

Plenary Speech I

11:00-12:00, Friday, December 6

Erhai Ballroom

**Active Perception and Dexterous Operation Skill Learning of Robot
Visual – Tactile Sensing**



Professor Fuchun Sun

Tsinghua University, China

Abstract

In the process of human evolution, with more and more complex operation tasks and higher requirements for dexterity, this process also changes and evolves the brain structure. The operation of human hand is the driving force of human

evolution. Dexterous hand is equally important to robot. It can be said that the intelligent revolution of robot starts from dexterous operation of robot hands. This report systematically analyzes the wide application of smart operation in the fields of manufacturing, kitchen furniture and art, and introduces the visual tactile sensor developed by our team and its function and performance in robot smart operation. Then, taking "how to sense like a human being" as the topic, the paper puts forward the framework of robot active perception, introduces the main achievements of the team in visual multi-target detection, visual tactile representation, multimodal fusion and developmental learning, and takes "how to operate like a human being" as the problem, gives the main achievements of the team in learning smart operation skills such as active imitation learning and preference learning Achievements. Finally, the development trend of robot dexterous operation skill learning is given.

Biography

Prof. Fuchun Sun is professor of Department of Computer Science and Technology and President of Academic Committee of the Department, Tsinghua University, deputy director of State Key Lab. of Intelligent Technology & Systems, Beijing, China. He also serves as the Vice president of China Artificial Intelligence Society and executive director of China Automation Society. His research interests include robotic perception and intelligent control. He has won the Championship of the Autonomous Grasp Challenges at IROS2016 and IROS 2019. He is the recipient of the excellent Doctoral Dissertation Prize of China in 2000 by Ministry of Education of China and the Choon-Gang Academic Award by Korea in 2003, and was recognized as a Distinguished Young Scholar in 2006 by the Natural Science Foundation of China. He served as an associated editor of IEEE Trans. on Neural Networks during 2006-2010, IEEE Trans. On Fuzzy Systems during 2011-2018, IEEE Trans. on Cognitive and Development since 2018, and IEEE Trans. on Systems, Man and Cybernetics: Systems since 2015.

Plenary Speech II

11:00-12:00, Saturday, December 7

Erhai Ballroom

Proprioceptive Transluminal Robotics in Connection with Monkey King



Professor Hongliang Ren

National University of Singapore (NUS), Singapore

Abstract

Representing a major paradigm shift from open surgery, minimally invasive surgery (MIS) assisted by transluminal robots and sensing is emerging by accessing the surgical targets via either keyholes or natural orifices. It is challenging to get delicate and safe manipulations due to the constraints imposed by the confined

workspace, complicated surgical environments, and the limited available sensing technologies. Addressing the above transluminal challenges and aiming at human-centered intelligent robots, this talk will share our recent researches in bioinspired robotic mechanisms, delicate sensing, collaborative human-robot interactions, mostly in the context of medical applications. We draw inspirations from the legendary Monkey King's stories for endoluminal biomimetic robotic transformation, proprioception, non-invasive access, and fiber-innervated sensing. The context-aware robots allow us to bypass critical important intracranial or intracorporeal structures, to conform shapes to be compliant with the environments.

Biography

Prof. Hongliang Ren is currently leading a research group on medical mechatronics in the Biomedical Engineering Department of National University of Singapore (NUS). He is an affiliated Principal Investigator for the Singapore N.1. Institute of Neurotechnology (SINAPSE/N.1.), NUS (Suzhou) Research Institute, and Advanced Robotics Center at National University of Singapore (NUS). Dr. Ren received his Ph.D. in Electronic Engineering (Specialized in Biomedical Engineering) from The Chinese University of Hong Kong (CUHK) in 2008. Prior to joining NUS, he was a Research Fellow at The Johns Hopkins University, Children's Hospital Boston & Harvard Medical School, and Children's National Medical Center, USA. His main areas of interest include biorobotics & intelligent control, medical mechatronics, soft continuum robots and sensors, multisensory learning in surgical robotics. Dr. Ren is IEEE Senior Member and currently serves as Associate Editor for IEEE Transactions on Automation Science & Engineering (T-ASE) and Medical & Biological Engineering & Computing (MBEC). He is the recipient of NUS Young Investigator Award & Engineering Young Researcher Award, IAMBE Early Career Award 2018, Interstellar Early Career Investigator Award 2018 & ICBHI Young Investigator Award 2019.

Plenary Speech III

11:00-12:00, Sunday, December 8

Erhai Ballroom

Visual Servoing of Robots in Unstructured Environments



Professor Hesheng Wang

Shanghai Jiao Tong University, China

Abstract

Visual servoing is an important technique that uses visual information for the feedback control of robots. By directly incorporating visual feedback in the dynamic control loop, it is possible to enhance the system stability and the control performance. Many challenges appear when robots come to our daily life. Compare to industrial applications, the robot need deal with many unexpected situations in

unstructured environments. The system should estimate the depth information, the target information and many other information online. In this talk, various visual servoing approaches will be presented to work in unstructured environments. These methods are also implemented in many robot systems such as manipulator, mobile robot, soft robot, quadrotor and so on.

Biography

Prof. Hesheng Wang received the Ph.D. degree in Automation & Computer-Aided Engineering from the Chinese University of Hong Kong. Currently, he is a Professor of Department of Automation, Shanghai Jiao Tong University, China. He has published more than 100 papers in refereed journals and conferences. He is an associate editor of Assembly Automation and International Journal of Humanoid Robotics, a Technical Editor of IEEE/ASME Transactions on Mechatronics. He served as an associate editor for IEEE Transactions on Robotics from 2015 to 2019. He was the general chair of IEEE RCAR2016 and program chair of IEEE AIM2019 and IEEE ROBIO2014. He was a recipient of Shanghai Rising Star Award in 2014, The National Science Fund for Outstanding Young Scholars in 2017 and Shanghai Shuguang Scholar in 2019. He is a Senior Member of IEEE.