

Geometrical Effect on Dynamic Structures of a Plastic Spiking Network

Chun-Chung Chen

Institute of Physics, Academia Sinica

While the functioning activities of a biological network are largely determined by its structure, often the structure of the network itself is, in turn, determined by the activities. This plasticity underlies the process of learning in network of neurons. We consider a simple model of such a system based on spike-timing-dependent plasticity on a network of leaky-integrate-and-fire neurons constrained on a two-dimensional space with short-range connectivity. Non-uniform connection strength emerges in the transition region of the system between the noise-dominated and self-sustaining-activity regimes. We show the resulting structures in the connection strength represent the formation of local preferred propagation directions. On a global scale this directional field organizes a cyclic firing order similar to the path or ring type structures in earlier results on fully-connected network. In contrast with the earlier results, the geometrical constrain suppresses the formation of the hub like structures possibly through the limiting short-range connectivity.