

[04/11/2015 - P002]

Temporal Correlation Between Stimulus And Response In Spiking Neural Networks,

EDUARDA DEMORI SUSIN, BEATRIZ EYMI PIMENTEL MIZUSAKI, RUBEM ERICHSEN JÚNIOR, LEONARDO GREGORY BRUNET, *UFRGS* ■

It is well known that temporal processing on time scales of tens and hundreds of milliseconds plays an important role in simple and complex sensory problems in the brain, such as, motion discrimination, and speech recognition. Recent studies showed that cultured cortical networks can be shaped by the history of an external stimulus by reflecting the temporal patterns of these stimuli in the network dynamics, suggesting that cortical networks are capable of learning the stimulus time scales. Although one might know that synaptic plasticity may be a key process in this phenomenon, the detailed process underlying it still demands for an explanation.

In this work we are concerned in exploring, mathematically and computationally, by means of a bottom-up model, the possible mechanisms that take place in these time events. For that we make use of a conductance-based integrate-and-fire model with a spike-timing-dependent-plasticity (STDP) rule. We train the network with a special-temporal pattern, similar to previous experimental works, and search for the network topology and plasticity effects. We use networks with three different topological connections: random, regular square lattices and small world, with different connectivity and connection probabilities, and change gradually the parameters of the STDP model in order to control the plasticity action.

We have verified that the minimum frequencies that allow a self-sustained activity is closely dependent of network size. Namely small networks demand higher frequencies than bigger ones, and usually asynchronous irregular (AI) states are only found in large networks. Assuming that this kind of state is important for modeling, since it is observed in an awake cortex, we also added poissonian processes in a fraction of neurons randomly chosen, mimicking a network of bigger size. This produced the expected AI behavior and turned possible the use of realistic synaptic weights and the acquisition of firing rates of ~ 10 Hz. This work is still in progress, and the step we are implementing now is the fine tuning of the stimulus-response system. This will allow us to evaluate the time scales for which the network is able to respond to the stimulus.