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Influence of Memristors as Coupled Element on Chaotic Synchronization of Coupled Chaotic Circuits

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1. Introduction

A memristor was proposed by L. O. Chua in 1971. After that, in 2008, Hewlett-Packard researchers implemented the memristor as a semiconductor element. The memristor is used in many studies of chaotic circuits, because the memristor is the fourth fundamental passive element of the electric circuit.

In this study, the influence of memristor as a coupling element on chaos synchronization of coupled chaos circuit was investigated. Differences of phenomena between a system with memristor and a system without memristor was investigated.

2. System Models

Figures 1 show system models. Figure 1 (1) shows System A. Two Mori-Shinriki circuits are combined at the node of negative resistance with a resistor. Figure 1 (2) shows System B. Two Mori-Shinriki circuits are combined at the node of negative resistance with a resistor and two memristors. It is Figs. 1 combining the nodes of the negative resistance of two Mori-Shinriki circuits with the coupling element. The observed phenomenon was compared between SystemA and SystemB.

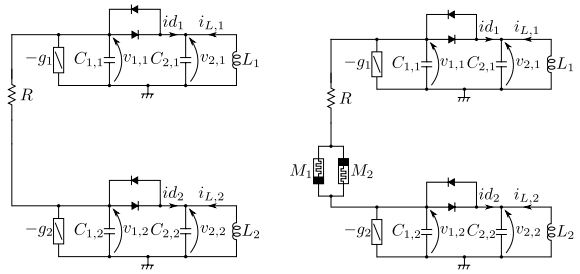

Figure 1: System models. (1)System A. (2)System B.

3. Simulation Results

In this study, circuit equations are derived from the system models and simulated. The resistor R of each system was selected as a controlling parameter. Table 1 shows a relationship between resistor R and observed phenomena. Figures 2 show the simulation results in Tab. 1. Figures 2 (1) shows State A, position of attractors of x_1, x_1 and x_4, x_5 are plus. Figures 2 (2) shows State B, position of attractors of x_1, x_1 and x_4, x_5 are minus.

In System A, synchronization, the state A of Fig. 2 (1), the state B of Fig. 2 (2), and asynchronization were observed. In System B, synchronization, the state B, and asynchronization were observed. From Tab. 1, compared System A to System B, the synchronization range decreased because state A disappeared and state B increased.

Table 1: Relationship between resistor R and observed phenomena.

R	20000Ω	21000Ω	22000Ω	23000Ω	24000Ω	25000Ω
System A						
System B						

R	26000Ω	27000Ω	28000Ω	29000Ω	30000Ω	31000Ω
System A						
System B						

R	32000Ω	33000Ω	34000Ω	35000Ω	36000Ω	37000Ω
System A						
System B						

Synchronization Asynchronization
State A State B

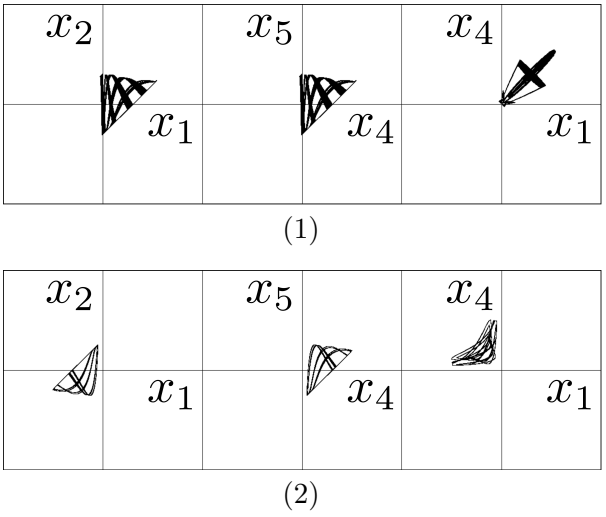

Figure 2: Simulation results of System A. (1)State A. $R = 28\text{k}\Omega$. (2)State B. $R = 34\text{k}\Omega$.

4. Conclusions

In this study, the influence of memristor as a coupling element on chaos synchronization of coupled chaos circuit was investigated. Differences of phenomena between a system with memristor and a system without memristor was investigated. As a result, compared System A with System B, the synchronization range decreased because state A disappeared and state B increased.