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Performance of Information Transmission from Perspective of Complex Networks Consisting of Oscillators

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1. Introduction

In the last decade, the performance of communication networks has been studied in terms of complex networks, where some properties are closely related to real-world networks. In this study, we first investigate the synchronization between nodes in complex networks and then investigate the network performance by relating the synchronization to the efficiency of information transmission.

2. System Model

Figure 1 shows van der Pol oscillator. Figure 2 shows Barabási Albert scale-free network (BA scale-free) and the number of nodes N=100. Further the network model composed of oscillators are used to calculate the synchronization rate between each node.

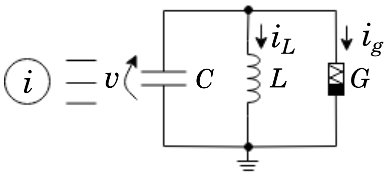

Figure 1: Oscillator.

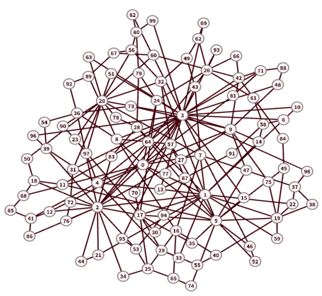

Figure 2: Network model.

3. Information Transmission Algorithm

In this study, information is represented as packets. Packets are generated by the host nodes and transmit through the links one hop at a step until they reach the destinations. Also, each node in the network has a buffer B. Then, the packets transmission algorithm operates as follows:

1. Packets Generarion
   At each time step, hosts generate R packets.
2. Packets Transmission
   The number of transmitting packets for node per step is S. At each time step, packets of each node are forwarded to their destinations by one step according to the shortest path routing algorithm.
3. Packets Dropped
   If the total number of packets reaching one node is larger than buffer size B, transmitted packets are dropped.
4. Packets Released
   Packets already arrived at their destinations are released from the buffer.

Further we consider performance parameter to compare the performance of packets transmission. It is the arrival rate σ and the equation for parameter is defined as follows:

$$\sigma = \frac{number\ of\ arrival\ packets}{time\ step}. \quad (1)$$

4. Results

In this study, the simulation parameters the buffer size for each node B=100 and the number of transmitting packets S is set in three patterns. The first sets the S of each node randomly. The second sets the S of all nodes constant. The third is to set S based on the synchronization rate. Further the total number of time steps T=2000 and the relationship between the average arrival rate $\tilde{\sigma}$ and the number of generating packets R is shown in Fig. 3.

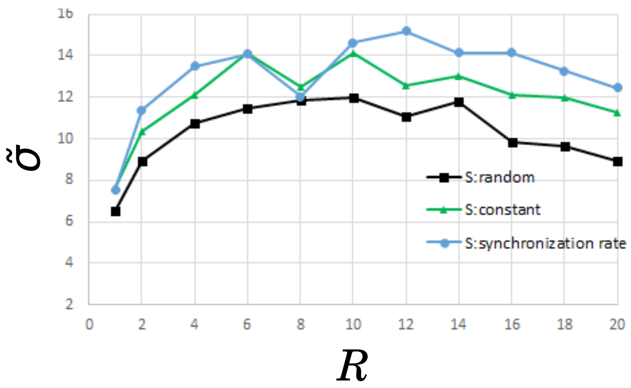

Figure 3: The relationship between the average arrival rate $\tilde{\sigma}$ and the number of generating packets R.

From Fig. 3, it is confirmed that $\tilde{\sigma}$ is large when S is set based on the synchronization rate and $\tilde{\sigma}$ is small when S is set to random.

5. Conclusion

In this study, we calculated the synchronization rates between each node using network model composed of oscillators and investigated the performance of information transmission when the synchronization rate was taken into account in the number of transmitting packets S.

As a result, it was confirmed that the average arrival rate $\tilde{\sigma}$ is large.