

COMPUTATIONAL NEURAL MODELS AT MOLECULAR, CELLULAR AND BEHAVIORAL LEVELS - THREE CASE STUDIES

Ashwin Mohan

Dr. Satish S. Nair, Dissertation Supervisor

ABSTRACT

Biological findings from molecular, cellular and behavior levels can be difficult to understand functions. Computational tools and systems concepts facilitate integration of information across levels to further understanding of functional level issues. This integration is eventually formalized as experimentally accessible models that facilitate visualization of the system as a whole.

At the molecular level, a computational model of the synapse was used to study cellular adaptations after cocaine addiction. The molecular diffusion model was used to propose feasible glial geometries to study the role of diffusion path length on synaptic isolation. At the network level, a biophysical network model of the basal amygdala was developed to investigate interconnectivity between cellular nuclei to produce three types of cells observed after auditory fear conditioning. At the behavior level, a computational model of rapid signaler-receiver interactions in this group-living insect was developed to study the emergence of informative global patterns by providing interacting individuals with local cues.