memristor devices at an industrial scale

Memristor-Based Nanoelectronic Computing Circuits and Architectures Ioannis Vourkas,Georgios Ch.

Sirakoulis,2015-08-26 This book considers the design and development of nanoelectronic computing circuits systems and architectures focusing particularly on memristors which represent one of today s latest technology breakthroughs in nanoelectronics The book studies explores and addresses the related challenges and proposes solutions for the smooth transition from conventional circuit technologies to emerging computing memristive nanotechnologies Its content spans from fundamental device modeling to emerging storage system architectures and novel circuit design methodologies targeting advanced non conventional analog digital massively parallel computational structures Several new results on memristor modeling memristive interconnections logic circuit design memory circuit architectures computer arithmetic systems simulation software tools and applications of memristors in computing are presented High density memristive data storage combined with memristive circuit design paradigms and computational tools applied to solve NP hard artificial intelligence problems as well as memristive arithmetic logic units certainly pave the way for a very promising memristive era in future electronic systems Furthermore these graph based NP hard problems are solved on memristive networks and coupled with

Cellular Automata CA inspired computational schemes that enable computation within memory All chapters are written in an accessible manner and are lavishly illustrated The book constitutes an informative cornerstone for young scientists and a comprehensive reference to the experienced reader hoping to stimulate further research on memristive devices circuits and systems

Regular Nanofabrics in Emerging Technologies M. Haykel Ben Jamaa,2011-03-28 Regular Nanofabrics in Emerging Technologies gives a deep insight into both fabrication and design aspects of emerging semiconductor technologies that represent potential candidates for the post CMOS era Its approach is unique across different fields and it offers a synergetic view for a public of different communities ranging from technologists to circuit designers and computer scientists The book presents two technologies as potential candidates for future semiconductor devices and systems and it shows how fabrication issues can be addressed at the design level and vice versa The reader either for academic or research purposes will find novel material that is explained carefully for both experts and non initiated readers Regular Nanofabrics in Emerging Technologies is a survey of post CMOS technologies It explains processing circuit and system level design for people with various backgrounds

Memristive Devices for Brain-Inspired Computing Sabina Spiga,Abu Sebastian,Damien Querlioz,Bipin Rajendran,2020-06-12 Memristive Devices for Brain Inspired Computing From Materials Devices and Circuits to Applications Computational Memory Deep Learning and Spiking Neural Networks reviews the latest in material and devices engineering for optimizing memristive devices beyond storage applications and toward brain inspired computing The book provides readers with an understanding of four key concepts including materials and device aspects with a view of current materials systems and their remaining barriers algorithmic aspects comprising basic concepts of neuroscience as well as various computing concepts the circuits and architectures implementing those algorithms based on memristive technologies and target applications including brain inspired computing computational memory and deep learning This comprehensive book is suitable for an interdisciplinary audience including materials scientists physicists electrical engineers and computer scientists Provides readers an overview of four key concepts in this emerging research topic including materials and device aspects algorithmic aspects circuits and architectures and target applications Covers a broad range of applications including brain inspired computing computational memory deep learning and spiking neural networks Includes perspectives from a wide range of disciplines including materials science electrical engineering and computing providing a unique interdisciplinary look at the field

Design of Reliable and Energy-efficient Nanoscale Integrated Systems Jianwei Dai,2011

Model-driven Physical Design for Future Nanoscale Architectures Ciprian Teodorov,2011 In the context where the traditional CMOS technology approaches its limits some nanowire based fabric proposals emerged which all exhibit some common key characteristics Among these their bottom up fabrication process leads to a regularity of assembly which means the end of custom made computational fabrics in favor of regular structures Hence research activities in this area focus on structures conceptually similar to today s reconfigurable PLA and or FPGA

architectures A number of different fabrics and architectures are currently under investigation e g CMOL FPNI NASIC These proof of concept architectures take into account sortie fabrication constraints and support fault tolerance techniques What is still missing is the ability to capitalize on these experiments while offering a one step shopping point for further research especially at the physical design level of the circuit design tool flow Sharing metrics tools and exploration capabilities is the next challenge to the nano computing community We address this problem by proposing a model driven physical design toolkit based on the factorization of common domain specific concepts and the reification of the tool flow We used this tool flow to drive the design space exploration in the context of a novel nanoscale architecture and we showed that such an approach assures design convergence based on frequent quantitative evaluations moreover it enables incremental evolution of the architecture and the automation flow

Unveiling the Magic of Words: A Review of "**Design Exploration Of Emerging Nano Scale Non Volatile Memory**"

In a global defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their ability to kindle emotions, provoke contemplation, and ignite transformative change is really awe-inspiring. Enter the realm of "**Design Exploration Of Emerging Nano Scale Non Volatile Memory**," a mesmerizing literary masterpiece penned by way of a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve to the book is central themes, examine its distinctive writing style, and assess its profound impact on the souls of its readers.

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Table of Contents Design Exploration Of Emerging Nano Scale Non Volatile Memory

1. Understanding the eBook Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - The Rise of Digital Reading Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Advantages of eBooks Over Traditional Books
2. Identifying Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - 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 Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - User-Friendly Interface
4. Exploring eBook Recommendations from Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Personalized Recommendations
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory User Reviews and Ratings

- Design Exploration Of Emerging Nano Scale Non Volatile Memory and Bestseller Lists
- 5. Accessing Design Exploration Of Emerging Nano Scale Non Volatile Memory Free and Paid eBooks
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory Public Domain eBooks
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory eBook Subscription Services
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory Budget-Friendly Options
- 6. Navigating Design Exploration Of Emerging Nano Scale Non Volatile Memory eBook Formats
 - ePub, PDF, MOBI, and More
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory Compatibility with Devices
 - Design Exploration Of Emerging Nano Scale Non Volatile Memory Enhanced eBook Features
- 7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Highlighting and Note-Taking Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Interactive Elements Design Exploration Of Emerging Nano Scale Non Volatile Memory
- 8. Staying Engaged with Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Design Exploration Of Emerging Nano Scale Non Volatile Memory
- 9. Balancing eBooks and Physical Books Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Design Exploration Of Emerging Nano Scale Non Volatile Memory
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Setting Reading Goals Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - Fact-Checking eBook Content of Design Exploration Of Emerging Nano Scale Non Volatile Memory
 - 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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