Computational Biology Seminar Series for Undergraduates

Neuronal Oscillators and Synchronous Gamma (40 Hz) Rhythms in the Brain

Carmen C. Canavier, School of Medicine LSU Health Sciences Center

Professor and Vice Chair for Research, Department of Cell Biology and Anatomy

Life Sciences Building Annex A101
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Abstract:

Synchrony in neural circuits has been implicated in cognitive functions such as attention, working memory and retrieval and encoding of information, and abnormal synchrony has been implicated in psychiatric and neurological disorders. Neural oscillations are comprised of synchronous activity of a population of neurons. Neural oscillators can be implemented at the level of single oscillatory neurons, or at the level of a network of excitable elements. Electrical signaling in single neurons can be modeled using an electrical equivalent circuit comprised of linear and nonlinear conductances in parallel with a membrane capacitance. The tendency of oscillators to synchronize can be predicted using phase response curves, which plot the amount that an oscillation cycle is lengthened or shortened by a perturbation. The synchronization tendencies depend on the nonlinear dynamics of the neurons, specifically whether they integrate their inputs or resonate to a preferred frequency. Here we define criteria for synchronization of a population of all-to-all coupled identical neurons, and explain how this synchrony might be preserved in a population of noisy, sparsely firing heterogeneous neurons.

Speaker's Bio:

Carmen Canavier is currently Professor and Vice Chair for Research in the Department of Cell Biology and Anatomy in the Medical School at the Louisiana State University Health Sciences Center in New Orleans. She received her PhD in Electrical and Computer Engineering from Rice University in 1991. She is a computational neuroscientist whose main scientific interests include nonlinear neural oscillators and pattern formation in networks of such oscillators. Her main focus areas are the use of phase resetting curves to predict synchronization between neural oscillators and the use of nonlinear dynamical techniques and multi-compartmental modeling to analyze neural pacemakers and bursting neurons. Her modeling efforts are currently focused on the dopaminergic neurons of the mammalian midbrain, central pattern generating circuits, and on gamma and theta oscillations in the hippocampal formation.

This lecture has a reception @ 05:00 pm

Center for Computation & Technology
2003 Digital Media Center • Telephone: +1 225/578-5890 • Fax: +1 225/578-8957