Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON
Celebrating 25 Years

Fall 2024 Seminar Series

Optimizing Intracortical Microstimulation: Addressing Perceptual Fading through Inhibition, Metabolic Stress Reduction, and Gliomodulation

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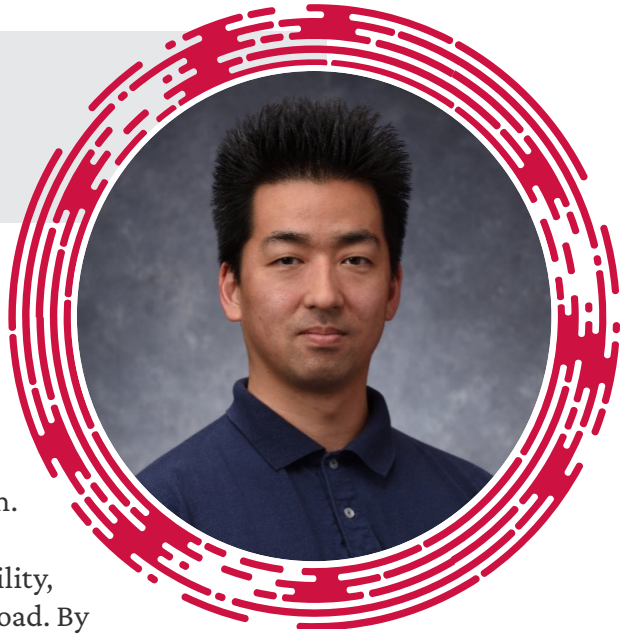

Intracortical microstimulation (ICMS) offers promising applications in neuroprosthetics by providing direct modulation of neural circuits. However, long-term ICMS effectiveness is limited by perceptual fading, a phenomenon where neural responses decrease with repeated stimulation. This seminar will examine strategies to counteract perceptual fading by addressing three critical elements: inhibitory modulation, metabolic stress reduction, and gliomodulation. Gliomodulation, encompassing astrocytes, microglia, and oligodendrocytes, plays an essential role in maintaining synaptic stability, managing inflammatory responses, and reducing network metabolic load. By facilitating axonal myelination and supporting energy efficiency, oligodendrocytes significantly lower metabolic stress, which is crucial for sustained neural activity during ICMS. Additionally, modulating inhibitory interneurons helps maintain excitatory balance, thereby preserving the fidelity of neural signals and reducing adaptation. We will discuss techniques to optimize ICMS protocols for balanced inhibitory activity, gliotransmission, and reduced metabolic demands. The seminar will outline experimental approaches for integrating these elements to achieve stable, durable neural responses and enhanced clinical viability of ICMS-based neuroprosthetics.

ABOUT the SPEAKER

Takashi Kozai is the Ernest E Roth Associate Professor of Bioengineering at the University of Pittsburgh. He received the B.A. (magna cum laude) degree with distinction in Molecular, Cellular, and Developmental Biology, and another B.A. degree with distinction in Biochemistry from the University of Colorado, Boulder, CO, USA, both in 2005, and M.S. and Ph.D. degrees in Biomedical Engineering from the University of Michigan, Ann Arbor, MI, USA, in 2007 and 2011, respectively. From 2011 to 2013, he was a Postdoc with the Department of Bioengineering, University of Pittsburgh, Pittsburgh, PA, USA, where he was appointed as a Research Assistant Professor from 2013-2015 before starting his own lab. His research interests include: (1) Manipulation of neuronal and non-neuronal cells to influence the function of neuronal networks, (2) Understanding the role of neuroimmune cells in neuronal damage and regeneration, and (3) Improving long-term performance of implanted electrodes and integrating man-made (engineered) technology with the human brain for the purpose of studying normal and injured/diseased nervous systems in vivo at the cellular level, as well as restoring function to patients.

Monday, November 25 at Noon
1003 Engineering Centers (Tong Auditorium)