KU Student Chapter

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Tuesday, May 2, 2017
4:00 pm
306 Snow Hall

Predicting Epileptogenesis after Traumatic Brain Injury and Using Virtual Reality to Correct Segmentation Errors in MRI

Dominique Duncan

Assistant Professor of Neurology
University of Southern California

The first part of my talk focuses on identifying biomarkers that can predict epileptogenesis after traumatic brain injury (TBI). This project, The Epilepsy Bioinformatics Study for Antiepileptogenic Therapy (EpiBioS4Rx), is a multi-site, international collaboration including a parallel study of humans and rats, collecting MRI, EEG, and blood samples. Because the development of epilepsy following TBI is a multifactorial process and crosses multiple modalities, identifying biomarkers to quantify the condition has proved difficult. Without a full understanding of the underlying biological effects, there are currently no cures for epilepsy. This study hopes to address both issues, calling upon data generated and collected at sites spread worldwide among different laboratories, clinical sites, in different formats, and across multicenter preclinical trials. Before these data can even be analyzed, a central platform is needed to standardize these data and provide tools for searching, viewing, annotating, and analyzing them. We are building a centralized data archive for EEG that will link to the Laboratory of Neuro Imaging (LONI) Image Data Archive (IDA) for MRI data and allow the broader epilepsy research community to access this shared data in addition to analytic tools to identify and validate biomarkers of epileptogenesis in images and electrophysiology as well as in molecular, serological, and tissue studies.

The second part of this talk focuses on crowdsourcing manual validation of algorithmically-segmented brain volumes using virtual reality. LONI has the largest collection/repository of neuroanatomical MRI scans in the world. One of the lab's workflow processes involves algorithmic segmentation of the scans into labeled anatomical regions using FreeSurfer software. Since this automation cannot yet achieve perfect accuracy, there is a team of students who are trained to fix these errors manually, which is a tedious, time-consuming process. We are working on transforming the way this is accomplished using VR technology (HTC Vive) to deal with the volumes directly in 3D space, which aims to be both more intuitive and efficient. The goal is to crowdsource this task to make the process even more efficient.

Dominique is an assistant professor of Neurology at USC. She began working at the Laboratory of Neuro Imaging at the USC Stevens Neuroimaging and Informatics Institute in 2015 as a postdoc working with Dr. Arthur Toga. Dominique's background spans both mathematics and neuroscience. While being a student at Lawrence Free State High School, she completed over 100 credit hours at KU in Mathematics, Classics, Slavic Languages and Literature, and other areas. She double majored in Mathematics and Polish Literature with honors as an undergraduate at the University of Chicago and minored in Computational Neuroscience. Her doctoral work in Electrical Engineering at Yale University was done with an adviser from Mathematics, but she also interacted closely with researchers at the Neurology Department. In her PhD thesis, she analyzed intracranial EEG data using nonlinear factor analysis to identify preseizure states of patients treated at Yale for epilepsy. After graduation, she was a professor of Mathematics at Sichuan University in Chengdu, China for a summer program where she taught Calculus 2, Calculus 3, and Linear Algebra to undergraduate students. She then took a postdoc position in Neurology at the Stanford University School of Medicine as well as one in Mathematics at UC Davis, where she developed an algorithm based on diffusion maps to classify Alzheimer's patients using MRI data.

Dominique also has an extraordinary record of leadership, serving as an elected member of the Yale Graduate and Professional Student Senate for 6 years, an elected member of the Stanford University Postdoctoral Association, the Chair of the UC Davis Postdoctoral Scholars Association, and the Communications Chair of the USC Postdoctoral Association. She also serves as an associate editor, co-editor, and reviewer for a number of journals and international conference papers. Her current projects include combining machine learning and crowdsourcing manual validation of algorithmically segmented brain volumes through gamification and virtual reality, identifying biomarkers of epileptogenesis after traumatic brain injury, and studying the effects of high intensity but low impact exercise on the brain.