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Analog Circuit Design contains the contribution of 18 tutorials of the 14th workshop on Advances in Analog Circuit Design. Each part discusses a specific todote topic on new and valuable design ideas in the area of analog circuit design. Each part is presented by six experts in that field and state of the art information is shared and overviewed. This book is number 14 in this successful series of Analog Circuit Design, providing valuable information and excellent overviews of analog circuit design, CAD and RF systems. Analog Circuit Design is an essential reference source for analog circuit designers and researchers wishing to keep abreast with the latest development in the field. The tutorial coverage also makes it suitable for use in an advanced design course.

This book describes a new design methodology that allows optimization-based synthesis of RF systems in a hierarchical multilevel approach, in which the system is designed in a bottom-up fashion, from the device level up to the (sub)system level. At each level of the design hierarchy, the authors discuss methods that increase the design robustness and increase the accuracy and efficiency of the simulations. The methodology described enables circuit sizing and layout in a complete and automated integrated manner, achieving optimized designs in significantly less time than with traditional approaches. Describes an efficient and accurate methodology to design automatically RF systems, with guaranteed accuracy from the device to the system level; Discusses analytical and machine learning techniques for modelling integrated inductors and uses such models in synthesis approaches; Compares synthesis strategies for RF circuits based on bottom-up versus flat approaches; Discusses layout-aware bottom-up design methodologies for RF circuits; Discusses variability-aware bottom-up design methodologies for RF circuits; Describes multilevel bottom-up design methodologies from the device up to the system level.

A frequency synthesizer is one of the most critical building blocks in any wireless transceiver system. Its design is getting more and more challenging as the demand for low-voltage low-power high-frequency wireless systems continuously grows. As the supply voltage is decreased, many existing design techniques are no longer applicable. This book provides the reader with architectures and design techniques to enable CMOS frequency synthesizers to operate at low supply voltage at high frequency with good phase noise and low power consumption. In addition to updating the reader on many of these techniques in depth, this book will also introduce useful guidelines and step-by-step procedure on behaviour simulations of frequency synthesizers. Finally, three successfully demonstrated CMOS synthesizer prototypes with detailed design consideration and description will be elaborated to illustrate potential applications of the architectures and design techniques described. For engineers, managers and researchers working in radio-frequency integrated-circuit design for wireless applications.

This book constitutes the refereed joint proceedings of eleven European workshops on the Theory and Applications of Evolutionary Computation, EvoWorkshops 2009, held in Tübingen, Germany, in April 2009 within the scope of the EvoStar 2009 event. The 68 revised full papers and 23 revised short papers presented were carefully reviewed and selected from a total of 143 submissions. With respect to the eleven workshops covered, the papers are organized in topical sections on telecommunication networks and other parallel and distributed systems, environmental issues, finance and economics, games, design automation, image analysis and signal processing, interactive evolution and humanized computational intelligence, music, sound, art and design, continuous parameter optimisation, stochastic and dynamic environments, as well as transportation and logistics.

Today digital signal processing systems use advanced CMOS technologies requiring the analog-to-digital converter to be implemented in the same (digital) technology. Such an implementation requires special circuit techniques. Furthermore the susceptibility of converters to ground bounce or digital noise is an important design criterion. In this part different converters and conversion techniques are described that are optimized for receiver applications. Part II, Sensor and Actuator Interfaces, interfaces for sensors and actuators shape the gates through which information is acquired from the real world into digital information systems, and vice versa. The interfaces should include analog signal conditioning, analog-to-digital conversion, digital bus interfaces and data-acquisition networks. To simplify the use of data-acquisition systems additional features should be incorporated, like self-test, and calibration

This book introduces the concept of voltage-controlled-oscillator (VCO)-based analog-to-digital converters (ADCs). Detailed explanation is given of this promising new class of high resolution and low power ADCs, which use time quantization as opposed to traditional analog-based (i.e. voltage) ADCs.

This book focuses on modelling and simulation, control and optimization, signal processing, and forecasting in selected nonlinear dynamical systems, presenting both literature reviews and novel concepts. It develops analytical or numerical approaches, which are simple to use, robust, stable, flexible and universally applicable to the analysis of complex nonlinear dynamical systems. As such it addresses key challenges are addressed, e.g. efficient handling of time-varying dynamics, efficient design, faster numerical computations, robustness, stability and convergence of algorithms. The book provides a series of contributions discussing either the design or analysis of complex systems in sciences and engineering, and the concepts developed involve nonlinear dynamics, synchronization, optimization, machine learning, and forecasting. Both theoretical and practical aspects of diverse areas are investigated, specifically neurocomputing, transportation engineering, theoretical electrical engineering, signal processing, communications engineering, and computational intelligence. It is a valuable resource for students and researchers interested in nonlinear dynamics and synchronization with applications in

selected areas.

