UNIVERSITY of HOUSTON | ENGINEERING

Department of Biomedical Engineering

Biomedical Engineering Department Distinguished Lecture Series

Monday, October 14, 2024, 10AM

Location: Michael J. Cemo Hall Room 105

4246 Martin Luther King Blvd, Houston TX 77204

Closed-loop Non-Invasive Neural Therapeutics

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Abstract

Precision and personalized delivery of neurostimulation, such as transcranial magnetic stimulation (TMS), is believed to be critical for the effective treatment of psychiatric diseases such as major depressive disorder (MDD). In this talk, I will present our work that uses an integrated instrument consisting of simultaneous fMRI, EEG, and TMS (which we term “fET”) to determine the precise timing of TMS stimulation to deliver to an individual in order to maximize engagement of the therapeutic target—in this case, the anterior cingulate cortex. I will present results from a double-blind clinical trial that uses the fET instrument to set individualized parameters of a closed-loop EEG-TMS neurostimulator for treating MDD. We demonstrate that this closed-loop precision delivery of stimulation, which is matched to specific brain dynamics, affects brain dynamics, functional and effective connectivity, and, ultimately, the clinical outcome of the treatment. Our approach enables new types of non-invasive neural therapeutics that are personalized to an individual as well as a disease or condition.

Biosketch

Professor Paul Sajda is the Vikram S. Pandit Professor of Biomedical Engineering and Chair of the Department of Biomedical Engineering at Columbia University. He is also a Professor of Electrical Engineering and Radiology (Physics) a Member of Columbia's Data Science Institute, and an Affiliate of the Zuckerman Institute of Mind, Brain, and Behavior. He received a BS in electrical engineering from MIT in 1989 and an MSE and PhD in bioengineering from the University of Pennsylvania in 1992 and 1994, respectively. Professor Sajda is interested in what happens in our brains when we make a rapid decision and, conversely, what processes and representations in our brains drive our underlying preferences and choices, particularly when we are under time pressure. His work in understanding the basic principles of rapid decision-making in the human brain relies on measuring human subject behavior simultaneously with cognitive and physiological states. Professor Sajda applies the basic principles he uncovers to construct real-time brain-computer interfaces that improve interactions between humans and machines. He is also applying his methodology to understand how deficits in rapid decision-making may underlie and be diagnostic of many types of psychiatric diseases and mental illnesses. Professor Sajda is a co-founder of several neurotechnology companies and works closely with a range of scientists and engineers, including neuroscientists, psychologists, computer scientists, and clinicians. He is a fellow of the IEEE, AMBIE, IAMBE, and AAAS. He is also a recipient of the Vannevar Bush Faculty Fellowship (VBFF), which is the DoD's most prestigious single-investigator award. Professor Sajda currently serves as the President of IEEE EMBS (23-24).