
SYMBOLIC ANALYSIS IN ANALOG INTEGRATED CIRCUIT DESIGN

Symbolic Analysis In Analog Integrated Circuit Design

Lawrence P. Huelsman, Georges Gielen



Symbolic Analysis In Analog Integrated Circuit Design:

Symbolic Analysis in Analog Integrated Circuit Design Henrik Floberg, 2012-12-06 Symbolic Analysis in Analog Integrated Circuit Design provides an introduction to computer aided circuit analysis and presents systematic methods for solving linear i.e. small signal and nonlinear circuit problems which are illustrated by concrete examples Computer aided symbolic circuit analysis is useful in analog integrated circuit design Analytic expressions for the network transfer functions contain information that is not provided by a numerical simulation result However these expressions are generally extremely long and difficult to interpret therefore it is necessary to be able to approximate them guided by the magnitude of the individual circuit parameters Engineering has been described as the art of making approximations The inclusion of symbolic analysis in analog circuit design reduces the implied risk of ambiguity during the approximation process A systematic method based on the nullor concept is used to obtain the basic feedback transistor amplifier configurations Approximate expressions for the locations of poles and zeros for linear networks are obtained using the extended pole splitting technique An unusual feature in Symbolic Analysis in Analog Integrated Circuit Design is the consistent use of the transadmittance element with finite linear or nonlinear or infinite i.e. nullor gain as the only requisite circuit element The describing function method is used to obtain approximate symbolic expressions for the harmonic distortion generated by a soft or hard transconductance nonlinearity embedded in an arbitrary linear network The design and implementation of a program i.e. CASCA for symbolic analysis of time continuous networks is described The algorithms can also be used to solve other linear problems e.g. the analysis of time discrete switched capacitor networks Symbolic Analysis in Analog Integrated Circuit Design serves as an excellent resource for students and researchers as well as for industry designers who want to familiarize themselves with circuit analysis This book may also be used for advanced courses on the subject [Symbolic Analysis for Automated Design of Analog Integrated Circuits](#) Georges Gielen, Willy M.C. Sansen, 2012-12-06 It is a great honor to provide a few words of introduction for Dr Georges Gielen's and Prof Willy Sansen's book Symbolic analysis for automated design of analog integrated circuits The symbolic analysis method presented in this book represents a significant step forward in the area of analog circuit design As demonstrated in this book symbolic analysis opens up new possibilities for the development of computer aided design CAD tools that can analyze an analog circuit topology and automatically size the components for a given set of specifications Symbolic analysis even has the potential to improve the training of young analog circuit designers and to guide more experienced designers through second order phenomena such as distortion This book can also serve as an excellent reference for researchers in the analog circuit design area and creators of CAD tools as it provides a comprehensive overview and comparison of various approaches for analog circuit design automation and an extensive bibliography The world is essentially analog in nature hence most electronic systems involve both analog and digital circuitry As the number of transistors that can be integrated on a single integrated circuit IC substrate steadily increases over time an

ever increasing number of systems will be implemented with one or a few very complex ICs because of their lower production costs

Symbolic Analysis of Analog Circuits: Techniques and Applications Lawrence P. Huelsman, Georges Gielen, 2012-12-06 This book brings together important contributions and state of the art research results in the rapidly advancing area of symbolic analysis of analog circuits It is also of interest to those working in analog CAD The book is an excellent reference providing insights into some of the most important issues in the symbolic analysis of analog circuits

Design of Analog Circuits Through Symbolic Analysis Mourad Fakhfakh, Esteban Tlelo-Cuautle, Francisco V. Fernández, 2012 Symbolic analyzers have the potential to offer knowledge to sophomores as well as practitioners of analog circuit design Actually they are an essential complement to numerical simulators since they provide insight into circuit behavior which numerical Advanced Symbolic Analysis for VLSI Systems Guoyong Shi, Sheldon X.-D. Tan, Esteban Tlelo Cuautle, 2014-06-19 This book provides comprehensive coverage of the recent advances in symbolic analysis techniques for design automation of nanometer VLSI systems The presentation is organized in parts of fundamentals basic implementation methods and applications for VLSI design Topics emphasized include statistical timing and crosstalk analysis statistical and parallel analysis performance bound analysis and behavioral modeling for analog integrated circuits Among the recent advances the Binary Decision Diagram BDD based approaches are studied in depth The BDD based hierarchical symbolic analysis approaches have essentially broken the analog circuit size barrier Symbolic Analysis Techniques Francisco Fernández, 1998 Electrical Engineering Symbolic Analysis Techniques Applications to Analog Design Automation Symbolic Analysis Techniques is a collection of original contributions from renowned experts in the field presenting the most recent and important applications of symbolic analysis to analog circuit design This timely self contained volume features an in depth tutorial introduction to the techniques and algorithms underlying modern symbolic analyzers and includes many references at the end of each chapter Applications are discussed in a variety of important fields Automatic generation of optimum circuit topologies Interactive circuit improvement and automated design space exploration Non fixed topology analog synthesis tools Semiconductor parameter extraction Analog testability and fault diagnosis And many more related areas Symbolic Analysis Techniques also features an extensive comparison of modern symbolic analyzer characteristics and limitations Brimming with practical instructions on tasks like formula simplification and post processing this book will be of use and interest to graduate students researchers and engineers involved in computer aided circuits analysis and analog design automation

