Abstract of Presentation

Name	**Affiliation**
Ikuko Nishikawa	Ritsumeikan University

Research interest: **(URL:** http://www.sys.ci.ritsumei.ac.jp/**)**

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Presentation Title:

Estimation of the neural circuit for the command generation in the premotor center of an insect brain

Abstract :

We report an approach to estimate the functional connection from the possible anatomical connections and physiological response of each neuron. Here we focus on the brain of *Bombyx mori*, a male silkmoth, which exhibits a programmed behavior for the pheromone orientation on a pheromone detection [1]. The neuroethological experiments revealed that the motor command is generated in the premotor center, composed of the lateral accessory lobe (LAL) and the ventral protocerebrum (VPC). The morphology and the physiological response to the pheromone stimulus are obtained for each main type of LAL-VPC neuron through the intensive electrophysiological and immunohistochemical experiments[2]. However, how the motor command is generated in LAL-VPC, or the information pathway in the network, is still unknown. That is, each piece of puzzle is fairly well investigated, though they are not yet fit in to reveal the whole picture. The goal of our present study is to investigate the functional connection in LAL-VPC to elucidate the mechanism of the motor command generation for the programmed behavior.

The present approach is to consider an artificial three-layered neural network based on the experimental findings of LAL-VPC neuron[2]. Each input/output unit corresponds to one type of neuron. Each connection corresponds to input/output terminal of a neuron. And each hidden unit corresponds to a neuropile region, where LAL-VPC neurons connect each other. To describe the discrete time dynamics of LAL-VPC, input unit expresses a neuron state at time t, while corresponding output unit expresses its state at t+1. Input/output signals are given by the physiology data of each neuron. Then, back-propagation (BP) algorithm is used to obtain the connection weight, which corresponds to the functional connection strength to generate the LAL-VPC dynamics.

The network has 86 units for input/output layers, 10 hidden units, and 189 connections based on the experimental data. Among 2,000 BP trials, about 10% attained the error below a certain threshold, converging to the close connection vectors. 61 connections are zero, that is, one third of the anatomically observed connections are not used. Several main connections correspond to each physiological type. Two neurons fail to reproduce the observed physiology, for which missing connections are predicted. An extended framework using more extensive data followed by a simulation is now undergoing, to reveal the dynamics in LAL-VPC by integrating the multi-level neuron data.

[1] Kanzaki, R. et al.: Morphology and physiology of pheromone- triggered flipflopping descending interneurons of the male silkworm moth, *Bombyx mori*. *J Comp Physiol A*, **175:**1-14 (1994)

[2] Iwano, M. et al.: Neurons Associated With the Flip-Flop Activity in the Lateral Accessory Lobe and Ventral Protocerebrum of the Silkworm Moth Brain. *J Comparative Neurology, Research in Systems Neuroscience*, **518**:366-388 (2010)