

Signal Processing Seminar

Title: A Signal Processing Framework for Inferring Functional Brain Networks

Speaker: Professor Selin Aviyente
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Date: Wednesday, April 1, 2009

Time: 4:00 - 5:00 pm

Where: 4269 Beckman Institute

Abstract: Increasingly sophisticated neuroimaging methods have opened up important areas of basic research in psychiatry, psychology, and neurology. These neuroimaging modalities pose new challenges and opportunities for the signal processing community to analyze highly complex, multi-dimensional and dynamic data. One particular challenge is the identification of dynamic functional networks underlying observed neural activity. Current imaging approaches index local neural activity very well, but there is an increasing need for methods that provide measures of the interaction between regional activations. In this talk, I will focus on signal processing methods to quantify this interaction between different parts of the brain based on the electroencephalogram (EEG) measurement of the brain activity. Even though the nature of interactions between local networks of the brain remains a point of debate, it has been recently argued that networks of reciprocal interactions are the key for integration. Among various modes of reciprocal interactions, phase synchronization between the participating neuronal groups has been the most studied and plausible mechanism. In order to quantify the time and frequency dependent nature of interactions through phase synchronization, we have developed a time-frequency phase synchrony (TFPS) measure. This measure, based on Rihaczek distribution, can quantify the time-varying nature of interactions between neuronal populations with high time-frequency resolution. After the functional connectivity is quantified through the proposed TFPS measure, the underlying local and global network patterns are identified using graph theoretic methods. The proposed methods are applied to EEG data containing the error-related negativity (ERN), a brain potential response that indexes endogenous action monitoring. Finally, I will conclude the talk by discussing some future research directions in functional network inference including the use of information theoretic methods and graphical models.

Bio: Selin Aviyente received her B.S. degree with high honors in electrical and electronics engineering from Bogazici University, Istanbul in 1997. She received her M.S. and Ph.D. degrees, both in Electrical Engineering: Systems, from the University of Michigan, Ann Arbor, in 1999 and 2002, respectively. Since 2002, she has been an assistant professor in the Department of Electrical and Computer Engineering at Michigan State University. Her research focuses on statistical signal processing, in particular non-stationary signal analysis, with applications to image classification and biological signals. Her current research focuses on the study of the functional networks in the brain. She is the recipient of 2005 Withrow Teaching Excellence Award and 2008 NSF CAREER Award.