Hybrid discrete-time neural networks

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Abstract

This talk is concerned with hybrid dynamical systems, which combine evolution equations with state transitions. When the evolution equations are discrete-time (also called map-based), this is a hybrid discrete-time system. A class of biological neural network models belongs to the so-called hybrid discrete-time system, that is, N identical map-based neuron models are connected by means of electrical and chemical synapses with fast threshold modulations (FTM). FTM is a connection scheme that can mimic the switching dynamics of a neuron subject to synaptic inputs. The dynamic equations of the neuron can be modeled by different forms and types, for example, depending on the state (either firing or not firing) and type (excitatory or inhibitory) of their presynaptic neighbors. In this talk, first of all, we will review previous work within the context of hybrid discrete-time neuron models, exemplifying useful techniques to analyze them. Secondly, we will discuss the global stability region and the emergent phenomenon of a model that includes electrical synapses in addition to chemical synapses with FTM under three different connecting ways. We will analyze how bifurcations and master stability functions can predict the stability of synchronized states in these three common networks. These main results are extended to relatively larger map-based neural networks.

References