THE UNIVERSITY OF CHICAGO

Departments of Computer Science, Mathematics, Statistics, and the Computation Institute

SCIENTIFIC AND STATISTICAL COMPUTING SEMINAR

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Collective Dynamics in Simple Neural Circuits

THURSDAY, February 21, 2013, at 4:30 PM

Eckhart 133, 5734 S. University Avenue

ABSTRACT

The brain's networks contain numerous mechanisms that can lead to synchronized (or correlated) dynamics among cells. Moreover, different patterns of correlations can have a wide range of impacts on the fidelity with which a network encodes incoming signals—degrading this coding, enhancing it, or doing very little at all. Faced with these diverse possibilities, we seek organizing principles along two lines. First, using simplified circuit models, we develop explicit links between the (normal form) dynamics of single cells and the "two-point" correlations produced among pairs of cells. Next, we address an intriguing fact from recent empirical studies. The activity of neural circuits in response to some stimuli—but not others—can be captured by statistical models based on these pairwise correlations alone. We describe circuit mechanisms that guarantee such a pairwise-based description—and mechanisms that lead it to fail, opening the door to a high level of complexity in the resulting dynamics.

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