LEARNING ON SILICON
Adaptive VLSI
Neural Systems

edited by
Gert Cauwenberghs
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Learning On Silicon Adaptive Vlsi Neural Systems

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Learning On Silicon Adaptive Vlsi Neural Systems:

Learning on Silicon G. Cauwenberghs,Magdy Bayoumi,1999-06-30 Learning on Silicon combines models of adaptive information processing in the brain with advances in microelectronics technology and circuit design The premise is to construct integrated systems not only loaded with sufficient computational power to handle demanding signal processing tasks in sensory perception and pattern recognition but also capable of operating autonomously and robustly in unpredictable environments through mechanisms of adaptation and learning This edited volume covers the spectrum of Learning on Silicon in five parts adaptive sensory systems neuromorphic learning learning architectures learning dynamics and learning systems The 18 chapters are documented with examples of fabricated systems experimental results from silicon and integrated applications ranging from adaptive optics to biomedical instrumentation As the first comprehensive treatment on the subject Learning on Silicon serves as a reference for beginners and experienced researchers alike It provides excellent material for an advanced course and a source of inspiration for continued research towards building intelligent adaptive machines **Nano and Molecular Electronics Handbook** Sergey Edward Lyshevski,2018-10-03 There are fundamental and technological limits of conventional microfabrication and microelectronics Scaling down conventional devices and attempts to develop novel topologies and architectures will soon be ineffective or unachievable at the device and system levels to ensure desired performance Forward looking experts continue to search for new paradigms to carry the field beyond the age of microelectronics and molecular electronics is one of the most promising candidates The Nano and Molecular Electronics Handbook surveys the current state of this exciting emerging field and looks toward future developments and opportunities Molecular and Nano Electronics Explained Explore the fundamentals of device physics synthesis and design of molecular processing platforms and molecular integrated circuits within three dimensional topologies organizations and architectures as well as bottom up fabrication utilizing quantum effects and unique phenomena Technology in Progress Stay current with the latest results and practical solutions realized for nanoscale and molecular electronics as well as biomolecular electronics and memories Learn design concepts device level modeling simulation methods and fabrication technologies used for today s applications and beyond Reports from the Front Lines of Research Expert innovators discuss the results of cutting edge research and provide informed and insightful commentary on where this new paradigm will lead The Nano and Molecular Electronics Handbook ranks among the most complete and authoritative guides to the past present and future of this revolutionary area of theory and technology Artificial Neural Networks — ICANN 2002 Jose R. Dorronsoro,2003-08-03 The International Conferences on Arti cial Neural Networks ICANN have been held annually since 1991 and over the years have become the major European meeting in neural networks This proceedings volume contains all the papers presented at ICANN 2002 the 12th ICANN conference held in August 28 30 2002 at the Escuela T ecnica Superior de Inform atica of the Universidad Aut onoma de Madrid and organized by its Neural Networks

group ICANN 2002 received a very high number of contributions more than 450 Almost all papers were revised by three independent reviewers selected among the more than 240 serving at this year s ICANN and 221 papers were nally selected for publication in these proceedings due to space considerations quite a few good contributions had to be left out I would like to thank the Program Committee and all the reviewers for the great collective e ort and for helping us to have a high quality conference **Analog VLSI** Shih-Chii Liu,2002 An introduction to the design of analog VLSI circuits Neuromorphic engineers work to improve the performance of artificial systems through the development of chips and systems that process information collectively using primarily analog circuits This book presents the central concepts required for the creative and successful design of analog VLSI circuits The discussion is weighted toward novel circuits that emulate natural signal processing Unlike most circuits in commercial or industrial applications these circuits operate mainly in the subthreshold or weak inversion region Moreover their functionality is not limited to linear operations but also encompasses many interesting nonlinear operations similar to those occurring in natural systems Topics include device physics linear and nonlinear circuit forms translinear circuits photodetectors floating gate devices noise analysis and process technology **Advances in Neural Information Processing Systems 15** Suzanna Becker,Sebastian Thrun,Klaus Obermayer,2003 Proceedings of the 2002 Neural Information Processing Systems Conference *Ultra Low Power Bioelectronics* Rahul Sarpeshkar,2010-02-22 This book provides for the first time a broad and deep treatment of the fields of both ultra low power electronics and bioelectronics It discusses fundamental principles and circuits for ultra low power electronic design and their applications in biomedical systems It also discusses how ultra energy efficient cellular and neural systems in biology can inspire revolutionary low power architectures in mixed signal and RF electronics The book presents a unique unifying view of ultra low power analog and digital electronics and emphasizes the use of the ultra energy efficient subthreshold regime of transistor operation in both Chapters on batteries energy harvesting and the future of energy provide an understanding of fundamental relationships between energy use and energy generation at small scales and at large scales A wealth of insights and examples from brain implants cochlear implants bio molecular sensing cardiac devices and bio inspired systems make the book useful and engaging for students and practicing engineers Vision Chips Alireza Moini,2012-12-06 This chapter presents a set of introductory material which in addition to providing a general view on the topic highlights the importance of research in this area It also presents a short history of the design of smart vision sensors and points out some of the fundamental issues in the design of such sensors 1 1 A General Overview Machine vision is one of the main branches of artificial intelligence The richness of information present in images makes them the first choice as an input to an artificial system which tries to interact with its environment A large proportion of the brain of many advanced species is dedicated to visual information processing which illustrates the importance of visual information in biological systems Biological visual systems have evolved over millions of years and each specie has developed a specialized visual system tailored for the

