Development of Foundational AI models for Brain Source Imaging with Applications to Epileptogenic Zone Detection

Speaker: Feng Liu

Abstract:
Electrophysiological source imaging (ESI) refers to the process of reconstructing the underlying electrical and magnetic neurophysiological brain activities given the noninvasively recorded electroencephalogram (EEG) and/or Magnetoencephalography (MEG). ESI plays a significant role in both neuroscience studies and clinical applications as it is a fundamental tool of characterizing brain source signal of high temporal resolution. In this talk, I will first talk about some recent developments of ESI algorithms by our group based on hierarchical graphical models, and deep learning approaches leveraging the spatial-temporal graph structures of the source signal, with the application focused on seizure onset zone localization. Then I will talk about integration of simultaneous recorded invasive intracranial EEG (iEEG) and scalp EEG using a state -space model for source space brain networks analysis and its applications on characterizing the cortical-subcortical information flow during the encoding and maintaining stage of working memory. In the end, the role of LLMs (ChatGPT) and the first LLM platform (aiepilepsy.stevens.edu) developed by our group on EZ prediction based on description of patient's seizure semiology, and its performance compared to epileptologist, will be discussed.

Short Bio:
Dr. Feng Liu is an Assistant Professor of Systems Engineering at Stevens Institute of Technology. Dr. Liu was a Postdoctoral Research Fellow at Harvard Medical School from 2018 to 2020. In the meantime, Dr. Liu was a research affiliate at MIT and Martinos Center for Biomedical Imaging at MGH. Dr. Liu received his Ph.D. degree from the University of Texas at Arlington in Industrial Engineering in 2018 with a focus on machine learning for healthcare. His research interests include brain network analysis, brain imaging, inverse problem, health informatics, and dynamic system. Dr. Liu is the winner of the Best Paper Award at 11th International Conference of Brain Informatics in 2018, and the Best Paper Award of INFORMS Data Mining Society in 2019, Finalist of Best Paper Award in INFORMS DMDA workshop in 2023, Best Poster Award at AI for Epilepsy Conference in 2024. Dr. Liu has published more than 70 papers in peer-reviewed journals and conferences. Dr. Liu's research group has received multiple grants from NIH, DoD and New Jersey Health foundation as PI or mPI.