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Multistability in the Kuramoto model with synaptic plasticity

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Abstract

We present a simplified phase model for neuronal dynamics with spike timing-dependent plasticity (STDP). For asymmetric, experimentally observed STDP we find multistability: a co-existence of a fully synchronized, a fully desynchronized and a variety of cluster states in a wide enough range of the parameter space. The multistability can occur only for asymmetric STDP, and we study how the co-existence of synchronization and desynchronization and clustering depends on the distribution of the eigenfrequencies. The efficacy of the proposed method is tested on the Kuramoto model which is, de facto, one of the sample models for description of the phase dynamics in neuronal ensembles. We discuss possible consequences of our results in the context of therapeutic brain stimulation techniques.