Public Abstract

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Title:COMPUTATIONAL NEURAL MODELS AT MOLECULAR, CELLULAR AND BEHAVIOR LEVELS - THREE CASE STUDIES

Biologists and physiologists acquire data at all scales ranging from molecular and cellular to network and behavioral levels. Biological experiments are typically focused, and integrating findings from different levels to understand functions can become difficult using present experimental paradigms. 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. This work focuses on the modeling and analysis of a set of biological phenomenon at the molecular, cellular/network, and behavior levels.

At the molecular level, a computational model a synapse was developed to study neuroadaptations after withdrawal from drug addiction (e.g., cocaine) in the reward center of the brain. The computational study helped identify parameters not yet known to biologists and was used to characterize molecular level interactions. At the network level, a biophysical computational model of the mammalian fear circuit was developed to investigate possible interconnectivity between various types of brain regions after auditory fear conditioning. At the behavior level, a computational model of treehopper insects was used to study the emergence of informative global patterns by providing the insects with limited local information. The model was also used to predict the influence of local information on global behavior, which could eventually be verified by biologists using controlled experiments.