論文内容の要旨

論文題目 Analysis of development of visual system through synaptic plasticity

（シナプス可塑性による視覚系の学習機構に関する研究）

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The development of direction selectivity in the visual system depends on visual experience. In the developing *Xenopus* retinotectal system, tectal neurons (TNs) become direction-selective through spike timing-dependent plasticity (STDP) after repetitive retinal exposure to a moving bar in a specific direction. I investigated the mechanism responsible for the development of direction selectivity in the *Xenopus* retinotectal system using a neural circuit model with STDP. In this retinotectal circuit model, a moving bar stimulated the retinal ganglion cells (RGCs), which provided feed-forward excitation to the TNs and interneurons (INs). The INs provided delayed feed-forward inhibition to the TNs. The TNs also received feedback excitation from neighboring TNs. As a synaptic learning rule, we developed a molecular STDP model and used this model for synapses between the RGCs and TNs. The retinotectal circuit model reproduced experimentally observed features of the development of direction selectivity, such as increase in input to the TN. The peak of

feed-forward excitation from RGCs to TNs shifted earlier as a result of STDP. Together with the delayed feed-forward inhibition, a stronger earlier transient feed-forward signal was generated, which exceeded the threshold of the feedback excitation from the neighboring TNs and resulted in amplification of input to the TN. The suppression of the delayed feed-forward inhibition resulted in the development of orientation selectivity rather than direction selectivity, indicating the pivotal role of the delayed feed-forward inhibition in direction selectivity. Thus, I propose a mechanism for the development of direction selectivity involving a delayed feed-forward inhibition with STDP and the amplification of feedback excitation.