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Special Issue on
Recent Advances in Nonlinear Circuits: Theory and Applications

Preface

Nonlinear dynamics and especially chaotic behavior appears widely and naturally in many nonlinear dynamical systems; its study has led to a vast multidisciplinary research field, ranging from the natural sciences (chemistry, biology, ecology, physics, etc.) to the social sciences (economics, sociology, etc.) and engineering (electronics, control, communication, security, etc.). From all these fields, electronics seem to attract more interest because of their nature and rapid development. The easy simulation of chaotic phenomena with nonlinear circuits and the great number of applications, which these circuits have, are some of the reasons that appoint the research in this field significant.

Recent advances in nonlinear circuits' theory and computational methodologies have provided new ways of understanding many complex phenomena, via novel tools of nonlinear dynamics. Also, many interesting applications of nonlinear circuits, such as in cryptography, in secure communication systems and in neuronal networks, have been proposed.

This volume includes important scientific papers that will stimulate the continuing efforts to understand the nature of nonlinear circuits. These articles present theoretical, numerical and experimental studies on chaotic dynamics in nonlinear circuits, as well as research on novel chaos synchronization and control methods and new applications.

In more details, the first paper of this volume, by Cuautle, Rodríguez, Santillán, Arreola and Cantera presents the simulation and experimental realization of a multi-scroll chaotic oscillator based on saturated nonlinear function series, while the second one from Volos, Kyprianidis and Stouboulos deals with a very interesting application of this class of systems, that is a text encryption scheme realized with a chaotic pseudo-random bit generator based on the well-known Logistic map. The third paper of the same authors presents the study of various synchronization phenomena (complete, anti-phase and partial synchronization) in the case of resistively coupled (mutually or in a ring connection) non-autonomous, nonlinear circuits. The next paper by Kengne, Tchitnga, Tchagna Kouanou, and Fomethe investigates the dynamics and synchronization of a fractional-order four dimensional nonlinear system based on a two-stage Colpitts oscillator by using the Grünwald-Letnikov method.

The fifth paper by Emanuel Gluskin presents an approximate analytical (structural) superposition in terms of two, or more, α-circuits, which are one-ports circuits named "f-circuits", composed of similar conductors described by a monotonic polynomial, or quasi-polynomial characteristic $i=f(v)$, with $f(v) \sim v^a$. The sixth paper from Vaidyanathan Sundarapandian presents the very interesting subject of anti-synchronization of a novel 3-D chaotic system via active and adaptive controllers, while the next paper of the same author deals with the adaptive synchronization of two novel chaotic systems with hyperbolic sinusoidal and cosinusoidal nonlinearity and unknown parameters.

Next, the design and numerical simulation of a chaotic synchronization between two unidirectionally coupled three-order Jerk circuits with modulus nonlinearity and its application in a secure communication system is presented in the paper written by Sambas, Sanjaya and Mamat. In the ninth paper presented by Maaita, Kyprianidis, Volos, and Meletlidou the study of a nonlinear Duffing-type circuit driven by two voltage sources with different frequencies is investigated numerically showing rich complex dynamics, including phenomena such as quasiperiodicity of 3-tori and chaos. The next paper of Miladi, Feki and Derbe deals with the use of unconventional methods to control the chaotic behavior of switched time systems and its application to a stepper motor. The eleventh paper by Andreatos and Leros presents a novel secure image encryption scheme based on a Chua chaotic noise generator while the last one by Kyprianidis and Makri presents the complex dynamics of a system of FitzHugh-Nagumo type neurons coupled with gap junction under external voltage stimulation.

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