

Quantum Science & Technology

Entanglement-Enhanced Sensing and Data Processing

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Date: Friday, August 18, 2023

Time: 10:00am – 11:30am

In-person: EEB 248

Abstract: The 20th century has witnessed the rise of quantum mechanics and its fueled scientific and technological revolution. The humankind is now on the verge of a second quantum revolution sparked by quantum information science and engineering (QISE). Entanglement as a quintessential quantum resource lies at the heart of QISE, giving rise to a plethora of quantum-enabled or enhanced capabilities that shift the landscape of communication, sensing, and computing. In this talk, I will present our recent experimental advances in entanglement-enhanced sensing and data processing. I will first describe entangled sensor networks for precise radiofrequency and optomechanical sensing beyond the standard quantum limit. Building on entangled sensors, I will introduce quantum-enhanced machine learning for data classification at a physical layer. Next, I will discuss a major endeavor to foster the transition from basic quantum research to near-term, widely impactful real-world quantum technologies: the construction of a quantum-network testbed as a distributed infrastructure to advance convergent QISE research and education.



Biography: Dr. Zheshen Zhang is an Associate Professor of Electrical Engineering and Computer Science at University of Michigan–Ann Arbor. Prior to joining University of Michigan, Dr. Zhang was an Assistant Professor at University of Arizona from 2017 to 2022, a Research Scientist, and a Postdoctoral Associate both at MIT from 2012 to 2017. Dr. Zhang received his PhD degree in Electrical and Computer Engineering from Georgia Tech. Dr. Zhang's research encompasses a broad spectrum of quantum networks, quantum communications, quantum sensing, and quantum computing. His team harnesses unique quantum resources such as

entanglement to develop quantum sensors surpassing the classical measurement limits, quantum communication systems with enhanced security and capacity, quantum networks for long-range entanglement distribution, and quantum processors capable of tackling problems intractable on classical computers. His work was recognized by an NSF CAREER Award in 2022. Dr. Zhang currently serves on the Editorial Board of *Communications Physics* of Nature Portfolio and *Progress in Quantum Electronics* of Elsevier.

Hosted by: Quntao Zhang, Wade Hsu, Mengjie Yu, Jonathan Habif & Eli Levenson-Falk