Wireless RF and microwave ICs depend critically on passive devices, such as inductors, capacitors, and transformers. Passive devices allow the optimization of key RF circuit building blocks by minimizing noise, maximizing gain and frequency of operation, and minimizing power. The integration of passive devices on the Si IC substrate requires a critical understanding of substrate coupling and loss, including electrically induced conductive and displacement current flowing in the substrate as well as magnetically induced eddy currents. Design, Simulation and Applications of Inductors and Transformers for Si RF ICs provides a deep understanding of the physics involved in the operation of these devices at microwave frequencies. Additionally, the book tackles two critical blocks that depend critically on the passive devices, the voltage-controlled oscillator and a distributed amplifier. Design, Simulation and Applications of Inductors and Transformers for Si RF ICs will be of interest to RF and microwave integrated circuit engineers, computer aided designers, device physicists, and electromagnetic researchers, as well as power electronics engineers.

This work covers the design of CMOS fully integrated low power low phase noise voltage controlled oscillators for telecommunication or datacommunication systems. The need for low power is obvious, as mobile wireless telecommunications are battery operated. As wireless telecommunication systems use oscillators in frequency synthesizers for frequency translation, the selectivity and signal to noise ratio of receivers and transmitters depend heavily on the low phase noise performance of the implemented oscillators. Datacommunication systems need low jitter, the time-domain equivalent of low phase noise, clocks for data detection and recovery. The power consumption is less critical. The need for multi-band and multi-mode systems pushes the high-integration of telecommunication systems. This is offered by sub-micron CMOS featuring digital flexibility. The recent crisis in telecommunication clearly shows that mobile hand-sets became mass-market high-volume consumer products, where low-cost is of prime importance. This need for low-cost products - livens tremendously research towards CMOS alternatives for the bipolar or BiCMOS solutions in use today.

In the arena of parasitic-aware design of CMOS RF circuits, efforts are aimed at the realization of true single-chip radios with few, if any, off-chip components. The parasitic-aware RF circuit synthesis techniques described in this book effectively address critical problems in this field.

Modern telecommunication systems are highly complex from an algorithmic point of view. The complexity continues to increase due to advanced modulation schemes, multiple protocols and standards, as well as additional functionality such as personal organizers or navigation aids. To have short and reliable design cycles, efficient verification methods and tools are necessary. Modeling and simulation need to accompany the design steps from the specification to the overall system verification in order to bridge the gaps between system specification, system simulation, and circuit level simulation. Very high carrier frequencies together with long observation periods result in extremely large computation times and requires, therefore, specialized modeling methods and simulation tools on all design levels. The focus of Modeling and Simulation for RF System Design lies on RF specific modeling and simulation methods and the consideration of system and circuit level descriptions. It contains application-oriented training material for RF designers which combines the presentation of a mixed-signal design flow, an introduction into the powerful standardized hardware description languages VHDL-AMS and Verilog-A, and the application of commercially available simulators. Modeling and Simulation for RF System Design is addressed to graduate students and industrial professionals who are engaged in communication system design and want to gain insight into the system structure by own simulation experiences. The authors are experts in design, modeling and simulation of communication systems engaged at the Nokia Research Center (Bochum, Germany) and the Fraunhofer Institute for Integrated Circuits, Branch Lab Design Automation (Dresden, Germany).

Many new topologies and circuit design techniques have emerged recently to improve the performance of active inductors, but a comprehensive treatment of the theory, topology, characteristics, and design constraint of CMOS active inductors and transformers, and a detailed examination of their emerging applications in high-speed analog signal processing and data communications over wire and wireless channels, is not available. This book is an attempt to provide an in-depth examination and a systematic presentation of the operation principles and implementation details of CMOS active inductors and transformers, and a detailed examination of their emerging applications in high-speed analog signal processing and data communications over wire and wireless channels. The content of the book is drawn from recently published research papers and are not available in a single, cohesive book. Equal emphasis is given to the theory of CMOS active inductors and transformers, and their emerging applications. Major subjects to be covered in the book include: inductive characteristics in high-speed analog signal processing and data communications, spiral inductors and transformers – modeling and limitations, a historical perspective of device synthesis, the topology, characterization, and implementation of CMOS active inductors and transformers, and the application of CMOS active inductors and transformers in high-speed analog and digital signal processing and data communications.

