Circuit Modelling, Simulation and Realization of the new Sundarapandian-Pehlivan Chaotic System

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Summary

Sundarapandian and Pehlivan discovered a novel chaotic attractor. Basic dynamical properties of the new attractor system were analyzed by means of equilibrium points, eigenvalue structures, Lyapunov exponents and parameters regions [1]. This paper introduces the electronic circuit modelling, simulation and realization of the newly discovered chaotic attractor. Our investigation was completed using a combination of theoretical analysis, simulations and real experimental implementation. To implement as electronics of this new chaotic system is very easy due to having zero initial conditions.

1 Introduction

The Lorenz system displays very complex dynamical behaviour, especially the well-known two-scroll butterfly-shaped chaotic attractor [2]. Chen constructed another chaotic system [3], which is, nevertheless, not topologically equivalent to the Lorenz's system [3]-[4]. The Chen's system is dual to the Lorenz system and similarly has a simple structure [4]. Lü and Chen found the critical chaotic system [5], which represents the transition between the Lorenz and Chen attractors. Recently, Yang et al. [6] and Pehlivan et al. [7] introduced and analyzed the new 3D chaotic systems with six terms including only two quadratic terms in a form very similar to the Lorenz, Chen, Lü and Yang-Chen systems, but they have two very different fixed points: two stable node-foci.

There has been increasing interest in exploiting chaotic dynamics in engineering applications, where some attention has been focused on effectively creating chaos via simple physical systems, such as electronic circuits [8-12].

Motivated by such previous work Sundarapandian and Pehlivan discovered a novel chaotic attractor [1].

In this paper, Section I introduces the Sundarapandian chaotic system. Section 2 presents the electronic circuit modelling and OrCad-PSpice® simulation results. The real circuit implementation oscilloscope outputs are given in Section 3. Finally, conclusions and discussions are given.

2 Circuit Modelling of the Chaotic System

The simple electronic circuit is modelled that can be used to study chaotic phenomena. The circuit employs simple electronic elements such as resistors, and operational amplifiers, and is easy to construct.

Figure 1 and 2 show Orcad-PSpice simulation result and circuit schematic of the 1new chaotic circuit. In this simulation, parameters and initial conditions are taken as $a=1.5$, $b=0.4$, $c=0.4$, $x_1(0)=0$, $x_2(0)=0$, $x_3(0)=0.1$ respectively.

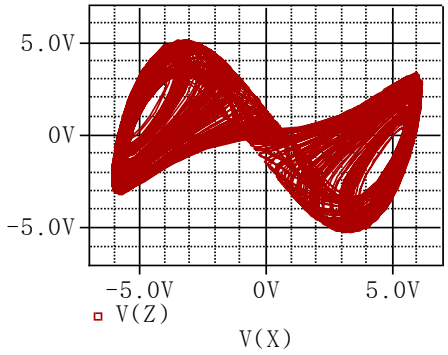

Fig. 1. Pspice Simulation Result of the New Chaotic Circuit (xz-attractor)

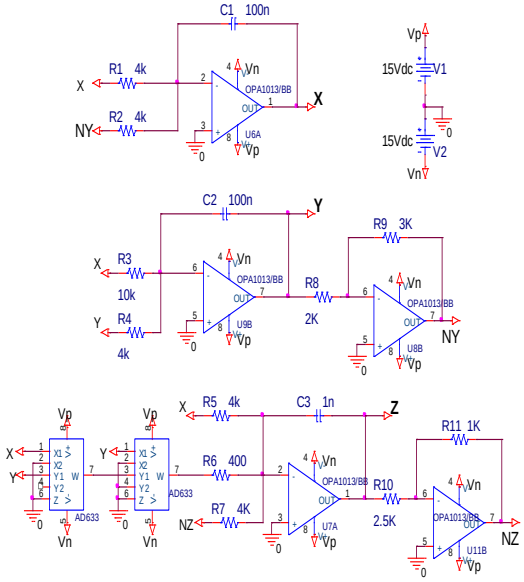

Fig. 2. Circuit Schematic of the New Chaotic Attractor

3 Electronic Circuit Design and Implementation of The New Attractor

Figure 3 shows oscilloscope outputs of the real circuit implementation.

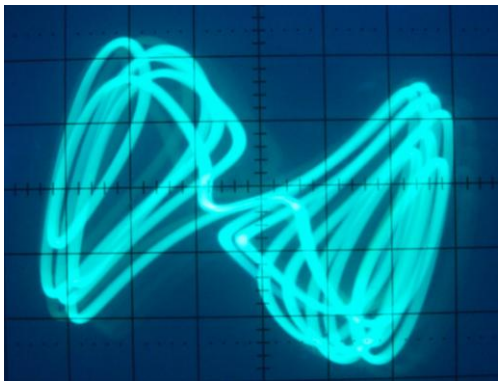

Fig. 3. Oscilloscope output of the real circuit implementation (xz-attractor)

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