Computer-Aided Design of Analog Integrated Circuits and Systems Rob A. Rutenbar, Georges G. E. Gielen, 2002-05-06 The tools and techniques you need to break the analog design bottleneck Ten years ago analog seemed to be a dead end technology Today System on Chip SoC designs are increasingly mixed signal designs With the advent of application specific integrated circuits ASIC technologies that can integrate both analog and digital functions on a single chip analog has become more crucial than ever to the design process Today designers are moving beyond hand crafted one

transistor at a time methods They are using new circuit and physical synthesis tools to design practical analog circuits new modeling and analysis tools to allow rapid exploration of system level alternatives and new simulation tools to provide accurate answers for analog circuit behaviors and interactions that were considered impossible to handle only a few years ago To give circuit designers and CAD professionals a better understanding of the history and the current state of the art in the field this volume collects in one place the essential set of analog CAD papers that form the foundation of today's new analog design automation tools Areas covered are Analog synthesis Symbolic analysis Analog layout Analog modeling and analysis Specialized analog simulation Circuit centering and yield optimization Circuit testing Computer Aided Design of Analog Integrated Circuits and Systems is the cutting edge reference that will be an invaluable resource for every semiconductor circuit designer and CAD professional who hopes to break the analog design bottleneck

Distortion

Analysis of Analog Integrated Circuits Piet Wambacq, Willy M.C. Sansen, 2013-04-17 The analysis and prediction of nonlinear behavior in electronic circuits has long been a topic of concern for analog circuit designers The recent explosion of interest in portable electronics such as cellular telephones cordless telephones and other applications has served to reinforce the importance of these issues The need now often arises to predict and optimize the distortion performance of diverse electronic circuit configurations operating in the gigahertz frequency range where nonlinear reactive effects often dominate However there have historically been few sources available from which design engineers could obtain information on analysis techniques suitable for tackling these important problems I am sure that the analog circuit design community will thus welcome this work by Dr Wambacq and Professor Sansen as a major contribution to the analog circuit design literature in the area of distortion analysis of electronic circuits I am personally looking forward to having a copy readily available for reference when designing integrated circuits for communication systems

Pathological Elements in Analog Circuit Design Mourad Fakhfakh, Marian Pierzchala, 2018-03-23 This book is a compilation and a collection of tutorials and recent advances in the use of nullors combinations of nullators and norators and pathological mirrors in analog circuit and system design It highlights the basic theory trends and challenges in the field making it an excellent reference resource for researchers and designers working in the synthesis analysis and design of analog integrated circuits With its tutorial character it can also be used for teaching Singular elements such as nullors and pathological mirrors can arguably be considered as universal blocks since they can represent all existing analog building blocks and they allow complex integrated circuits to be designed simply and effectively These pathological elements are now used in a wide range of applications in modern circuit system theory and also in design practice

Analog Circuit Design Michiel Steyaert, Arthur H.M. van Roermund, Johan Huijsing, 2006-03-14 Analog Circuit Design contains the contribution of 18 tutorials of the 14th workshop on Advances in Analog Circuit Design Each part discusses a specific todate 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

