1-6

Dynamic Behavior in Coupled Two Rings of Chaotic Circuits

Katsuki NAKASHIMA Kazuki UETA Yoko UWATE Yoshifumi NISHIO
(Tokushima University)

1. Introduction

Recently, topology of complex networks is studied for influence on the system from various viewpoints. In this study, we investigate the synchronization phenomena of coupled two rings when we use a chaotic circuit. In addition, we observe the synchronization phenomena by increasing the coupling strength.

2. System model

The chaotic circuit is shown in Fig. 1 and the system model is shown in Fig. 2. In this study, we couple three chaotic circuits on the ring structure and we propose a system model that the two rings are coupled via a resistor. A ring chaotic circuit generates chaotic attractor and the other ring generates three-periodic attractors. Then we investigate synchronization phenomena.

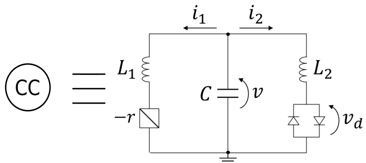

Figure 1: Chaotic circuit.

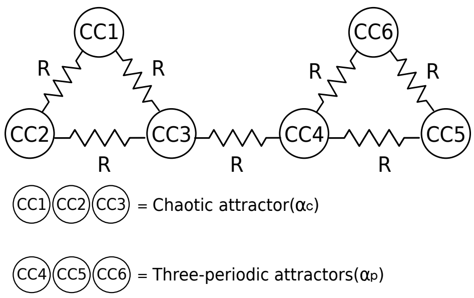

Figure 2: System model.

The normalized equations of chaos circuits are given as follows:

$$\begin{cases} \dfrac{dx_i}{d\tau} = \alpha x_i + z_i \\ \dfrac{dy_i}{d\tau} = z_i - f(y_i) \\ \dfrac{dz_i}{d\tau} = -x_i - \beta y_i - \displaystyle\sum_{i,j=1}^{6} \gamma_{ij}(z_i - z_j) \\ \qquad\qquad (i, j = 1, 2, \cdots, 6). \end{cases} \tag{1}$$

where γ is the coupling strength. $f(y_i)$ is described as follows:

$$f(y_i) = \frac{1}{2}\left(\left|y_i + \frac{1}{\delta}\right| - \left|y_i - \frac{1}{\delta}\right|\right). \tag{2}$$

We define α_c to generate the chaotic attractor, and α_p is defined to generate the three-periodic attractors.

3. Simulation results

We set the parameters of the system as $\alpha_c = 0.460$, $\alpha_p = 0.412$, $\beta = 3.0$ and $\delta = 470.0$. Figure 3 shows atractor of each chaotic circuits and Fig. 4 shows different waveform when we set the coupling strength as $\gamma = 0.001$. CC5 and CC6 of a ring circuit of three-periodic attractors are synchronized. Figure 5 shows atractor of each chaotic circuits and Fig. 6 shows different waveform when we set the coupling strength as $\gamma = 0.23$. In case of $\gamma = 0.23$, CC1 and CC2 are synchronized than CC5 and CC6. Synchronous and asynchronous states changes in the timing of the cycle.

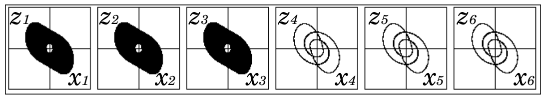

Figure 3: Attractor ($\gamma = 0.001$).

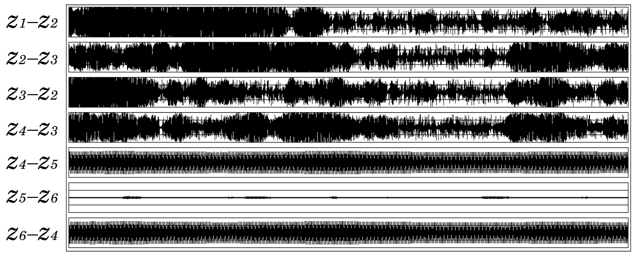

Figure 4: Different waveform ($\gamma = 0.001$).

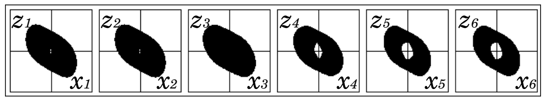

Figure 5: Attractor ($\gamma = 0.23$).

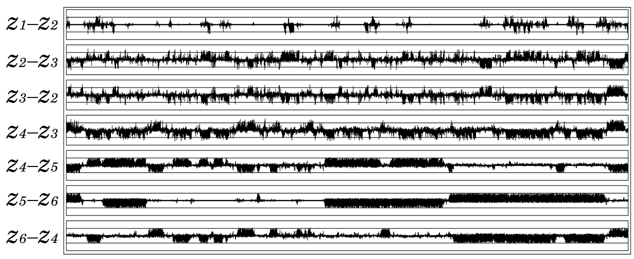

Figure 6: Different waveform ($\gamma = 0.23$).

4. Conclusions

In this study, we have proposed a system model using two ring circuits that are coupled by a resistor. We have invesigated synchronization phenomena by increasing the coupling strength. As a result, chaos solution is synchronized than periodic solution when the coupling strength increases.