The University of Chicago
Department of Statistics

Seminar Series

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Bayesian Sampling in Perceptual Bistability

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133 Eckhart Hall, 5734 S. University Avenue

Refreshments following the seminar in Eckhart 110.

ABSTRACT

When an observer views a stimulus that allows two distinct interpretations, only one interpretation is perceived at any given time, and perception switches between the two in a stochastic manner. Well-known examples of this phenomenon, called perceptual bistability, are the Necker cube and the face-vase illusion. I will show experimental results that strongly suggest that the dynamics of perceptual bistability arises from a sampling process of an underlying probability distribution over the causes of the stimulus. Next, I will describe diffusion models embedded in double-well potentials, known to perform Langevin Monte-Carlo sampling, that generate the observed behaviors. The generality of this model will be illustrated with rate-based models and more biophysically realistic spiking neurons endowed with attractor dynamics. In conclusion, neuronal networks in the brain seem to sample probability distributions, at least during conditions of high uncertainty or ambiguity in the stimulus. Our results invite us to explore the hypothesis that the brain is an approximate inference machine that uses sampling algorithms throughout tasks and domains.

References:

[1]. R. Moreno-Bote, J. Rinzel and N. Rubin, Noise-induced alternations in an attractor network model of perceptual bistability, Journal of Neurophysiology, 98: 1125-1139 (2007).

[2]. R. Moreno-Bote, A. Shpiro, J. Rinzel and N. Rubin. Bi-stable depth ordering of superimposed moving gratings. Journal of Vision, 8(7):20, 1-13 (2008).

[3]. A. Shpiro, R. Moreno-Bote, N. Rubin and J. Rinzel, Balance between noise and adaptation in competition models of perceptual bistability. Journal of Computational Neuroscience, 27, 37-54 (2009).

[4]. R. Moreno-Bote, D. Knill and A. Pouget. Sampling and optimal cue combination during bistable perception. Frontiers in Systems Neuroscience. Conference Abstract: Computational and systems neuroscience. doi: 10.3389/conf.neuro.06.2009.03.098.

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