Trade-Offs in Analog Circuit Design Chris Toumazou, George S. Moschytz, Barrie Gilbert, 2007-05-08 As the frequency of communication systems increases and the dimensions of transistors are reduced more and more stringent performance requirements are placed on analog circuits This is a trend that is bound to continue for the foreseeable future and while it does understanding performance trade offs will constitute a vital part of the analog design process It is the insight and intuition obtained from a fundamental understanding of performance conflicts and trade offs that ultimately provides the designer with the basic tools necessary for effective and creative analog design Trade offs in Analog Circuit Design which is devoted to the understanding of trade offs in analog design is quite unique in that it draws together fundamental material from and identifies interrelationships within a number of key analog circuits The book covers ten subject areas Design methodology Technology General Performance Filters Switched Circuits Oscillators Data Converters Transceivers Neural Processing and Analog CAD Within these subject areas it deals with a wide diversity of trade offs ranging from frequency dynamic range and power gain bandwidth speed dynamic range and phase noise to tradeoffs in design for manufacture and IC layout The book has by far transcended its original scope and has become both a designer's companion as well as a graduate textbook An important feature of this book is that it promotes an intuitive approach to understanding analog circuits by explaining fundamental relationships and in many cases providing practical illustrative examples to demonstrate the inherent basic interrelationships and trade offs Trade offs in Analog Circuit Design draws together 34 contributions from some of the world's most eminent analog circuits and systems designers to provide for the first time a comprehensive text devoted to a very important and timely approach to analog circuit design

Circuit Analysis and Feedback Amplifier Theory Wai-Kai Chen, 2018-10-03 Culled from the pages of CRC's highly successful best selling The Circuits and Filters Handbook Second Edition Circuit Analysis and Feedback Amplifier Theory presents a sharply focused comprehensive review of the fundamental theory behind professional applications of circuits and feedback amplifiers It supplies a concise convenient reference to the key concepts models and equations necessary to analyze design and predict the behavior of large scale circuits and feedback amplifiers illustrated by frequent examples Edited by a distinguished authority this book emphasizes the theoretical concepts underlying the processes behavior and operation of these devices It includes guidance on the design of multiple loop feedback amplifiers More than 350 figures and tables illustrate the concepts and where necessary the theories principles and mathematics of some subjects are reviewed Expert contributors discuss analysis in the time and frequency domains symbolic analysis state variable techniques feedback amplifier configurations general feedback theory and network functions and feedback among many other topics Circuit Analysis and Feedback

Amplifier Theory builds a strong theoretical foundation for the design and analysis of advanced circuits and feedback amplifiers while serving as a handy reference for experienced engineers making it a must have for both beginners and seasoned experts

EDA for IC Implementation, Circuit Design, and Process Technology Luciano Lavagno, Louis Scheffer, Grant Martin, 2018-10-03 Presenting a comprehensive overview of the design automation algorithms tools and methodologies used to design integrated circuits the Electronic Design Automation for Integrated Circuits Handbook is available in two volumes The second volume EDA for IC Implementation Circuit Design and Process Technology thoroughly examines real time logic to GDSII a file format used to transfer data of semiconductor physical layout analog mixed signal design physical verification and technology CAD TCAD Chapters contributed by leading experts authoritatively discuss design for manufacturability at the nanoscale power supply network design and analysis design modeling and much more Save on the complete set

Top-Down Design of High-Performance Sigma-Delta Modulators Fernando Medeiro, Belén Pérez Verdú, Angel Rodríguez-Vázquez, 2013-04-18 The interest for $\Sigma\Delta$ modulation based NO converters has significantly increased in the last years The reason for that is twofold On the one hand unlike other converters that need accurate building blocks to obtain high resolution $\Sigma\Delta$ converters show low sensitivity to the imperfections of their building blocks This is achieved through extensive use of digital signal processing a desirable feature regarding the implementation of NO interfaces in mainstream CMOS technologies which are better suited for implementing fast dense digital circuits than accurate analog circuits On the other hand the number of applications with industrial interest has also grown In fact starting from the earliest in the audio band today we can find $\Sigma\Delta$ converters in a large variety of NO interfaces ranging from instrumentation to communications These advances have been supported by a number of research works that have lead to a considerably large amount of published papers and books covering different sub topics from purely theoretical aspects to architecture and circuit optimization However so much material is often difficultly digested by those unexperienced designers who have been committed to developing a $\Sigma\Delta$ converter mainly because there is a lack of methodology In our view a clear methodology is necessary in $\Sigma\Delta$ modulator design because all related tasks are rather hard

