

Analog Circuits and Signal Processing

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Trends in Circuit Design for Analog Signal Processing

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Preface

Analog circuits are fundamentally necessary in many complex and high-performance systems, although digital signal processing is becoming increasingly more powerful and many types of signal processing have indeed moved to digital domain due to the advances in IC technology which provides compact and efficient implementation of these algorithms in silicon. This is caused by the reality that naturally occurring signals are analog. In other words, analog circuits act as a bridge between the real world and digital systems. In analog signal processing, many circuit topologies, including active filters, oscillators, and immittance simulators, have been proposed in the literature. Today, process technologies such as CMOS and BiCMOS have advanced. Now, it is easier to realize this type of topologies for analog signal processing; as a result, it is not complete to propose only this type of circuits without applying the aforementioned considerations.

In analog circuit design, the current trend is to realize the proposed circuit by showing its performance limitations and adding application examples for the proposed circuit to be used in the real world. It is known that application areas of analog signal processing are wide and range from very low frequencies at several Hz levels of biomedical signals to RF applications operating at GHz level, from EEG signals to cognitive radio and encrypted communications or low-noise amplifiers in wireless communications. In this respect, this book offers to readers a strong overview and new ideas in order to catch the recent trends and advanced applications.

This book discusses new possibilities in analog circuit design, including applications on communication, measurement, and RF systems, combining the main features for circuit design with actual circuit realizations and demonstrating several performance limitations on chosen circuit examples.

This book covers illustrations, tables, and new proposals derived from authors' published papers. In this respect, the book makes a strong overview of the recent advances in the last couple of decades.

It is known that application areas of analog signal processing are wide and range from very low frequencies at several Hz levels of biomedical signals to RF applications operating at GHz level, from EEG signals to cognitive radio and encrypted

communications or low-noise amplifiers in wireless communications. Therefore, the designer should know the limitations that affect the performance of their circuit before the actual realization. Consequently, the performed work is not sufficient without demonstrating the circuit characteristics in view of microelectronics and fabrication technology. In this manner, readers get a huge opportunity to improve themselves with the help of this book covering new advances and possibilities in the related research area including application on communication, measurement, and RF systems.

The subject of our book is fully derived from published papers by Kuntman (and some parts by Ozenli). The main subject is based on the concept “Alternative Active Elements to Operational Amplifiers for Analog IC Design.” In the last two decades, Kuntman et al. worked on this subject, derived several topologies, and the results were published in the literature. Our book presents a survey of these works. We think that this book will also be helpful for high-level MSc and PhD students as well as researchers from industry working in the area of analog IC design.

Istanbul, Turkey

Hakan Kuntman
Deniz Özenli

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Hakan Kuntman received his BSc, MSc, and PhD degrees from Istanbul Technical University in 1974, 1977, and 1982, respectively. In 1974, he joined the Department of Electronics and Communication Engineering at Istanbul Technical University. In 1993, he became Professor of Electronics in the same department (retired, 2016). His research interest includes design of electronic circuits, modeling of electron devices and electronic systems, active filters, and design of analog IC topologies. Dr. Kuntman has authored many publications on modeling and simulation of electron devices and electronic circuits for computer-aided design, analog VLSI design, and active circuit design. He is the author or the co-author of 129 journal papers published or accepted for publishing in international journals, 179 conference papers presented or accepted for presentation in international conferences, 161 Turkish conference papers presented in national conferences, and 10 books related to the above-mentioned areas. (h-index 37). He advised and completed the work of 16 PhD students and 44 MSc students. Dr. Kuntman is a member of the Chamber of Turkish Electrical Engineers (EMO).

From 2001 to 2004, he acted as the head of the Department of Electronics and Communication Engineering, and from 2004 to 2010, he was the dean of the Electrical and Electronics Engineering Faculty at Istanbul Technical University. Furthermore, Dr. Kuntman is one of the founders of the ELECO conferences and acted as the Conference Chairman several times.

Deniz Özenli received his BSc degree from Istanbul University in electrical and electronics engineering in 2009 and MS as well as PhD degrees from Istanbul Technical University in 2011 and 2018, respectively. He is now an assistant professor in the Department of Electronics Engineering at the Turkish Air Force Academy. He was also visiting assistant professor in the Department of Electrical and Electronics Engineering at Marmara University for the VLSI lectures. His main research interests are analog filters, low-voltage current and voltage mode circuits, computer-aided analog circuit design, VLSI design, as well as image and video processing. During his PhD, he carried out different analog filter applications in the basis of

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