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PLENARY TALK

Intelligent Robotic Assistance in Precision Surgery: Vision, Automation, and Human-Robot Collaboration

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Abstract:

Surgical robotics has revolutionized modern medicine, enhancing precision, safety, and efficiency in complex procedures. However, many surgical fields, including ophthalmology, continue to rely heavily on manual techniques, demanding exceptional dexterity, coordination, and sustained focus from surgeons. The next frontier in robotic surgery lies in intelligent systems that integrate real-time perception, automation, and human-robot collaboration to enhance surgical outcomes while reducing surgeon workload.

This talk presents an overview of our research on intelligent robotic assistance for precision surgery, with a focus on vision-based robotic systems for ophthalmic and microsurgical procedures. One of our key innovations is an intelligent vision-based robotic-assisted system for vitreoretinal surgery, which enhances intraoperative safety through real-time scene understanding, automates surgical lighting to improve visualization, and records surgical actions for skill assessment and training. Beyond ophthalmology, our work extends to developing AI-driven robotic systems for other surgical applications, enabling autonomous assistance in delicate operations where precision and real-time decision-making are critical.

By integrating computer vision, machine learning, and robotic automation, our research aims to push the boundaries of robotic surgery, making procedures safer, more efficient, and accessible to a broader range of surgeons. This talk will explore the challenges and breakthroughs in intelligent surgical robotics, the role of AI in enhancing human dexterity, and the future of robotic-assisted surgery in various medical domains.

Speaker Bio:

Chee-Kong Chui is an Associate Professor in the Department of Mechanical Engineering at the National University of Singapore (NUS). He received his B.Sc. (Hon) and M.Sc. (By research) degrees from NUS, and his Ph.D. degree from The University of Tokyo, Japan. Chee-Kong is a Senior Member of IEEE and a Co-Chair (2019-Present) of the Technical Committee (TC) on Cyber-Medical Systems of IEEE Systems, Man, and Cybernetics (SMC) Society. He served as Chairman (2015-2016) and Committee Member (2014 and 2017-2018) of the IEEE Engineering in Medicine & Biological Society (EMBS) Singapore Chapter. Since 2014, he has been a Board Member of the Asian Society of Computer Aided Surgery.

With over 20 years of research and development experience across universities and research institutes, his work integrates mechanics, electronics, computing, and medicine. His current research focuses on intelligent cyber-physical systems, robotic-assisted surgery, and AI-driven automation of healthcare and manufacturing. His contributions to surgical robotics, vision-based automation, and human-robot collaboration aim to enhance surgical precision, safety, and efficiency, particularly in complex procedures such as microsurgeries and other minimally invasive interventions.