Realization Of Sprott Case C Attractor With CCIIs

Yılmaz Uyaroglu[1], İhsan Pehlivan[2]

[1]Sakarya University, Eng. Faculty, Electrical Electronics Engineering Department, 54187, Esentepe Campus, Sakarya, Turkey, uyaroglu@sakarya.edu.tr
[2]Electronics and Computer Education Department, Sakarya University, 54187, Esentepe Campus, Sakarya, Turkey, ipehlivan@sakarya.edu.tr

Summary

The nonlinear autonomous Sprott Case C chaotic equations are algebraically simple but can generate a complex chaotic attractor. In this paper, we propose to realize Sprott Case C Equation known well by using CCIIs. Chaotic electronic implementation of the Sprott Case C attractor was realized using OrCad-PSpice® with CCIIs. We gathered a new design which advocates a wide band of frequencies and prosperously gives the simulation results of Sprott Case C Equation. Chaotic graphics were just the same as other realizations devised before.

1 Introduction

Up to now, various chaotic systems are introduced in[1,7]. Sprott embarked upon an extensive search for autonomous three dimensional chaotic systems with fewer than seven terms in the right hand side of the model equations[8]. Several thousands of chaotic cases were found by using computer programs. Only 33 cases are distinct in the point that their functional forms are different and not related by a trivial transposition of variables. By performing various algebraic transformations on these cases, 15 additional cases were found satisfying for the criterions of simplicity that mentioned above. Of these total 48 (33+15) cases only 19 (Labeled by 'A' to 'S') appear to be distinct in the sense that there is no obvious transformation from one to another. In these 19 ('A' to 'S') cases, 'A' to 'E' (five) have five terms and two nonlinearities while cases 'F' to 'S' (fourteen) have six terms and one nonlinearity in the right hand side. In this search, no case was found fewer than five terms and any number of quadratic nonlinearity, which shows chaotic behavior. Among these nineteen cases, only Case 'A' is conservative (volume preserving) while others are dissipative flows (volume contracting) and shows strange attractors.

This paper focuses on realization of Sprott Case C Attractor with CCIIs. Section II presents the dynamical analyses of Sprott Case C attractor. In Section III, electronic circuit design and PSpice® Simulations of chaotic Sprott Case C system. Finally, conclusions and discussions are given.

2 Dynamical analyses of Sprott Case C attractor

Following Sprott Case C chaotic system was used for realizing the chaotic circuit.

$$\begin{aligned} \dot{x} &= y \cdot z \\ \dot{y} &= x - y \\ \dot{z} &= 1 - x^2 \end{aligned} \qquad (1)$$

Using Matlab-Simulink modeling, xy phase portrait of the Sprott Case C system are achieved in Figure 1.

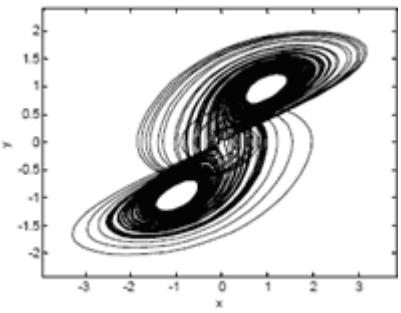

Fig. 1. x-y phase portrait of Sprott Case C Attractor

3 Electronic circuit design and simulation of the Sprott Case C attractor with CCIIs

Chaotic differential equations of the Sprott Case C chaotic circuit are given below.

$$\dot{x} = \frac{1}{R_1C_1} y.z$$

$$\dot{y} = \frac{R_4}{R_2R_5C_2} x - \frac{R_4}{R_3R_5C_2} y \qquad (2)$$

$$\dot{z} = \frac{R_8V_p}{R_7R_9C_3} - \frac{R_8}{R_6R_9C_3.} x^2$$

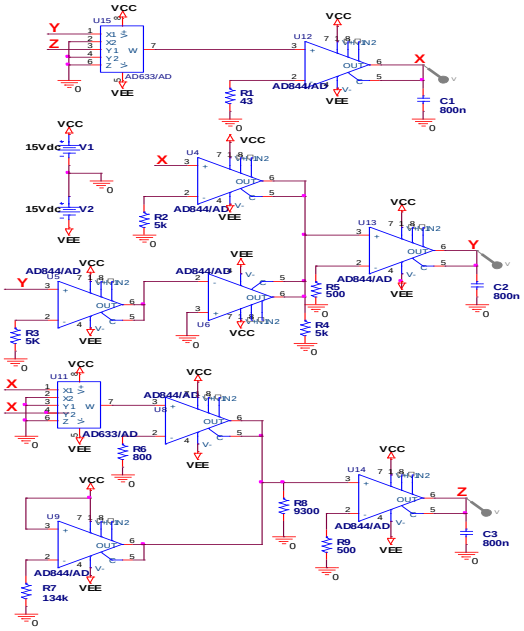

Fig. 2. Circuit Schematic of the Sprott Case C attractor with CCIIs

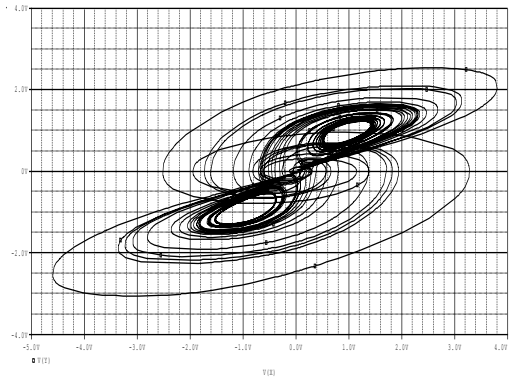

Fig. 3. Pspice Simulation Result of the Sprott Case C attractor with CCIIs (xy-attractor)

Acknowledgement

This work was supported by the Sakarya University Scientific Research Projects Commission Presidency (No. 2010-01-00-002).

References

1. G. Chen and T. Ueta. Yet Another Chaotic Attractor, *International Journal of Bifurcation and Chaos, vol. 9*, no. 7, 1999, pp. 1465-1466.
2. T. Ueta and G. Chen. Bifurcation Analysis of Chen's Attractor, *International Journal of Bifurcation and Chaos, vol. 10*, no.8, 2000, pp. 1917-1931.
3. J. Lü and G. Chen. A New Chaotic Attractor Coined, *International Journal of Bifurcation and Chaos*, vol. *12*, no. 3, 2002, pp. 659-661.
4. Q.G. Yang, Z.C. Wei and G.R. Chen. An Unusual 3D Autonomous Quadratic Chaotic System with Two Stable Node-Foci, *International Journal of Bifurcation and Chaos, vol. 20*, no. 4, 2010, pp. 1061-1083.
5. I. Pehlivan and Y. Uyaroglu. A New Chaotic Attractor from General Lorenz System Family and its Electronic Experimental Implementation, *Turkish Journal of Electrical Engineering and Computer Science, vol. 18*, no. 2, 2010, pp. 171-184.
6. K.M. Cuomo and A.V. Oppenheim. Circuit Implementation of Synchronized Chaos with Applications to Communications, Physical Review Letters, *vol. 71*, no. 1, July 1993, pp. 65-68.
7. V. Sundarapandian and I. Pehlivan. *Analysis, Control, Synchronization and Circuit Design of a Novel Chaotic System.* Mathematical and Computer Modelling, (Accepted 2011., doi:10.1016/j.mcm.2011.11.048)
8. J.C. Sprott. Simple Chaotic Systems and Circuits, *American Journal of Physics, vol. 68*, no. 8, August 2000, pp. 758-763.