The Department of Mathematical Sciences presents a colloquium with

Andrey Dovzhenok

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Thursday, March 28, 2013
3:30 – 4:30 pm
60WCharlton Room 125

Bistability and Hysteresis at the Depolarization Block in Neurons: A Modeling Study

Neurons are excitable cells that process and transmit information through electrical signals called action potentials or spikes. Many neurons display bistability--coexistence of two firing modes such as bursting (a train of action potentials followed by a period of quiescence) and tonic spiking or tonic spiking and silence. Bistability has been proposed to endow neurons with richer forms of information processing in general and to be involved in short-term memory in particular by allowing a brief signal to elicit long-lasting changes in firing. Here we focus on bistability that allows for a choice between tonic spiking and depolarization block (a silent state that occurs in every neuron when it receives excessive excitation) in a wide range of the depolarization levels. We consider the spike-producing currents in two neurons, models of which differ by the parameter values. The dopaminergic neuron model displays bistability in a wide range of applied currents at the depolarization block. The Hodgkin-Huxley model of the squid giant axon shows no bistability. We varied parameter values in the model to analyze transitions between the two parameter sets. We show that bistability primarily characterizes the inactivation of the Na^+ current. Our study suggests a connection between the amount of the Na^+ window current and the length of the bistability range. For the dopaminergic neuron we hypothesize that bistability can be linked to a prolonged action of antipsychotic drugs.

Refreshments will be served at 2:45 pm in the Faculty and Graduate Student Lounge, Room 4118 French Hall

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