essential tasks of survival such as catching a prey or escaping a predator Implementing electronic hardware for image processing therefore may benefit from the underlying fundamental aspects of biological vision though in no respect should this be regarded as a solid framework for electronic vision systems Traditionally computer vision algorithms are performed on images captured by conventional cameras and processing is accomplished by means of general purpose digital computers More advanced systems utilize dedicated hardware to speed up the processing stage *Smart CMOS Image Sensors and Applications* Jun Ohta,2017-12-19 Because of their high noise immunity and low static power supply drain complementary metal oxide semiconductor CMOS devices produce less heat than other forms of logic and allow a high density of logic functions on a chip These beneficial characteristics have fueled the use of CMOS image sensors in consumer electronics robot vision biotechnology and medicine With the introduction of smart functions in CMOS image sensors even more versatile applications are now possible Exploring this popular technology Smart CMOS Image Sensors and Applications focuses on the smart functions implemented in CMOS image sensors as well as the applications of these sensors After discussing the history of smart CMOS image sensors the book describes the fundamental elements of CMOS image sensors It covers some optoelectronic device physics and introduces typical CMOS image sensor structures such as an active pixel sensor APS Subsequent chapters elucidate the functions and materials of smart CMOS image sensors and present examples of smart imaging The final chapter explores various applications of smart CMOS image sensors Several appendices supply a range of information on constants illuminance MOSFET characteristics and optical resolution This book provides a firm foundation in existing smart CMOS image sensor technology and applications preparing you for the next phase of smart CMOS image sensors Structured Electronic Design Arie van Staveren,Chris J.M. Verhoeven,Arthur H.M. van Roermund,2006-04-18 Analog design still has unfortunately a flavor of art Art can be beautiful However art in itself is difficult to teach to students and difficult to transfer from experienced analog designers to new trainee designers in companies Structured Electronic Design High Performance Harmonic Oscillators and Bandgap References aims to systemize analog design The use of orthogonalization of the design of the fundamental quality aspects noise distortion and bandwidth and hierarchy in the subsequent design steps enables designers to achieve high performance designs in a relatively short time As a result of the systematic design procedure the effect of design decisions on the circuit performance is made clear Additionally the use of resources for reaching a specified performance is tracked This book therefore describes the structured electronic design of high performance harmonic oscillators and bandgap references The structured design of harmonic oscillators includes the maximization of the carrier to noise ratio by means of tapping i e an impedance adaption method for noise matching The bandgap reference a popular implementation of a voltage reference is studied via the unusual concept of the linear combination of base emitter voltages The presented method leads to the design of high performance references in CMOS and Bipolar technology Using this concept on a high level of abstraction the quality with respect to for

