Neuroengineering Seminar

Performance Limitations of Thalamic Relay: Insights into Thalamo-Cortical Processing, Parkinson's Disease and Deep Brain Stimulation

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Thalamic networks in the brain are responsible for strategically filtering sensory information subject to attentional demands. For example, one can gaze at a butterfly and completely be unaware of the flowers and bushes that surround it, even though these surroundings are entirely within the subject's visual field. This occurs because visual thalamic neurons only *relay* the information in the visual field that the subject is paying attention to back to visual cortex for perception. How and when this relay occurs has never been precisely quantified.

In this talk, we utilize a biophysical-based model to quantify relay of a thalamic cell as a function of its input parameters and electrophysiological properties. Specifically, we compute bounds on relay reliability and show how these bounds can explain experimentally observed patterns of neural activity in the basal ganglia in (i) health where reliability is high, (ii) in Parkinson's disease (PD) where reliability is low, and (iii) in PD during therapeutic deep brain stimulation where reliability is restored. Our bounds also predict different rhythms that emerge in the lateral geniculate nucleus in the thalamus during different attentional states of a cat.

Sridevi V. Sarma (M'04) received the B.S. degree in electrical engineering from Cornell University, Ithaca, NY, in 1994, and the M.S. and Ph.D. degrees in electrical engineering and computer science from the Massachusetts Institute of Technology, Cambridge, in 1997 and 2006, respectively. She was a Postdoctoral Fellow in the Brain and Cognitive Sciences Department, Massachusetts Institute of Technology, from 2006 to 2009. She is now an Assistant Professor in the Institute for Computational Medicine, Department of Biomedical Engineering, Johns Hopkins University, Baltimore, MD. Her research interests include modeling, estimation, and control of neural systems. Dr. Sarma is a recipient of the GE faculty for the future scholarship, the National Science Foundation graduate research fellow, the L'Oreal For Women in Science fellow, the Burroughs Wellcome Fund Careers at the Scientific Interface Award, the NSF CAREER award, and the Presidential Early Career Award for Scientists and Engineers (PECASE).

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