High-Frequency Oscillator Design for Integrated Transceivers covers the analysis and design of all high-frequency oscillators required to realize integrated transceivers for wireless and wired applications. This includes the design of oscillator types as single-phase LC oscillators, I/Q LC oscillators, multi-phase LC oscillators, and ring oscillators in various IC technologies such as bipolar, BiCMOS, CMOS, and SOI (silicon on insulator). Starting from an in depth review of basic oscillator theory, the authors discuss key oscillator specifications, numerous oscillator circuit topologies, and introduce the concepts of design figures of merit (FOMs) and benchmark FOMs, which assist the oscillator designer during the overall design cycle. Taking advantage of behavioral modeling, the elementary properties of LC oscillators and ring oscillators are analyzed first. A detailed analysis of oscillator properties at circuit level follows taking parasitic elements and other practical aspects of integrated oscillator design into account. Special attention is given to advantages and limitations of linear time invariant (LTI) phase noise modeling,

leading to the concept of optimum coupling in I/Q LC oscillators and a simulation method for fast and efficient phase noise optimization in oscillators. In addition, all modern linear time variant (LTV) phase noise theories are covered. As not only phase noise is of high importance to the designer, but optimization of other oscillator properties as well, additional subjects such as various tuning methods of LC oscillators are analyzed, too. Design examples of integrated LC and ring oscillators in the frequency range of 100 MHz up to 11 GHz are thoroughly discussed throughout the book. The clear and structured discussion of basic oscillator properties make High-Frequency Oscillator Design for Integrated Transceivers an excellent starting point for the inexperienced oscillator designer. The detailed analysis of many oscillator types and circuit topologies, the discussion of numerous practical design issues together with fast optimization methods, and more than 200 carefully selected literature references on oscillator literature, LC oscillator and ring oscillator designs make this book a very valuable resource for the experienced IC designer as well.

High-speed, power-efficient analog integrated circuits can be used as standalone devices or to interface modern digital signal processors and micro-controllers in various applications, including multimedia, communication, instrumentation, and control systems. New architectures and low device geometry of complementary metaloxidesemiconductor (CMOS) technologies have accelerated the movement toward system on a chip design, which merges analog circuits with digital, and radio-frequency components.

Radio-Frequency Integrated-Circuit Engineering addresses the theory, analysis and design of passive and active RFIC's using Si-based CMOS and Bi-CMOS technologies, and other non-silicon based technologies. The materials covered are self-contained and presented in such detail that allows readers with only undergraduate electrical engineering knowledge in EM, RF, and circuits to understand and design RFICs. Organized into sixteen chapters, blending analog and microwave engineering, Radio-Frequency Integrated-Circuit Engineering emphasizes the microwave engineering approach for RFICs.

- Provides essential knowledge in EM and microwave engineering, passive and active RFICs, RFIC analysis and design techniques, and RF systems vital for RFIC students and engineers
- Blends analog and microwave engineering approaches for RFIC design at high frequencies
- Includes problems at the end of each chapter

The steady downscaling of device-feature size combined with a rapid increase in circuit complexity as well as the introduction of new device concepts based on non-silicon-material systems poses great challenges for device and circuit designers. One of the major tasks is the development of new and improved device models needed for accurate device and circuit design. Another task is the development of new circuit-simulation tools to handle very large and complex circuits. This book addresses both these issues with up-to-date reviews written by leading experts in the field. The first three chapters of the book discuss advanced device models both for existing technologies and for new, emerging technologies. Among the topics covered are models for MOSFETs, thin-film transistors (TFTs), and compound semiconductor devices, including GaAs HEMTs and HFETs, heterodimensional devices, quantum-tunneling devices, as well as wide-bandgap devices. Chapters 4 and 5 discuss advanced circuit simulators that hold promise for handling circuits of much higher complexity than what is possible for typical state-of-the-art circuit simulators today.

