

17-21

Simple Chaotic Oscillator Using Two RC Circuits

Shuhei MASUDA Yumiko UCHITANI Yoshifumi NISHIO
(Tokushima University)

1 Introduction

Recently, synchronization phenomena in coupled systems of chaotic oscillators attract many researchers' attentions as interesting phenomena from a mathematic view point of chaos theory. However, a lot of synchronization phenomena of chaos are still veiled and it is necessary to investigate synchronization phenomena of various coupled systems.

In this study, simple chaotic circuits using two coupled RC circuits are proposed. We observe the generation of interesting chaotic phenomenon.

2 Circuit model

Figure 1 shows the circuit model. In the circuit, two RC circuits are coupled via simple comparators of operational amplifiers. The rectangular voltage wave is inputted to the other input terminals of the comparators and the comparators produce the output voltage $\pm E$ which is their power supply voltage according to the input signals.

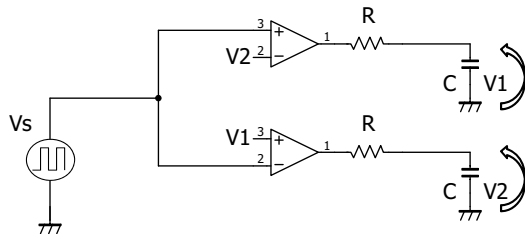


Figure 1: Circuit model.

Figure 2 shows the rectangular voltage wave inputted to the comparators.

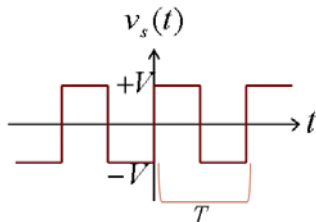


Figure 2: Rectangular voltage wave.

By using the following variables and the parameters,

$$v_1 = Ex_1, \quad v_2 = Ex_2, \quad t = RC\tau, \quad (1)$$

the normalized circuit equations are given as follows.

$$\begin{aligned} x_1 &= k_1 e^{-\tau} \pm 1, \\ x_2 &= k_2 e^{-\tau} \pm 1, \end{aligned} \quad (2)$$

where k_1 and k_2 are the arbitrary constants and \pm are decided according to the outputs of the comparators.

3 Computer calculated results

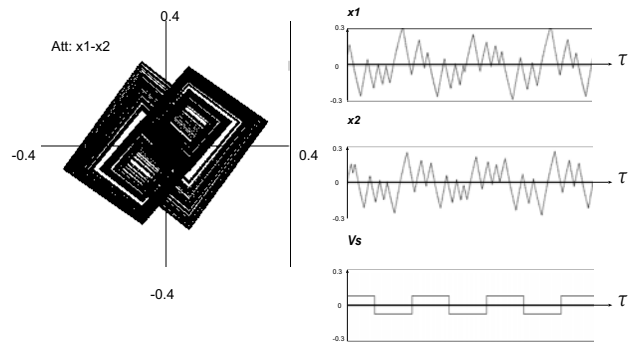


Figure 3: Attractor x_1-x_2 Figure 4: Time waveform.

Figures 3 and 4 show computer calculated results for $V/E = 0.075$ and $T/RC = 3.0$. We can confirm that the circuit exhibits chaos.

4 Circuit experimental results

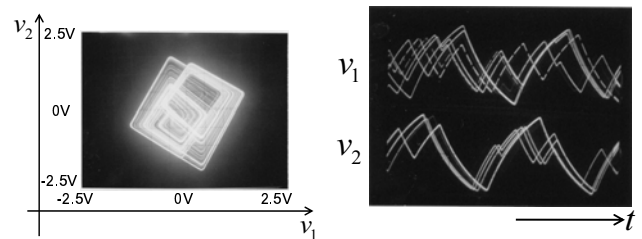


Figure 5: Attractor v_1-v_2 . Figure 6: Time waveform.

Figures 5 and 6 show the circuit experimental results for $C = 47\mu F$ and $R = 1.2\Omega$. These results agree well to the computer calculated results.

5 Conclusions

In this study, we have proposed a simple chaotic oscillator including two RC circuits. We have confirmed that the circuit generated chaotic oscillation by both computer calculations and circuit experiments.