# SUMMARY OF Ph.D. DISSERTATION

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Title

Time series information processing using pulse neural networks


Abstract

This paper considers pulse neural networks models for time series information processing. Compared to conventional integrator type neuron models, a pulse neuron is a model more similar to biological neurons. Therefore, it is expected that pulse neural networks might be able to achieve highly intelligent information processing which could not be realized with conventional neural networks. The major advantages of the pulse neuron model include: easiness to implement on a hardware device, easiness to implement physiological properties of real neurons, and the ability to process time series information. Among those advantages, we focus on the ability to process time series information in order to invent pulse neural network models with high engineering usefulness.

This paper is composed of two researches to achieve this goal. The first research considers reinforcement learning algorithms for pulse neural networks. Reinforcement learning is applicable to wider variety of problems than the other learning methods. In addition, recent physiological researches suggest that reinforcement learning is used in animal brains. From this viewpoint, we propose two different pulse neural network models with reinforcement learning algorithms based on dynamic growth of the network and neurons.

The other research considers the implementation of physiological properties found on real neurons, and its application. From this viewpoint, we propose a pulse neural network model composed of neurons with short-term synaptic depression. The short term synaptic depression is a behaviour found in animal brains recently. We applied this property to dynamic attention control on movies.

We carried out several computer simulations for all of these network models to confirm their usefulness.