VARIANCE OF SPATIOTEMPORAL SPIKING PATTERNS BY DIFFERENT STIMULATED NEURONS IN CULTURED NEURONAL NETWORKS

Yoshi Nishitani[1], Chie Hosokawa[2], Yuko Mizuno-Matsumoto[3], Tomomitsu Miyoshi[4], Hajime Sawai[5] & Shinichi Tamura[6]
[1]Dept. of Radiology, Graduate School of Medicine, Osaka University, Suita 565-0871, **JAPAN**
[2]Health Research Institute, AIST, Ikeda, Osaka 563-8577, **JAPAN**
[3]Graduate School of Applied Informatics, University of Hyogo, Kobe 650-0044, **JAPAN**
[4]Dept. of Integrative Physiology, Graduate School of Medicine, Osaka University, Suita 565-0871, **JAPAN**
[5]College of Health and Human Sciences, Osaka Prefecture University, Habikino, Osaka 583-8555, **JAPAN**
[6]NBL Technovator Co., Ltd., 631 Shindachimakino, Sennan 590-0522, **JAPAN**

ABSTRACT

How a neuronal network of ambiguously behaving neurons establishes a highly reliable information processing system, distinct data communication, and organized communication links remains unclear. To solve this mystery, we must spatiotemporally analyze the spike trains in neuronal networks. In our previous study, we observed spike propagation as a cluster of excitation waves in simulated neuronal networks. We call this phenomenon spike wave propagation. In this paper, we attempted to observe spike wave propagation in cultured neuronal networks. In addition, we tried to calculate the dynamic time warping (DTW) distance of the temporal spiking forms spread from several different stimulated neurons in the cultured neuronal network. Using this distance, called the Inter DTW distance, we investigate whether stimulated neurons can be similarly identified in physiological neuronal networks. To this end, we subjected the same neurons to 5 stimulation events and calculated the DTW distances within the trials. The resulting distances, called the Local DTW distances, were significantly smaller than the Inter DTW distances, particularly for neurons far from the stimulated neurons. Moreover, the spatial patterns of the electrodes in this scenario were significantly different for different stimulated neurons. These results suggest that stimulated neurons can identify distant neurons by the spatiotemporal patterns in the network and that distinct data communications occur via multiple communication links in the brain.

Keywords: Cultured neuronal networks, Spike wave, Spatialtemporal patterns.