instance noise and power supply rejection can be identified In this book it is shown with several design examples that this method provides an excellent starting point for the design of high performance bandgap references Auxiliary to the harmonic oscillator and bandgap reference design are the negative feedback amplifiers In this book the systematic design of the dynamic behavior is emphasized By means of the identification of the dominant poles it is possible to give an upper limit of the attainable bandwidth even before the real frequency compensation is accomplished Structured Electronic Design High Performance Harmonic Oscillators and Bandgap References is a valuable book for researchers and designers as well as students in the field of analog design It helps both the experienced and trainee designer to come to grips with the design of analog circuits The presented method is illustrated by several well described design examples **Bio-Medical CMOS ICs** Hoi-Jun Yoo,Chris van Hoof,2010-11-02 This book is based on a graduate course entitled Ubiquitous Healthcare Circuits and Systems that was given by one of the editors at his university It includes an introduction and overview to the field of biomedical ICs and provides information on the current trends in research The material focuses on the design of biomedical ICs rather than focusing on how to use prepared ICs Handbook of Nature-Inspired and Innovative Computing Albert Y. Zomaya,2006-01-10 As computing devices proliferate demand increases for an understanding of emerging computing paradigms and models based on natural phenomena Neural networks evolution based models quantum computing and DNA based computing and simulations are all a necessary part of modern computing analysis and systems development Vast literature exists on these new paradigms and their implications for a wide array of applications This comprehensive handbook the first of its kind to address the connection between nature inspired and traditional computational paradigms is a repository of case studies dealing with different problems in computing and solutions to these problems based on nature inspired paradigms The Handbook of Nature Inspired and Innovative Computing Integrating Classical Models with Emerging Technologies is an essential compilation of models methods and algorithms for researchers professionals and advanced level students working in all areas of computer science IT biocomputing and network engineering *Continuous-Time Delta-Sigma Modulators for High-Speed A/D Conversion* James A. Cherry,W. Martin Snelgrove,2006-04-18 Among analog to digital converters the delta sigma modulator has cornered the market on high to very high resolution converters at moderate speeds with typical applications such as digital audio and instrumentation Interest has recently increased in delta sigma circuits built with a continuous time loop filter rather than the more common switched capacitor approach Continuous time delta sigma modulators offer less noisy virtual ground nodes at the input inherent protection against signal aliasing and the potential to use a physical rather than an electrical integrator in the first stage for novel applications like accelerometers and magnetic flux sensors More significantly they relax settling time restrictions so that modulator clock rates can be raised This opens the possibility of wideband 1 MHz or more converters possibly for use in radio applications at an intermediate frequency so that one or more stages of mixing might be done in the digital domain Continuous Time Delta Sigma Modulators

for High Speed A D Conversion Theory Practice and Fundamental Performance Limits covers all aspects of continuous time delta sigma modulator design with particular emphasis on design for high clock speeds The authors explain the ideal design of such modulators in terms of the well understood discrete time modulator design problem and provide design examples in Matlab They also cover commonly encountered non idealities in continuous time modulators and how they degrade performance plus a wealth of material on the main problems feedback path delays clock jitter and quantizer metastability in very high speed designs and how to avoid them They also give a concrete design procedure for a real high speed circuit which illustrates the tradeoffs in the selection of key parameters Detailed circuit diagrams simulation results and test results for an integrated continuous time 4 GHz band pass modulator for A D conversion of 1 GHz analog signals are also presented Continuous Time Delta Sigma Modulators for High Speed A D Conversion Theory Practice and Fundamental Performance Limits concludes with some promising modulator architectures and a list of the challenges that remain in this exciting field

Automated Calibration of Modulated Frequency Synthesizers Dan McMahill,2006-04-18 In recent years there has been considerable interest in highly integrated low power portable wireless devices This monograph focuses on the problem of low power GFSK GMSK modulation and presents an architectural approach for improved performance Including several valuable tools for the practicing engineer **Direct Digital Synthesizers** Jouko Vankka,Kari A.I. Halonen,2013-04-17 A major advantage of a direct digital synthesizer DDS is that its output frequency phase and amplitude can be precisely and rapidly manipulated under digital processor control Other inherent DDS attributes include the ability to tune with extremely fine frequency and phase resolution and to rapidly hop between frequencies These combined characteristics have made the technology popular in military radar and communications systems In fact DDS technology was previously applied almost exclusively to high end and military applications it was costly power hungry difficult to implement and required a discrete high speed D A converter Due to improved integrated circuit IC technologies they now present a viable alternative to analog based phase locked loop PLL technology for generating agile analog output frequency in consumer synthesizer applications It is easy to include different modulation capabilities in the DDS by using digital signal processing DSP methods because the signal is in digital form By programming the DDS adaptive channel bandwidths modulation formats frequency hopping and data rates are easily achieved The flexibility of the DDS makes it ideal for signal generator for software radio The digital circuits used to implement signal processing functions do not suffer the effects of thermal drift aging and component variations associated with their analog counterparts The implementation of digital functional blocks makes it possible to achieve a high degree of system integration Recent advances in IC fabrication technology particularly CMOS coupled with advanced DSP algorithms and architectures are providing possible single chip DDS solutions to complex communication and signal processing subsystems as modulators demodulators local oscillators programmable clock generators and chirp generators The DDS addresses a variety of applications including cable modems measurement equipments arbitrary

waveform generators cellular base stations and wireless local loop base stations Direct Digital Synthesizers was written to find possible applications for radio communication systems It will have appeal for wireless and wireline communication engineers teachers and students **Design and Analysis of Integrator-Based Log-Domain Filter Circuits** Gordon W. Roberts,Vincent W. Leung,2006-04-18 This title deals with the design and analysis of log domain filter circuits It describes synthesis methods for developing bipolar or BiCMOS filter circuits with cut off frequencies ranging from the low kilohertz range to several hundred megahertz Numerous examples provide measured experimental data from IC prototypes

