Investigation of Clustering Phenomena in Coupled Chaotic Circuits

T. Nara, Y. Uwate, Y. Nishio

Tokushima University

{*nara, uwate, nishio*}*@ee.tokushima-u.ac.jp*

Clustering phenomena is one of interesting nonlinear phenomena observed from coupled chaotic circuits. Previously, many of studies for clustering have been carried out for discrete time model, for example Coupled Map Lattics (CML) and Self Organization Map (SOM) [1]-[2] and so on. However, analysis of using a continuous time model has not almost studied. Therefore, we focus on research of clustering phenomena using real electronic circuits in continuous time model.

On the other hand, coupled chaotic circuits that is real electronic circuits can be observed various amusing phenomenas. In recent years, many methods are studied to apply to clustering and synchronization phenomena observed in coupled chaotic circuits for natural sciences. At the same time, synchronization phenomena and clustering have been studied associated with the chaos phenomena [3]-[4].

In this study, the chaotic circuits arrange in 3-dimensional space. Futher, we investigate synchronizaiotn phenomena and clustering phenomena when the arrangement of coupled chaotic circuits reflect distance information. Then, we observe the synchronization phenomena with computer simulation. The chaotic circuit is shown in Fig. 1.

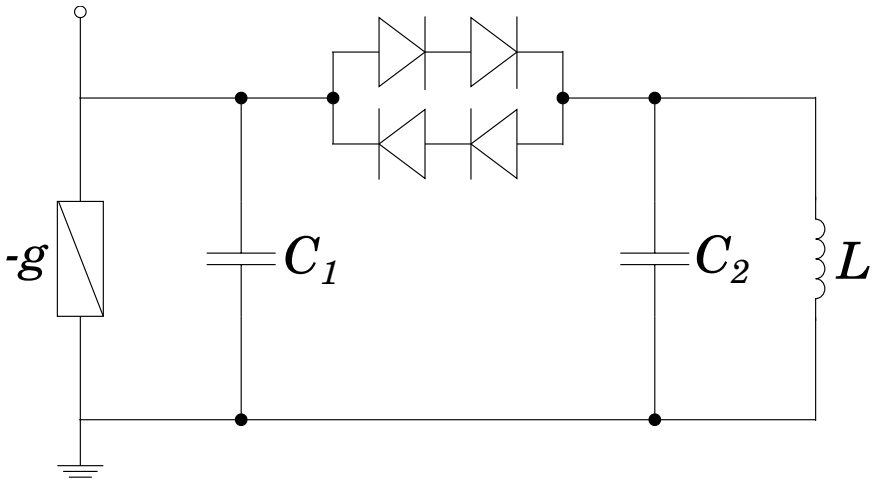

Figure 1: Circuit model.

Table 1 and Fig. 2 show the arrangement of chaotic circuits. All circuits are connected each other by resistors.

Table 1: The arrangement of chaotic circuits.

arrangement	x	y	z	arrangement	x	y	z	arrangementn	x	y	z
1	0.15	0.05	0.15	11	0.35	0.05	0.25	21	0.75	0.85	0.70
2	0.20	0.25	0.30	12	0.25	0.05	0.35	22	0.85	0.80	0.85
3	0.35	0.35	0.25	13	0.75	0.15	0.25	23	0.60	0.60	0.60
4	0.25	0.25	0.05	14	0.95	0.30	0.35	24	0.80	0.65	0.90
5	0.30	0.15	0.05	15	0.80	0.15	0.10	25	0.65	0.80	0.80
6	0.05	0.20	0.10	16	0.80	0.20	0.15	26	0.65	0.65	0.85
7	0.15	0.30	0.15	17	0.85	0.15	0.05	27	0.95	0.95	0.95
8	0.05	0.05	0.25	18	0.70	0.60	0.95	28	0.90	0.65	0.75
9	0.20	0.05	0.35	19	0.90	0.80	0.85	29	0.70	0.85	0.65
10	0.25	0.10	0.20	20	0.80	0.95	0.75	30	0.75	0.80	0.85

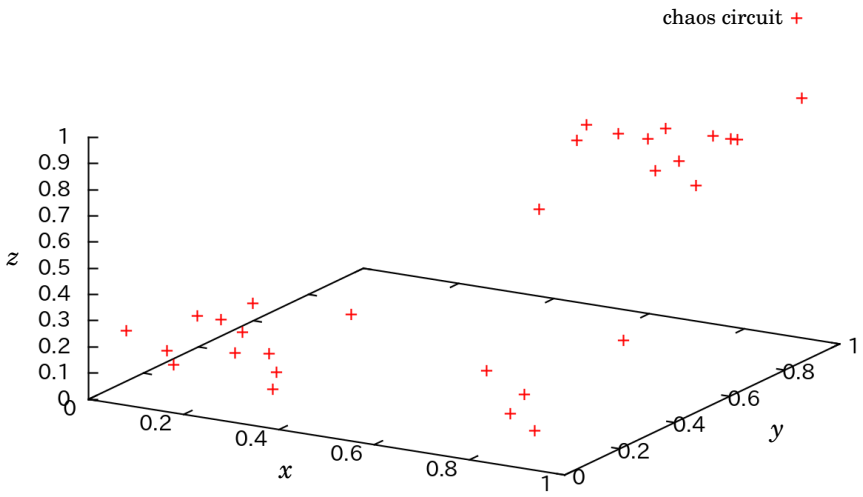

Figure 2: Chaotic circuits arrangement of 3-dimensional space.

References

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

[2] L. Angelini, F. D. Carlo, C. Marangi, M. Pellicoro and S. Stramaglia, "Clustering Data by Inhomogeneous Chaotic Map Lattice", *Phys. Rev. Lett.*, 85, pp. 554-557, 2000.

[3] Y. Takamaru, H. Kataoka, Y. Uwate and Y. Nishio, "Clustering Phenomena in Complex Networks of Chaotic Circuits", Proceedings of IEEE International Symposium on Circuits and Systems (ISCAS'12), pp. 914-917, May 2012.

[4] T. Chikazawa, Y. Uwate, Y. Nishio. "Investigation of Spreading Chaotic Behavior in Coupled Chaotic Circuit Networks with Various Features", Proceedings of RISP International Workshop on Nonlinear Circuits, Communications and Signal Processing (NCSP'17), pp. 337-340, Feb. 2017.