Specialty Area: ***Single Subject Neuroimaging***

Speaker Name: Christos Davatzikos, Ph.D., Christos@rad.upenn.edu

Highlights:

- Quantification of spatial patterns of brain atrophy and function can lead to highly sensitive and specific imaging markers of Alzheimer's Disease (AD), on an individual patient basis, unlike conventional measurements, such as hippocampal volumes.
- Machine learning and pattern recognition methods can achieve this goal, and help construct good diagnostic and predictive tools in early AD
- These markers show subtle changes many years before clinical progression, in normal older adults, thereby allowing us to identify individuals at risk for progressing clinically.

Title: Spatial imaging patterns in AD and its prodromal stages identified via pattern recognition methods.

Target Audience: clinicians interested in imaging surrogates of dementia, imaging researchers, practitioners using computer image analysis tools.

Outcomes/Objectives: To learn about advanced image analysis tools that offer great promise as early diagnostic and predictive markers of Alzheimer's Disease; understand the significant gain achieved by measuring more complex spatial patterns of brain atrophy and function, compared to focusing on a small number of predefined regions of interest, which is the traditional way of analyzing imaging data.

Purpose: To develop highly sensitive and specific imaging markers of AD, and detect subtle predictive changes very early in the disease stage, when interventions are likely to be more effective.

Methods: Pattern recognition and machine learning tools are used to quantify spatial imaging patterns, thereby measuring not only structural and functional signals at a given part of the brain, but also forming contrasts between different brain regions. A very small/subtle change in brain stricture, for example, would not be detected if different brain regions were investigated in isolation. However, it can be detected if it forms a spatial pattern that is highly distinctive. The spatial distribution of brain atrophy in AD is quite characteristics of this disease, and hence it can be captured more effectively via pattern analysis methods.

Results:

- AD-specific patterns of brain atrophy were found to have outstanding sensitivity and specificity (AUC=0.98) as individualized markers of AD
- These patterns had reasonably high predictive power in predicting clinical progression of MCI patients to AD.
- These patterns also displayed very early changes in normal older adults with no clinical symptoms, and were predictive of cognitive decline.

Conclusion: Radiologic reading of MRI and PET images can dramatically change in the upcoming decade, by incorporating advanced quantitative image analysis tools that capture subtle and complex spatial imaging patterns. Being able to predict an individual's probability of cognitive and clinical progression is significant from a clinical management, but also from a personal perspective.