This project reviews the three major analyses techniques in RF circuit simulation in Cadence Virtuoso. The SpectreRF Circuit simulator is used to analyze the Periodic Steady State (PSS), Periodic AC (PAC) and Quasi-Periodic Steady State analysis (QPSS alias Periodic Distortion) in Cadence Virtuoso. A down-conversion Gilbert mixer test schematic at 915 MHz LO frequency and 915.1 MHz RF frequency is used to analyze behavior of important metrics like convergence gain of a mixer using the above-mentioned simulation techniques. PSS simulation shows the voltage spectrum at different harmonics exhibited by this mixer test bench. PAC analysis gives the information about the conversion gain with respect to IF frequency. QPSS analysis is used to compute power conversion gain from power at IF and RF frequencies. Also, it is verified from QPSS analysis that as LO signal power increases, the voltage convergence gain decreases. Different characteristics of an RF-mixer test bench were learnt, analyzed and simulated using SpectreRF simulator.

try to predict it using mathematical expressions. His heuristic model without mathematical proof is almost universally accepted. However, it entails a circuit specific noise factor that is not known a priori and so is not predictive. In this work, we attempt to address the topic of oscillator design from a different perspective. By introducing a new paradigm that accurately captures the subtleties of phase noise we try to answer the question: 'why do oscillators behave in a particular way?' and 'what can be done to build an optimum design?' It is also hoped that the paradigm is useful in other areas of circuit design such as frequency synthesis and clock recovery. In Chapter 1, a general introduction and motivation to the subject is presented. Chapter 2 summarizes the fundamentals of phase noise and timing jitter and discusses earlier works on oscillator's phase noise analysis. Chapter 3 and Chapter 4 analyze the physical mechanisms behind phase noise generation in current-biased and Colpitts oscillators. Chapter 5 discusses design trade-offs and new techniques in LC oscillator design that allows optimal design. Chapter 6 and Chapter 7 discuss a topic that is typically ignored in oscillator design. That is flicker noise in LC oscillators. Finally, Chapter 8 is dedicated to the complete analysis of the role of varactors both in tuning and AM-FM noise conversion.

Summarizes cutting-edge physical layer technologies for multi-mode wireless RF transceivers. Includes original contributions from distinguished researchers and professionals. Covers cutting-edge physical layer technologies for multi-mode wireless RF transceivers. Contributors are all leading researchers and professionals in this field.

This book introduces readers to the potential of charge-sharing (CS) successive approximation register (SAR) analog-to-digital converters (ADCs), while providing extensive analysis of the factors that limit the performance of the CS topology. The authors present guidelines and useful techniques for mitigating the limitations of the architecture, while focusing on the implementation under restricted power budgets and voltage supplies.

The book presents design methods for analog integrated circuits with improved electrical performance. It describes different equivalent transistor models, design methods, and fabrication considerations for high-density integrated circuits in nanometer CMOS processes, and it analyzes circuit architectures that are suitable for analog building blocks. Highlighting various design challenges, the text offers a complete understanding of architectural- and transistor-level design issues of analog integrated circuits. It examines important trends in the design of high-speed and power-efficient front-end analog circuits that can be used for signal conditioning, filtering, and detection applications. Offers a comprehensive resource for mastering the analysis of analog integrated circuits. Describes circuit-level details of high-speed and power-efficient analog building blocks. Explores design methods based on various MOS transistor models (MOSFET,

FinFET). Provides mathematical derivations of all equations and formulas. Emphasizes practical aspects relevant to integrated circuit implementation. Includes open-ended circuit design case studies.

This book describes design techniques for wideband quadrature LO generation for software defined radio transceivers, with frequencies spanning 4GHz to around 80GHz. The authors discuss several techniques that can be used to reduce the cost and/or power consumption of one of the key component of the RF front-end, the quadrature local oscillator. The discussion includes simple and useful insights into quadrature VCOs, along with numerous examples of practical techniques.

VLSI for Wireless Communication, Second Edition, an advanced level text book, takes a system approach starting with an overview of the most up to date wireless systems and the transceiver architecture available today. Wireless standards are first introduced (updated to include the most recent 3G/4G standards in the second edition), and translates from a wireless standard to the implementation of a transceiver. This system approach is particularly important as the level of integration in VLSI increases and coupling between system and component design becomes more intimate. VLSI for Wireless Communication, Second Edition, illustrates designs with full design examples. Each chapter includes at least one complete design example that helps explain the architecture/circuits presented in this text. This book has close to 10 homework problems at the end of each chapter. A complete solutions manual is available on-line.

VLSI for Wireless Communication, Second Edition, is designed as a primary text book for upper-undergraduate level students and graduate level students concentrating on electrical engineering and computer science. Professional engineers and researchers working in wireless communications, circuit design and development will find this book valuable as well.

