COMPUTATIONAL MODELING OF FEAR MEMORY ALLOCATION IN AMYGDALAR NEURONAL POPULATIONS

Stelios Anastasakis [1], *George Kastellakis* [2], *Panayiota Poirazi* [2,*]

[1] Physics Department, University of Crete, Heraklion, Greece
[2] IMBB-FORTH, Heraklion, Greece
[*] poirazi@imbb.forth.gr

The amygdala is a subcortical area with a well-known role in emotional memories, such as fear memory. In auditory fear conditioning, a well studied form of classical conditioning, fear memories are stored in the synapses formed by afferent inputs to the Lateral Nucleus of the Amygdala. The process of this associative memory formation has been shown to be affected by the regulation of the activation of the transcription factor CREB. Lateral Amygdala neurons with artificially increased CREB activation are preferentially recruited to form the fear memory trace, and ablation or reversible inactivation of these neurons disrupts the fear memory (Han, Science 2009). CREB overexpression however does not alter the neuronal size of the memory trace.

In order to investigate the formation of the fear memory trace, we create a computational model of Lateral Amygdala neurons using adaptive integrate-and-fire neurons with plastic synapses. Our model incorporates an interplay between excitatory and inhibitory connections as well as afferent inputs according to experimental information. The spatial pattern of the synaptic connectivity within the neuronal population is modeled according to electrophysiological studies (Pape and Pare, Physiol. Rev. 2010) and CREB activation is modeled via the modulation of the excitability of excitatory neurons. By modeling connectivity and the time course of CREB expression, we aim to study the process and the properties of the fear memory trace formation and its implications for memory models. Preliminary results show that the connectivity pattern can limit the size of the population encoding the memory trace.