

Preface

Many chaotic circuit models have been developed and studied up to date. Autonomous and nonautonomous Chua's circuits hold a special importance in the studies of chaotic system modeling and chaos-based science and engineering applications. Since a considerable number of hardware and software-based design and implementation approaches can be applied to Chua's circuits, these circuits also constitute excellent educative models that have pedagogical value in the study of nonlinear dynamics and chaos.

In this book, we aim to present some hardware and software-based design and implementation approaches on Chua's circuits with interesting application domain examples by collecting and reworking our previously published works. The book also provides new educational insights for practicing chaotic dynamics in a systematic way in science and engineering undergraduate and graduate education programs. We hope that this book will be a useful practical guide for readers ranging from graduate and advanced undergraduate science and engineering students to nonlinear scientists, electronic engineers, physicists, and chaos researchers.

Organization of the book

Chapter 1 is devoted to autonomous Chua's Circuit which is accepted as a paradigm in nonlinear science. After comparing the circuit topologies proposed for Chua's circuit, the chapter presents several alternative hybrid realizations of Chua's circuit combining circuit topologies

proposed for the nonlinear resistor and the inductor element in the literature.

Numerical simulation and mathematical modeling of a linear or nonlinear dynamic system plays a very important role in analyzing the system and predetermining design parameters prior to its physical realization. Several numerical simulation tools have been used for simulating and modeling of nonlinear dynamical systems. In that context, Chapter 2 presents the use of MATLABTM and SIMULINKTM in dynamic modeling and simulation of Chua's circuit.

Field programmable analog array (FPAA) is a programmable device for analog circuit design and it can be effectively used for programmable and reconfigurable implementations of Chua's circuit. FPAA is more efficient, simpler and economical than using individual op-amps, comparators, analog multipliers and other discrete components used for implementing Chua's circuit and its changeable nonlinear structure. By using this approach, it is possible to obtain a fully programmable Chua's circuit which allows the modification of circuit parameters on the fly. Moreover, nonlinear function blocks used in this chaotic system can be modeled with FPAA programming and a model can be rapidly changed for realizing another nonlinear function. In Chapter 3, we introduce FPAA-based Chua's circuit models using different nonlinear functions in a programmable and reconfigurable form.

In Chapter 4, we describe an interesting switched chaotic circuit using autonomous and nonautonomous Chua's circuits. It is called as "Mixed-mode chaotic circuit (MMCC)". After introducing the original design of MMCC, alternative circuit implementations of the proposed circuit are given in the Chapter.

In order to operate in higher dimensional form of autonomous and nonautonomous Chua's circuits while keeping their original chaotic behaviors, we modified the voltage mode operational amplifier (VOA)-based autonomous Chua's circuit and nonautonomous Murali-Lakshmanan-Chua (MLC) circuit by using a simple experimental method. In Chapter 5, this experimental method and its application to autonomous and nonautonomous Chua's circuits are introduced with simulation and experimental results.

In Chapter 6, we discuss some interesting synchronization applications of Chua's circuits. Besides Chua's circuit realizations described in the previous chapters, some synchronization applications of state-controlled cellular neural network (SC-CNN)-based circuit which is a different version of Chua's circuit are also presented in the Chapter.

In Chapter 7, a versatile laboratory training board for studying Chua's circuits is introduced with sample laboratory experiments. The issues presented in this chapter are for education purposes and they will contribute to studies on nonlinear dynamics and chaos in different disciplines.

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