PHYSICAL MATHEMATICS SEMINAR

Of Moths and Maths: Robust Neuro-sensory Encoding in Moth Olfaction

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ABSTRACT:

Neuro-sensory systems encode their functionality into persistent spatio-temporal patterns of neuron activity, or so-called neural codes. Networks of neurons in the antennal lobe (AL) of moths form non-local neural codes that compete dynamically with each other through lateral inhibition, thus producing a robust signal-processing unit that increases signal-to-noise and enhances the contrast between neural codes. Our model uses a data-driven approach that is based directly upon neural recordings of the firing rates in the AL. A principal component analysis allows for a reconstruction of the dynamics in terms of the dimensionally reduced spatio-temporal codes. Specifically, the model supports the hypothesis that the dynamical mechanism responsible for the formation of neural codes is the existence of stable and orthogonal fixed points. Comparison of the model with experimental data demonstrates the model fully captures coding properties and dynamics of the neural recordings in the AL of Manduca sexta moths, as well as observed phenomenology in the olfactory responses in other insects. Construction of the model also proposes a recipe for the design of lateral connections to support a library of orthogonal neural codes.

TUESDAY, OCTOBER 30, 2012
2:30 PM
Building 4, Room 145

Reception at 3:30 PM in Building 2, Room 290
(Math Dept. Common Room)

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