Dr. Chih-Hsin Tsai

Computational EEG Analysis for Characterizing Cognitive Activity: Methods and Applications

Abstract: Electroencephalography (EEG) analysis exploits mathematical signal analysis methods to identify how brain regions' interactions result in cognition and behavior. Combining computer technology with traditional inferential statistics and then applying these to multichannel EEG data makes it possible to accurately identify and describe hidden patterns and correlations in functional brain networks. In this talk, we present an overview of the analysis approaches, including event-related potential analysis, spectral perturbation analysis, EEG source-imaging approaches, signal separation by independent component analysis (ICA), and Electromagnetic Spatiotemporal Independent Component Analysis (EMSICA). We also demonstrate that integrating these techniques enables a depth of understanding of complex brain dynamics that is not possible by other functional brain imaging methods to underscore human cognition.

Dr. Tso-Jung Yen

An Attention Algorithm for Solving Large Scale Structured L_0-norm Penalty Estimation Problems

Abstract: Technology advances have enabled researchers to collect large amounts of data with lots of covariates. Because of the high volume (large n) and high variety (large p) properties, model estimation with such big data has posed great challenges for statisticians. In this paper we focus on the algorithmic aspect of these challenges. We propose a numerical procedure for solving large scale regression estimation problems involving a structured *l*_0-norm penalty function. This numerical procedure blends the ideas of randomization, blockwise coordinate descent algorithms, and a closed form representation of the proximal operator of the structured *l*_0-norm penalty function. In particular, it adopts an "attention" mechanism that exploits the iteration errors to build a sampling distribution for picking up regression coefficients for updates. Simulation study shows the proposed numerical procedure is competitive when comparing with other algorithms for sparse estimation in terms of runtime and statistical accuracy when both the sample size and the number of covariates become large.