Examining the most important developments in highly integrated wireless RF front ends, this book describes and evaluates both active and passive solutions for on-chip high-Q filtering, and explores M-phase filters in depth. An accessible step-by-step approach is used to introduce everything an RF designer needs to know about these filters, including their various forms, principles of operation, and their performance against implementation-related imperfections. Real-world examples are described in depth, and detailed mathematical analyses demonstrate the practical quantification of pertinent circuit parameters.

For more than 40 years, Computerworld has been the leading source of technology news and information for IT influencers worldwide. Computerworld's award-winning Web site (Computerworld.com), twice-monthly publication, focused conference series and custom research form the hub of the world's largest global IT media network.

When I attended college we studied vacuum tubes in our junior year. At that time an average radio had 7 vacuum tubes and better ones even seven. Then transistors appeared in 1960s. A good radio was judged to be one with more than 10 transistors. Later good radios had 15–20 transistors and after that everyone stopped counting transistors. Today modern processors running personal computers have over 10 million transistors and more millions will be added every year. The difference between 20 and 20M is in complexity, methodology and business models. Designs with 20 transistors are easily generated by design engineers without any tools, whilst designs with 20M transistors can not be done by humans in reasonable time without the help of Prof. Dr. Gajski demonstrates the Y-chart automation. This difference in complexity introduced a paradigm shift which required sophisticated methods and tools, and introduced design automation into design practice. By the decomposition of the design process into many tasks and abstraction levels the methodology of designing chips or systems has also evolved. Similarly, the business model has changed from vertical integration, in which one company did all the tasks from product specification to manufacturing, to globally distributed, client server production in which most of the design and manufacturing tasks are outsourced.

This work is dedicated to CMOS based imaging with the emphasis on the noise modeling, characterization and optimization in order to contribute to the design of high performance imagers in general and range imagers in particular. CMOS is known to be superior to CCD due to its flexibility in terms of integration capabilities, but typically has to be

Mixed-Signal Circuits offers a thoroughly modern treatment of integrated circuit design in the context of mixed-signal applications. Featuring chapters authored by leading experts from industry and academia, this book: Discusses signal integrity and large-scale simulation, verification, and testing Demonstrates advanced design techniques that enable digital circuits and sensitive analog circuits to coexist without any compromise Describes the process technology needed to address the performance challenges associated with developing complex mixed-signal circuits Deals with modeling topics, such as reliability, variability, and crosstalk, that define pre-silicon design methodology and trends, and are the focus of companies involved in wireless applications Develops methods to move analog into the digital domain quickly, minimizing and eliminating common trade-offs between performance, power consumption, simulation time, verification, size, and cost Details approaches for very low-power performances, high-speed interfaces, phase-locked loops (PLLs), voltage-controlled oscillators (VCOs), analog-to-digital converters (ADCs), and biomedical filters Delineates the respective parts of a full system-on-chip (SoC), from the digital parts to the baseband blocks, radio frequency (RF) circuitries, electrostatic-discharge (ESD) structures, and built-in self-test (BIST) architectures Mixed-Signal Circuits explores exciting opportunities in wireless communications and beyond. The book is a must for anyone involved in mixed-signal circuit design for future technologies.

This book is the third in a series of books collecting the best papers from the three main regional conferences on electronic system design languages, HDLCon in the United States, APCHDL in Asia-Pacific and FDL in Europe. Being APCHDL bi-annual, this book presents a selection of papers from HDLCon'01 and FDL'01. HDLCon is the premier HDL event in the United States. It originated in 1999 from the merging of the International Verilog Conference and the Spring VHDL User's Forum. The scope of the conference expanded from specialized languages such as VHDL and Verilog to general purpose languages such as C++ and Java. In 2001 it was held in February in Santa Clara, CA. Presentations from design engineers are technical in nature, reflecting real life experiences in using HDLs. EDA vendors presentations show what is available - and what is planned-for design tools that utilize HDLs, such as simulation and synthesis tools. The Forum on Design Languages (FDL) is the European forum to exchange experiences and learn of new trends, in the application of languages and the associated design methods and tools, to design complex electronic systems. FDL'01 was held in Lyon, France, around seven interrelated workshops, Hardware Description Languages, Analog and Mixed signal Specification, C/C++ HW/SW Specification and Design, Design Environments & Languages, Real-Time specification for embedded Systems, Architecture Modeling and Reuse and System Specification & Design Languages.

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