

Synchronization Phenomena of Izhikevich Neuron Model as a Ladder Network

Ryota Oshima, Yoko Uwate and Yoshifumi Nishio
Tokushima University
Email: {ryota, uwate, nishio}@ee.tokushima-u.ac.jp

SUMMARY

The neural network has been widely studied and applied in various fields. Neural network is calculation models which can replicate some functions of human brain. Among these, we focus on neural firing.

In recent years, nonlinear behaviors and their underlying dynamics in biology, especially in the patterns of neural firing, have attracted much attention. Myriad of neurons exist in our brain. Information processing and transmission are performed by neural firing. Neural firing is a precipitous membrane potential change. Understanding the intention from our brain is possible by analyzing the neural firing. In addition, it is important to consider the synchronous firing in the firing of neurons. Synchronous firing has a role to switch the state of the nerve network to the next state. However, it is difficult to analyze neural firing because the neural firing happens by the complex network in our brain.

In this study, we investigate synchronization phenomena of ladder network which has four Izhikevich neurons coupled by gap junction. The Izhikevich neuron model [1][2] is presented that reproduces spiking and bursting behavior of known types of cortical neurons. We prepared Izhikevich neurons which have three kind of firing patterns. As a result, neurons settled in one of the firing pattern when coupling strengths are enhanced. In addition, we observe the synchronization phenomena between neurons.

REFERENCES

- [1] Eugene M. Izhikevich, "Simple Model of Spiking Neurons," IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 14, NO. 6, NOVEMBER 2003.
- [2] Eugene M. Izhikevich, "Which Model to Use for Cortical Spiking Neurons?," IEEE TRANSACTIONS ON NEURAL NETWORKS, VOL. 15, NO. 5, SEPTEMBER 2004.