# Synchronization State of Coupled Chaotic Circuits with Changing Time Delay

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## SUMMARY

In the natural world there are many nonlinear systems containing time delay, such as neural networks, control systems, meteorological systems, biological systems and so on. Namely, stability of such delay systems is important to elucidate these phenomena [1]. Generation of chaos of them all is reported self excited oscillation system containing time delay. This chaotic circuit can be easily realized by using simple electric circuit element and analyzed exactly [2]. There are examples of nonlinear phenomena, chaotic synchronization, clustering phenomenon and so on [3]. In particular, a number of studies on synchronization of coupled chaotic circuits have been made [4]. In previous study, we have investigated synchronization state observed in coupled time delayed chaotic circuits by inductor [5]. Coupled nonlinear circuits by inductor can be observed in-phase and anti-phase synchronization states [6][7]. As a result, two types of synchronization state is caused by increasing the chaotic strength of subcircuit. In roughly divided, two types of synchronization states depending on initial values and number of subcircuits can be observed. Moreover, synchronization state can be classified by the number of coupled chaotic circuit whether the number is even or odd.

In this study, we investigate synchronization states observed in coupled chaotic circuits with time delay by inductor. Time delay of chaotic circuit depends types of attractor. We focus on relationships between synchronization state and time delay. Single type synchronization state can be observed by changing time delay of subcircuits. Coexisting synchronization states depending on the initial values can be observed in specific time delay values. By carrying out computer simulations, we investigate the effect of various time delay values on the subcircuit to changing synchronization states.

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