Research Perspectives on Dynamic Translinear and Log-Domain Circuits Wouter A. Serdijn,Jan Mulder,2013-06-29 The area of analog integrated circuits is facing some serious challenges due to the ongoing trends towards low supply voltages low power consumption and high frequency operation The situation is becoming even more complicated by the fact that many transfer functions have to be tunable or controllable A promising approach to facing these challenges is given by the class of dynamic translinear circuits which are as a consequence receiving increasing interest Several different names are used in literature log domain exponential state space current mode companding instantaneous companding tanh domain sinh domain polynomial state space square root domain and translinear filters In fact all these groups are overlapping subclasses of the overall class of dynamic translinear circuits Research Perspectives on Dynamic Translinear and Log Domain Circuits is a compilation of research findings in this growing field It comprises ten contributions coming from recognized dynamic translinear researchers in Europe and North America Research Perspectives on Dynamic Translinear and Log Domain Circuits is an edited volume of original research **Systematic Design for Optimisation of Pipelined ADCs** João Goes,João C. Vital,José E. Franca,2006-04-18 Systematic Design for Optimisation of Pipelined ADCs proposes and develops new strategies methodologies and tools for designing low power and low area CMOS pipelined A D converters The task is tackled by following a scientifically consistent approach First of all the state of the art in pipeline A D converters is analysed with a double purpose a to identify the best suited among different strategies reported in literature and taking into account the objectives pursued b to identify the drawbacks of these strategies as a basic first step to improve them Then the book proposes a top down design approach for implementing high performance low power and low area CMOS pipelined A D converters through The conception development and implementation of self calibrated techniques to extend the linearity of some critical stages in the architecture of pipelined ADCs The detailed analysis and modelling of some major non idealities that limit the physical realisation of pipelined ADCs and the proposal development and implementation of design methodologies to support systematic design of optimised instances of these converters which combine maximum performance with minimum power dissipation and minimum area occupation LIST Several implementations together with consistent measured results are presented In particular a practical realisation of a low power 14 bit 5MS s CMOS pipelined ADC with background analogue self calibration is fully described The proposed approach is fully in line with the best practice

regarding the design of mixed signal integrated circuits On the one hand drawbacks of currently existing solutions are overcame through innovative strategies and on the other hand the expert knowledge is packaged and made available for re usability by the community of circuit designers Finally feasibility of the strategies and the associated encapsulated knowledge isgranted through experimental validation of working silicon Systematic Design for Optimisation of Pipelined ADCs serves as an excellent reference for analogue design engineers especially designers of low power CMOS A D converters The book may also be used as a text for advanced reading on the subject **Adaptive Analog VLSI Neural Systems** M. Jabri,R.J. Coggins,B.G. Flower,Barry G. Flower,1996 This book approaches VLSI neural networks from a practical viewpoint using case studies to show the full process of VLSI implementation of a network and addressing the important issues of learning algorithms and limited precision effects System aspects and low power implementation issues are also covered The authors are all international figures in the field from AT T Bell Labs Bellcore and SEDAL **Artificial Neural Networks** ,2002 **Analog Test Signal Generation Using Periodic ΣΔ-Encoded Data Streams** Benoit Dufort,G.W. Roberts,2012-12-06 Analog Test Signal Generation Using Periodic SigmaDelta Encoded Data Streams presents a new method to generate high quality analog signals with low hardware complexity The theory of periodic SigmaDelta encoded bitstreams is presented along with a set of empirical tables to help select the appropriate parameters of a bitstream An optimization procedure is also outlined to help select a bit sequence with the desired attributes A large variety of signals can be generated using this approach Silicon implementation issues are discussed with a specific emphasis on area overhead and ease of design One FPGA circuit and three different silicon implementations are presented along with experimental results It is shown that simple designs are capable of generating very high precision signals on chip The technique is further extended to multi bit signal generation where it is shown how to increase the performance of arbitrary waveform generators commonly found in past and present day mixed signal testers No hardware modifications are required only the numbers in memory are changed Three different calibration techniques to reduce the effects of the AWG s non linearities are also introduced together with supporting experimental evidence The main focus of this text is to describe an area efficient technique for analog signal generation using SigmaDelta encoded data stream The main characteristics of the technique are High quality signals SFDR of 110 dB observed Large variety of signals generated Bitstreams easily obtained with a fast optimization program Good frequency resolution compatible with coherent sampling Simple and fast hardware implementation Mostly digital except an easily testable 1 bit DAC and possibly a reconstruction filter Memory already available on chip can be reused reducing area overhead Designs can be incorporated into existing CAD tools High frequency generation

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Learning On Silicon Adaptive Vlsi Neural Systems Introduction

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