Relationship between Keep Time of Attractor States and a Parameter in Coupled Chaotic Circuits

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I. Introduction

Some chaotic circuits have coexisting attractors. There are a few studies of that are focused on synchronization of switching phenomenon. In our past study, we have observed the synchronization of switching phenomena. These phenomena are very interesting since the switching phenomena occurs same time in each circuit though the system keeps asynchronous states at all. Therefore, we investigate the relationship between keep time of attractor states and a parameter.

II. System Model

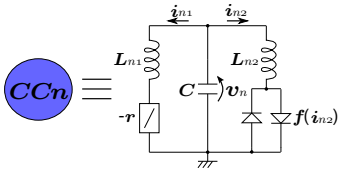

Fig. 1: Chaotic circuit.

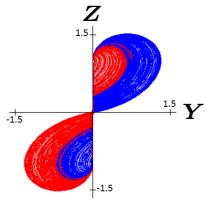

Fig. 2: Coexisting attractor.

Two chaotic circuits coupled by resister are used in this study as a system model. The normalized system equation is described as follows:

$$\begin{cases} \dot{x}_n &= \alpha x_n + z_n \\ \dot{y}_n &= \beta\{z_n - (2u(y_n) - 1)\} \\ \dot{z}_n &= -x_n - y_n - \delta\left(N z_n - \sum_{k=1}^{N} z_k\right) \end{cases} \quad (1)$$

Where $u()$ shows a step function and x_n, y_n and z_n are corresponding to i_{n1}, i_{n2} and v_n, respectively.

Figure 2 shows coexisting attractors which can be observed in Fig. 1. The attractors are classified by colors according to a Poincaré map.

III. Keep time of attractor states

Attractor states definitions are described as Table I. We measured keep time of attractor states in each states. Note that the states C and D have very short keep time because the attractors take the different states each other basically. We investigate the range of the parameter from $\delta = 0.20$ to 0.25. The others are set value as $\alpha = 0.405$ and $\beta = 3.0$ respectively. Figure 3 shows one of the results between keep time of the switching attractors and a parameter. The vertical is on log scale and shows the number of switching. This result shows that the keep time of switching is decreased exponentially as increasing the keep time.

TABLE I
Attractor-states definition.

Attractor1	Attractor2	Definition
Red	Blue	A
Blue	Red	B
Red	Red	C
Blue	Blue	D

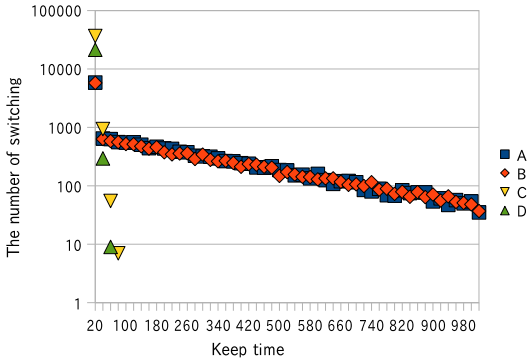

Fig. 3: Keep time of switching attractor.
$\alpha = 0.405$, $\beta = 3.0$ and $\delta = 0.21$.

IV. Conclusion

In this study, we investigate the relationship between a parameter and keep time of attractor states. As a result, increasing coupling strength δ means increasing the keep time.

References

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[2] T. Nishimoto, Y. Hosokawa and Y. Nishio, "Anti-phase Synchronization of Switching Phenomena in Globally Coupled System of Chaotic Circuits," *IEICE Technical Report*, no. NLP-48 & CAS2010-32, pp. 1–4, 2010.