S 15-2

READING NEURONAL SPIKE SEQUENCES

Shigeru Shinomoto

Department of Physics, Kyoto University, Kyoto, Japan

(1) The firing rates of cortical neurons change in time; yet, some aspects of their in vivo firing characteristics remain unchanged and are specific to individual neurons. Our recent study has shown that cortical neurons can be grouped into several firing types according to a measure of local variation of interspike intervals, Lv. The neocortex consists of heterogeneous neurons that differ not only from one cortical area to another, but also from one layer to another in their spiking patterns. (2) We propose an objective method for selecting the bin size of a time-histogram from the spike data, so that the resulting time-histogram best approximates the unknown underlying rate. It is notable that the optimal bin size diverges if only a small number of experimental trials are available from a moderately fluctuating rate process. In this case, any attempt at characterizing the underlying spike rate will lead to spurious results. Given a paucity of data, our method can also suggest how many more trials are needed until the set of data can be analyzed with the required resolution.

S 15-3

LEARNING AND MEMORY IN THE PREFRONTAL CORTEX

Min W. Jung, Eun H. Baeg and Yun B. Kim

Neuroscience Laboratory, Institute for Medical Sciences, Ajou University School of Medicine, Suwon, Korea

The ability to modify behavioral strategies in accordance with changes in environment is necessary for survival. The prefrontal cortex (PFC) is likely to be engaged in this adaptive process considering that one important function of the PFC is the planning of future behaviors. To test whether the PFC modifies its activities based on past experience, we investigated learning-induced changes in neural activity and synaptic plasticity in the rat PFC. Single neuron recording studies in behaving animals revealed that PFC neural activities change rapidly in parallel with behavior learning. Moreover, correlated spiking among neurons was altered in the process of learning, and long-term potentiation was induced by high-frequency stimulation in sensory cortical projections to the PFC. These results suggest that PFC neural activity changes dynamically in the process of learning, presumably as a consequence of synaptic weight modification in the PFC. In over-trained animals, correlated spiking among neurons remained similar although neuronal activity varied across two different behavioral tasks. These results are fully consistent with the view that multiple behavioral strategies are represented in a distributed and overlapping manner in the PFC neural network. Our study highlights the importance of learning and memory as an essential component of PFC functions.