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Ratio of Chaotic Propagation According Network Topology in Complex Networks with Coupled Chaotic Circuits

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I. SUMMERY

In the complex network, various type of propagation have attracted a great deal of attention from various fields. The pandemic outbreak of viral infection and the traffic jam of the transportation network are mentioned as an example of propagation in the real network. In the biology, mechanism of the communication in nerve cells and viral infection have not figure out yet. Furthermore, it is difficult to analyze propagation mechanism. So, we can prevent the unknown virus spreading if we comprehend the mechanism of the communication in nerve cells and viral infection. Additionally, it is important to investigate propagation phenomena observed from coupled chaotic circuits for future engineering applications. However, there are not many studies of large-scale network of continuous-time real physical systems such as electrical circuits.

In this study, we investigate the ratio of chaotic propagation according network topology in complex networks. We propose different topology networks using of chaotic circuits coupled by the resistors. Additionally, we propose the system model according network topology. Network topological structures in complex networks of N nodes and E edges can be evaluated by the typical three types structural metrics (degree, clustering coefficient and path length). First, degree (k) is the number of edges which is connected on a node. Second, clustering coefficient (C) shows the number of actual links between neighbors of a node divided by the number of possible links between those neighbors. Third, path length(L) shows the shortest path in the network between two nodes. These are given as follows;

$$C = \frac{1}{N}\sum_{n=1}^{N} C_n = \frac{1}{N}\sum_{n=1}^{N} \frac{2E_n}{k_n(k_n-1)}. \qquad (1)$$

$$L = \frac{2}{N(N-1)}\sum_{m=1}^{N-1}\sum_{n=m+1}^{N} l(m,n). \qquad (2)$$

In this system model, one circuit is set to generate chaotic attractor and the other circuits are set to generate three-periodic attractors. First, we observe how to spread of chaotic behavior by increasing the coupling strength. Moreover, we investigate ratio of propagation by changing the initial position of chaos attractor. Finally, we changed the positions of chaotic attractor and three-periodic attractors according to network topology.