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Investigation of Asymmetrical Coupled Chaotic Circuit Systems

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***Abstract*— In this study, some kinds of asymmetrical asymmetrical coupled chaotic circuit systems are investigated. Systems consist of two kinds of chaotic circuits. Each circuits are coupled globally. In these system, an interesting phenomena including synchronization phenomena are observed. The phenomenon is that a ratio of the synchronization time increases in spite of increasing parameter mismatches in the system.**

I. Introduction

Coupled chaotic systems generate various kinds of complex higher-dimensional phenomena such as spatio-temporal chaotic phenomena, clustering phenomena and so on. One of the most studied systems may be the coupled map lattice proposed by Kaneko[1]. The advantage of the coupled map lattice is its simplicity. However, many of nonlinear phenomena generated in nature would be not so simple. Therefore, it is important to investigate the complex phenomena observed in natural physical systems such as electric circuits systems

In this study, some kinds of asymmetrical global coupled chaotic systems are investigated. Especially, we pay attention to relationships between synchronization phenomena and small parameter mismatches. In these systems, an interesting phenomenon is observed. The phenomenon is that a ratio of the synchronization time increases in spite of increasing parameter mismatches in the system.

II. System Model

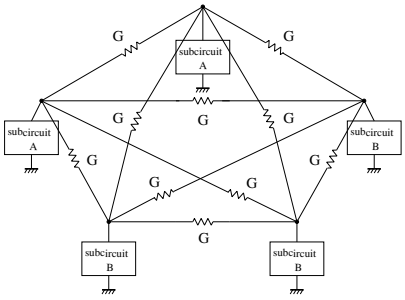

Fig. 1. System Model

Figure 1 shows a system model in this study. This system consists of two kinds of subcircuits and resistors as coupling elements. Subcircuits are coupled globally. An asymmetry of the system is realized by using two kinds of subcircuits (subcircuit A and B). Figure 2 shows one of the computer simulation results. In this case, Shinriki's circuit[2] is applied as subcircuits. The asymmetry is realized by using two coupling point. Horizontal axis shows small parameter mismatches (Q) and vertical axis shows the ratio of the synchronization time. The ratio of the synchronization time of A-subcircuit is increased by increasing small parameter mismatches. Normally, the ratio of the synchronization time is decreased by increasing small parameter mismatches. However, this phenomena show the opposite result. We suppose that the phenomenon can be explained as follows. The synchronizations of the one subcircuit group and the other subcircuit group are constricted each other. Therefore, in the case of decreasing the synchronization of one group, the synchronization of the other group increases. Same phenomena are observed other systems.

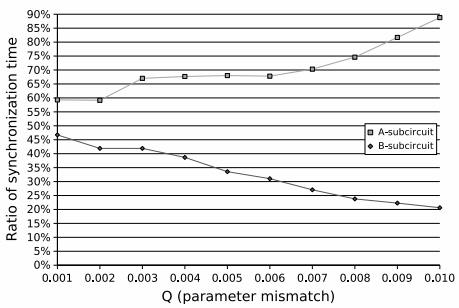

Fig. 2. Relationship of the ratio of the synchronization time and small parameter mismatches. $m = 2$, $n = 3$, $p_k = 0.001(k-1)$, $\alpha = 0.400$, $\beta = 0.500$, $\gamma = 20.0$ and $\delta = 0.070$

III. Conclusions

In this study, we reported about an investigation of asymmetrical coupled chaotic circuit systems.

References

[1] K. Kaneko, "Clustering, Coding, Switching, Hierarchical Ordering, and Control in a Network of Chaotic Elements," *Physica D*, vol. 41, pp. 137–172, 1990.

[2] M. Shinriki, M. Yamamoto and S. Mori, "Multimode Oscillations in a Modified van der Pol Oscillator Containing a Positive Nonlinear Conductance," *Proc. IEEE*, vol. 69, pp. 394–395, 1981.