Sensorimotor Control Learning using a New Adaptive Spiking Neuro-Fuzzy Machine, Spike-IDS and STDP

Abstract:
Human mind from system perspective deals with high dimensional complex world as an adaptive Multi-Input Multi-Output complex system. This view is theorized by reductionism theory in philosophy of mind, where the world is represented as logical combination of simpler sub-systems for human so that operate with less energy. On the other hand, Human usually uses linguistic rules to describe and manipulate his expert knowledge about the world; the way that is well modeled by Fuzzy Logic. But how such a symbolic form of knowledge can be encoded and stored in plausible neural circuitry? Based on mentioned postulates, we have proposed an adaptive Neuro-Fuzzy machine in order to model a rule-based MIMO system as logical combination of spatially distributed Single-Input Single-Output sub-systems. Each SISO systems as sensory and processing layer of the inference system, construct a single rule and learning process is handled by a Hebbian-like Spike-Time Dependent Plasticity (STDP).
Plasticity. To shape a concrete knowledge about the whole system, extracted features of SISO neural systems (or equivalently the rules associated with SISO systems) are combined. To exhibit the system applicability, a single link cart-pole balancer as a sensory-motor learning task, has been simulated. The system is provided by reinforcement feedback from environment and is able to learn how to get expert and achieve a successful policy to perform motor control.

Stichworte:
Sensorimotor Control Learning; Spiking Neural Networks; Neuro- Fuzzy; Spike Time Dependent Plasticity; Cart-Pole balancing

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