Preface

Advances in electronics technologies have led to a kind of a 'boom' in a very wide range of fields, such as, informatics, bioengineering, communications, electronic gadgets, to name a few.

Despites the fact that in the digital domain, designers can take full benefits of IPs and design automation tools to synthesize and design very complex systems, the analog designers' task is still considered as a 'handcraft', cumbersome and very time consuming process. This is mainly due to the lack of support by computer-aided design programs, which has led to a so-called 'productivity gap' (difference between what technology can offer and what can be manufactured). Thus, tremendous efforts are being deployed by researchers, R/D engineers, etc. to develop new design methodologies in the analog/RF and mixed-signal domains.

Actually, the analog/RF and mixed signal fields rely on three major areas, namely Synthesis, Design and Optimization. These domains form a trilogy in this realm of analog/RF and mixed-signal circuit and system design. Endeavors are being made to develop new synthesis techniques (building novel active circuits, for instance), design methodologies (proposing new circuits) and sizing/optimization techniques (offering more complex functionalities with advanced performances, higher frequency operating ranges, less power consumption, etc.).

On this basis, this book collects in sixteen Chapters, recent theories, synthesis techniques and design methodologies, as well as new sizing approaches. It highlights their application to the design of high performance analog/RF and mixed-signal circuits and systems. This book is intended to researchers and R/D engineers, as well. The book encompasses two parts: *Methodologies* and *Techniques*.

The first part, *Methodologies*, is composed of seven Chapters, very briefly introduced in the following:

Chapter 1, entitled 'Towards Automatic Structural Analysis of Mixed-Signal Circuits', is proposed by *M. Eick and H. Graeb*. It presents a new method for the automatic structural and functional analysis of analog, digital and mixed-signal circuits.

Chapter 2, 'Efficient Synthesis Methods for mm-wave Frequency Passive Components and Amplifiers', authored by *B. Liu and G. Gielen*, deals with an efficient high-frequency synthesis methods for integrated passive components as well as for the synthesis of mm-wave-frequency linear amplifiers, using the memetic machine

learning-based differential evolution method and the efficient machine learning-based differential evolution method, respectively.

Chapter 3, entitled 'Self-Healing Circuits Using Statistical Element Selection' and proposed by *V. H.-C. Chen, G. Keskin, and L. T. Pileggi*, analyzes the statistical element selection methodology for the implementation of low-power self-healing circuits and systems.

Chapter 4, 'Improving Design Feature Reuse in Analog Circuit Design through Topological-Symbolic Comparison and Entropy-based Classification', authored by *C. Ferent and A. Doboli* introduces a novel circuit synthesis methodology based on concept comparison, combination, learning, and re-use.

Chapter 5 that is entitled 'Graph-based symbolic and symbolic sensitivity analysis of analog integrated circuits' and proposed by *S. Rodriguez-Chavez, A.A. Palma-Rodriguez, E. Tlelo-Cuautle, and S.X.-D. Tan*, describes a graph-based technique for the solution of a system of equations for analog ICs formulated by applying symbolic NA and for symbolic sensitivity analysis.

Chapter 6 titled 'A Designer Centric Analog Synthesis Flow', which is authored by *F. Javid, S. Youssef, R. Iskander, and M.-M. Louërat*, presents a designer centric analog synthesis flow that is fully controlled by the designer and offers an intuitive design approach that is composed of a sizing tool and a layout generation tool.

Chapter 7; 'Analog Circuit Design based on Robust POFs using an Enhanced MOEA with SVM Models' by *N. Lourenço, R. Martins, M. Barros, and N. Horta* highlights a multi-objective design methodology for automatic analog integrated circuits synthesis, which enhances the robustness of the solution by varying technological and environmental parameters, and by the inclusion of corner cases.

The second part of the book, *Techniques*, encompasses the nine following Chapters:

Chapter 8; 'Applications of symbolic analysis in the design of analog circuits' by *F. Grasso, A. Luchetta, and M. C. Piccirilli*, describes the use of symbolic techniques in the realization of efficient automatic tools for designing analog circuits. In particular three phases of the design cycle of an integrated circuit are considered: the simulation phase, the design centering phase and the fault diagnosis phase.

Chapter 9, titled 'Synthesis of Electronically-Controllable Signal Processing/Signal Generation Circuits using Modern Active Building Blocks', is authored by *R. Senani, D. R. Bhaskar, A. K. Singh, and V. K. Singh* focuses on the synthesis of various electronically-controllable signal processing/signal generation circuits. The coverage includes the basics and hardware implementation of various building blocks mentioned above and includes some elegant representative applications using them.

Chapter 10, entitled 'Synthesis of Generalized Impedance Converter and Inverter Circuits Using NAM Expansion' by *A. M Soliman* proposes the use of the nodal admittance matrix expansion technique to generate all possible voltage generalized impedance converter and the current generalized impedance converter circuits, and the realizations of two types of the generalized impedance inverter circuits.

Chapter 11; 'Fractional Step Analog Filter Design', by *T. Freeborn, B. Maundy, and A. Elwakil* outlines the process to design, analyze, and implement continuous-time fractional-step filters, and presents new methods and design equations for the physical realization of these filters using fractional capacitors, SABs, FPAA hardware, and FDNR topologies.

Chapter 12, entitled 'The Flipped Voltage Follower: Theory and applications' and that is authored by *J. Ramirez-Angulo, M. R. Valero-Bernal, A. Lopez-Martin, R. G. Carvajal, A. Torralba*, *S. Celma-Pueyo, and N. Medrano-Marqués,* exposes and summarizes in a tutorial way, the most relevant information published to date on the FVF, and presents several improved FVF cells and structures and gives a comparison of their performances and characteristics.

Chapter 13, titled 'Synthesis of Analog Circuits using only Voltage and Current Followers as Active Elements', by *R. Senani, D.R. Bhaskar, A.K. Singh, and R.K. Sharma*, presents a brief account of some prominent works done on the analog circuit design using VFs and CFs as active elements, together with the design of VFs and CFs themselves.

Chapter 14; 'Design of Setable Active Lossy Inductors', proposed by *M. Pierzchala, and M. Fakhfakh* is concerned with transformation of passive LC filters into active RC-circuits using signal-flow graphs in the two-graph by using exclusively RC-elements and the newly introduced 'active switches'. The Chapter also deals with the reduction of the complexity of the constructed active circuits.

Chapter 15, entitled 'MIDAS: Microwave Inductor Design Automation on Silicon' by *L. Aluigi, F. Alimenti, L. Roselli, D. Pepe, and D. Zito* emphasizes a methodology to automate the design of microwave inductor on silicon and presents the implementation of an auxiliary CAD tool for Microwave Inductor Design Automation on Silicon.

Chapter 16; 'LC-VCO Design Challenges in the Nano-Era' authored by *P. Pereira, H. Fino, M. Fakhfakh, F. Coito, and M. Ventim-Neves* exposes an optimization based methodology for the design of LC-VCOs whose efficiency is granted by the use of analytical models to characterize the behavior of active and passive elements.

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