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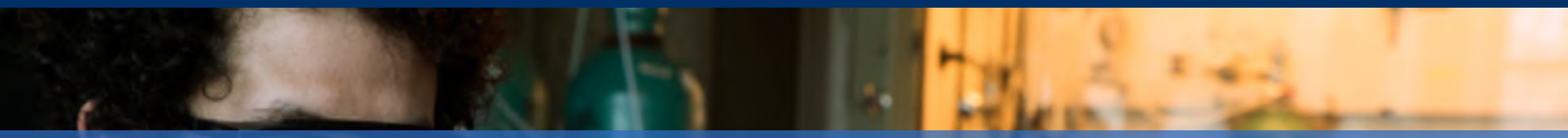

The Department of Mechanical Engineering Presents

Zonghe Chua

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Title: Vision-based Force Estimation in Robot-assisted Surgery by Humans and Machines

Abstract: Tissue handling is an important skill for surgeons to perform safe and effective surgery. In robot-assisted minimally invasive surgery (RMIS), such skill is difficult to acquire due to lack of haptic feedback. RMIS surgeons learn to estimate tissue interaction forces through visual feedback, often over many hours of in-vivo practice. My research leverages the RMIS telesurgical robotic platform as both a sensor and actuation suite to (a) develop automated data-driven vision-based force estimates that can provide objective measures of tissue handling skills, and (b) provide multimodal robot-mediated real-time feedback to the RMIS surgeon to improve their tissue handling skill. In this talk, I will present models and algorithms for vision-based force estimation in RMIS from both human and machine perspectives. From the human perspective, I evaluate the effect of haptic training on human teleoperators' abilities to visually estimate forces through a telesurgical robot. From the machine perspective, I design multimodal deep learning-based methods to estimate interaction forces and deliver haptic feedback during tissue manipulation. The results demonstrate that human teleoperators and machines can learn visual force estimation from haptic training and multimodal manipulation data respectively, setting the stage for future work in improved methods for human-machine skills development and autonomous robot-assisted surgery.

About the Speaker: Zonghe Chua is a Ph.D. candidate in the Collaborative Haptics and Robotics in Medicine Lab in the Department of Mechanical Engineering at Stanford University. He is a Young National University of Singapore Fellow, and the Lubert Stryer Bio-X Stanford Interdisciplinary Graduate Fellow. He received his B.S. in mechanical engineering from the University of Illinois at Urbana-Champaign in 2015, and M.S. in mechanical engineering from Stanford University in 2020. He will complete his Ph.D. in 2022. His research interests include human-in-the-loop robotic systems, data-driven methods for automated user performance evaluation, and haptic feedback.

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