Challenges in Big Data Analysis in Neuroimaging

Dr. Aristeidis Sotiras
Center for Biomedical Image Computing and Analytics (CBICA), University of Pennsylvania

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Abstract

Modern neuroimaging is now a big data science. The rapid developments in in-vivo neuroimaging have led to large quantities of digital information about the human brain. Modern neurotechnologies produce massive, complex imaging data from multiple modalities that reflect brain structure and function. Parsing, analyzing and interpreting this information is challenging due to the high dimensionality in the data. Another challenge is the inherent population heterogeneity. In this talk, I will discuss advances in multivariate pattern analysis techniques for neuroimaging. I will present two recent machine learning methods using supervised and unsupervised approaches, which were proposed to address the aforementioned challenges. In the first part of the talk, I will describe a non-negative matrix factorization method to summarize high-dimensional neuroimaging data with a set of highly interpretable brain networks. I will present results using structural neuroimaging data from a study of human brain aging and compare the proposed framework to commonly used matrix factorization techniques, such as PCA and ICA. In the second part of the talk, I will present a method that aims to reveal inherent heterogeneity in the patient group by jointly performing disease classification and clustering of disease sub-groups. The method, termed HYDRA, extends the SVM framework by introducing multiple linear hyperplanes that form a convex polytope which separates the two groups, while each face of the polytope effectively defines a disease subtype. Results using data from a study of Alzheimer's disease will be presented, showing disease sub-groups revealed by our method.

Bio

Dr. Sotiras is a research associate in the Center for Biomedical Image Computing and Analytics (CBICA) at the Radiology Department of the University of Pennsylvania. Dr. Sotiras received a Diploma in Electrical Engineering from the National Technical University of Athens in Greece, and M.Sc.
in Mathematics, Vision, and Machine Learning from Ecole Polytechnique, a Ph.D. in Applied Mathematics from Ecole Centrale Paris under the supervision of Prof. Paragios. He completed his postdoctoral training in multivariate pattern analysis in neuroimaging at the University of Pennsylvania, under the supervision of Prof. Davatzikos. His current research interests center around multivariate pattern techniques for quantitative image analysis.

Faculty Host: Dimitris Metaxas