Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON
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Fall 2024 Seminar Series

Traveling waves and space-time codes

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Travelling waves in the mammalian cortex mediate vital aspects of animal cognition, such as stimuli perception and working memory. Theoretical results suggest these waves preserve timing and are critical for plasticity across long-range neural circuits. Therefore, revealing the circuit mechanisms underlying sensory-evoked traveling waves is essential to understanding the neural basis of sensory perception. In this talk, I will describe our recent efforts using 2D nanotextured transparent ECoG-style electrodes to map circuits orchestrating cortical wave dynamics. First, by simultaneously mapping local-field-potentials and cellular ensemble dynamics (via two-photon calcium imaging), we will describe the circuit features tied to traveling waves under active and passive whisker touch in the barrel cortex and showcase how sparse waves are a critical component of accurate sensory perception. We will show how distinct translaminar circuit dynamics are crucial in deciding wave structure and propagation. Our results help establish a model in which translaminar spacetime patterns, organized by motor cortical feedback, sculpt touch-evoked traveling waves. I will then highlight and describe recent results from the motor cortex in which traveling waves support accurate timing, establishing how waves support communication across distances. Time permitting, I will briefly summarize our ongoing efforts in creating unique 3D transparent nanoelectrode arrays to map traveling waves and circuit dynamics across cortical regions.

ABOUT the SPEAKER

Krishna Jayant is an assistant professor at Purdue University's Weldon School of Biomedical Engineering. His laboratory's research focuses on delivering biophysically based accounts of behaviorally relevant computations using novel electrical and optical neurotechnologies. Projects in the lab cover various topics, including the examination of synaptic and dendritic computations in individual neurons and network-wide circuit computations that underlie sensorimotor integration, including synucleinopathies. Dr. Jayant completed his graduate training in electrical and computer engineering at Cornell University, where he worked with Dr. Edwin Kan on bioelectronics. He subsequently completed postdoctoral training at Columbia University with Dr. Rafael Yuste, Dr. Ken Shepard, and Dr. Ozgur Sahin, researching cutting-edge neurotechnologies to probe synaptic and dendritic biophysics. In addition to the NIH Director's New Innovator Award, Dr. Jayant has been recognized as an NIH NIBIB Trailblazer awardee, a Human Frontiers Science Young Investigator grant awardee, a Ralph E. Powe Junior Faculty Enhancement Award, and is also a recipient of an Air Force Office of Scientific Research DURIP award.

Monday, November 4 at Noon
1003 Engineering Centers (Tong Auditorium)