Dynamic Translinear and Log-Domain Circuits Jan Mulder, Wouter A. Serdijn, Albert C. van der Woerd, Arthur H.M. van Roermund, 2012-12-06 Log domain and translinear filters provide a competitive alternative to the challenges of ever increasing low voltage low power and high frequency demands in the area of continuous time filters Since translinear filters are fundamentally large signal linear they are capable of realizing a large dynamic range in combination with excellent tunability characteristics Large signal linearity is achieved by exploiting the accurate exponential behavior of the bipolar transistor or the subthreshold MOS transistor A generalization of the dynamic translinear principle exploiting the square law behavior of the MOS transistor is theoretically possible but not practically relevant Translinear and log domain filters are based on the dynamic translinear principle a generalization of the conventional static translinear principle Besides their application for linear filters dynamic translinear

circuits can also be used for the realization of non linear dynamic functions such as oscillators RMS DC converters and phase locked loops Dynamic Translinear and Log Domain Circuits Analysis and Synthesis covers both the analysis and synthesis of translinear circuits The theory is presented using one unifying framework for both static and dynamic translinear networks which is based on a current mode approach General analysis methods are presented including the large signal and non stationary analysis of noise A well structured synthesis method is described greatly enhancing the designability of log domain and translinear circuits Comparisons are made with respect to alternative analysis and synthesis methods presented in the literature The theory is illustrated and verified by various examples and realizations Dynamic Translinear and Log Domain Circuits Analysis and Synthesis is an excellent reference for researchers and circuit designers and may be used as a text for advanced courses on the topic

The Design of Low-Voltage, Low-Power Sigma-Delta Modulators Shahriar Rabii, Bruce A. Wooley, 2012-12-06 Oversampling techniques based on sigma delta modulation are widely used to implement the analog digital interfaces in CMOS VLSI technologies This approach is relatively insensitive to imperfections in the manufacturing process and offers numerous advantages for the realization of high resolution analog to digital A D converters in the low voltage environment that is increasingly demanded by advanced VLSI technologies and by portable electronic systems In The Design of Low Voltage Low Power Sigma Delta Modulators an analysis of power dissipation in sigma delta modulators is presented and a low voltage implementation of a digital audio performance A D converter based on the results of this analysis is described Although significant power savings can typically be achieved in digital circuits by reducing the power supply voltage the power dissipation in analog circuits actually tends to increase with decreasing supply voltages Oversampling architectures are a potentially power efficient means of implementing high resolution A D converters because they reduce the number and complexity of the analog circuits in comparison with Nyquist rate converters In fact it is shown that the power dissipation of a sigma delta modulator can approach that of a single integrator with the resolution and bandwidth required for a given application In this research the influence of various parameters on the power dissipation of the modulator has been evaluated and strategies for the design of a power efficient implementation have been identified The Design of Low Voltage Low Power Sigma Delta Modulators begins with an overview of A D conversion emphasizing sigma delta modulators It includes a detailed analysis of noise in sigma delta modulators analyzes power dissipation in integrator circuits and addresses practical issues in the circuit design and testing of a high resolution modulator The Design of Low Voltage Low Power Sigma Delta Modulators will be of interest to practicing engineers and researchers in the areas of mixed signal and analog integrated circuit design

Computer Aided Design and Design Automation Wai-Kai Chen, 2018-03-12 This volume of The Circuits and Filters Handbook Third Edition focuses on computer aided design and design automation In the first part of the book international contributors address topics such as the modeling of circuit performances symbolic analysis methods numerical analysis methods design by optimization statistical design optimization

and physical design automation In the second half of the text they turn their attention to RF CAD high performance simulation formal verification RTK behavioral synthesis system level design an Internet based micro electronic design automation framework performance modeling and embedded computing systems design Fundamentals of Circuits and Filters Wai-Kai Chen,2018-10-08 This volume drawn from the Circuits and Filters Handbook focuses on mathematics basics circuit elements devices and their models and linear circuit analysis It examines Laplace transformation Fourier methods for signal analysis and processing z transform and wavelet transforms It also explores network laws and theorems terminal and port representation analysis in the frequency domain and more **Variation-Aware Design of Custom Integrated Circuits: A Hands-on Field Guide** Trent McConaghy,Kristopher Breen,Jeffrey Dyck,Amit Gupta,2012-10-02 This book targets custom IC designers who are encountering variation issues in their designs especially for modern process nodes at 45nm and below such as statistical process variations environmental variations and layout effects It teaches them the state of the art in Variation Aware Design tools which help the designer to analyze quickly the variation effects identify the problems and fix the problems Furthermore this book describes the algorithms and algorithm behavior performance limitations which is of use to designers considering these tools designers using these tools CAD researchers and CAD managers **The Circuits and Filters Handbook** Wai-Kai Chen,2002-12-23 A bestseller in its first edition The Circuits and Filters Handbook has been thoroughly updated to provide the most current most comprehensive information available in both the classical and emerging fields of circuits and filters both analog and digital This edition contains 29 new chapters with significant additions in the areas of computer

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