IEEE ICMA 2021 Conference

Keynote Speech

Intelligent Robots and Moon Shot Program

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Abstract:

Recent robot technology (RT) has made remarkable progress in both manufacturing and service sectors. Because of this RT advanced technology, there are growing demands to make robots work more friendly and flexible coordinated with human for service. There are many researches and developing works undergoing for robot and human interaction, such as assistance and supports of human by robots in manufacturing, inspection and maintenance, entertainment, education, bio-medical applications, rehabilitation and techno-care of aged people. Robot is required to have the more flexibility and adaptation control to human behavior, more friendly robot and human interface, and estimation capability of human intention some way to make more proactive motion. There are a lot of problems to solve them with robotic sensor, actuator, control, communication and interface with human.
This talk is an overview of the Multi-scale robotics, based on the Cellular Robotics System, which is the basic concept of the emergence of intelligence, coevolution and self-organization in the multi-scale way from Organizational Level, Distributed Robotics to Biological Cell Engineering and Nanorobotics, which was proposed more than three decades ago. It consists of many elements how the system can be structured from the individual to the group/society levels in analogy with the biological system. It covers with the wide range of challenging topics, but intelligent robotics is focused on this talk.
In particular, focusing on the coevolution and self-organization capabilities, I will show a new initiative on AI and Robot, one of the Moon-Shot Programs started by Japanese Government, since 2020. Based on the Society 5.0, it is a new and challenging program aiming at the AI robotic system in 2050. I will introduce some of the projects in this program for realization of the Society 5.0 by back-casting technologies from the 2050 to the current ones.

Toshio Fukuda (M'83-SM'93-F'95) graduated from Waseda University, Tokyo, Japan in 1971 and received the Master of Engineering degree and the Doctor of Engineering degree both from the University of Tokyo, in 1973 and 1977, respectively. He is Professor Emeritus of Nagoya University and Professor of Meijo University and Waseda University. He is mainly engaging in the research fields of intelligent robotic system, micro and nano robotics, bio-robotic system and industry applications in robotics and automation.
He was the President of IEEE Robotics and Automation Society (1998-1999), and IEEE President (2020). He was Editor-in-Chief of IEEE/ASME Trans. Mechatronics (2000-2002). He was chairs of many conferences, such as the Founding General Chair of IEEE International Confere on Intelligent Robots and Systems (IROS, 1988), IEEE Conference on Cyborg and Bionic Systems (CBS, 2017), IEEE Conference on Intelligence and Safety of Robots (ISR, 2018). He has received many awards such as IEEE Robotics and Automation Pioneer Award (2004), Technical Field Award (2010). IEEE Fellow (1995). SICE Fellow (1995). JSME Fellow (2002), RSJ Fellow (2004), VRSJ Fellow (2011).

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Plenary Talk 1

The Future of Robot-Assisted Surgery

Ken Goldberg, Ph.D.

Professor and Director

William S. Floyd Jr. Distinguished Chair in Engineering

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Director, AUTOLAB and CITRIS "People and Robots" Initiative Founding Member, Berkeley AI Research (BAIR) Lab Joint Appointments: EECS, Art Practice, School of Information (UC Berkeley) and Radiation Oncology (UC San Francisco Medical School).

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Abstract:

An emerging generation of robots will assist surgeons by performing tedious subtasks such as suturing and debridement to improve consistency, reduce fatigue, and open the door to long-distance tele-surgery. Advances in AI can be applied to data collected from surgical systems such as Intuitive' s da Vinci to learn underlying control policies. In this talk I'll present recent advances from our lab including novel hardware and software with applications to cutting, suturing, palpation, dissection, retraction, debridement and a recent result -- "Superhuman Peg Transfer".

Ken Goldberg is UC Berkeley Professor of Industrial Engineering and Operations Research with joint appointments in EECS, College of Engineering, School of Information, and Art Practice, Director, CITRIS "People and Robots" Initiative, Co-Director, Center for Automation and Learning for Medical Robotics (Cal-MR), and Adjunct Professor of Radiation Oncology at UCSF Medical School. He was appointed the William S. Floyd Jr Distinguished Chair in Engineering and serves as Chair of the Industrial Engineering and Operations Research Department. He and his students pursue research in machine learning for robotics and automation in warehouses, homes, and operating rooms. Ken developed the first provably complete algorithms for part feeding and part fixturing and the first robot on the Internet. Despite agonizingly slow progress, he persists in trying to make robots less clumsy. He has over 250 peer-reviewed publications and 8 U.S. Patents. He co-founded and served as Editor-in-Chief of the IEEE Transactions on Automation Science and Engineering. Ken's artwork has appeared in 70 exhibits including the Whitney Biennial and films he has co-written have been selected for Sundance and nominated for an Emmy Award. Ken was awarded the NSF PECASE (Presidential Faculty Fellowship) from President Bill Clinton in 1995, elected IEEE Fellow in 2005 and selected by the IEEE Robotics and Automation Society for the George Saridis Leadership Award in 2016.

More information can be obtained in http://goldberg.berkeley.edu

Prof. Goldberg's 50 papers on surgical robotics and brachytherapy radiation delivery:
https://goldberg.berkeley.edu/pubs/#MR

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Plenary Talk 2

Co-worker Robots for Industrial Applications

Kazuhiro Kosuge

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Abstract:

A Co-worker Robot "PaDY" (in-time Parts/tools Delivery to You robot) was developed for an automobile assembly process usually carried out only by a human worker. PaDY delivers necessary parts and tools to the worker when he/she needs them to reduce the worker's load, to improve efficiency of the work and to prevent mistakes of the work. PaDY is a simple robot with two degrees of freedom and was easily implemented in a real

assembly process without difficult issues. When we try to apply this concept to different types of tasks, we encounter several issues. An adaptive motion planning scheme has been developed for easy implementation of the co-worker robot “PaDY.” A hybrid active/passive co-worker system has been developed for assisting an assembly of a heavy object. A mechanical logic has been developed for low cost and reliable implementation of a co-worker mobile robot developed for a kitting process. In this talk, several prototype systems will be introduced based on the new concepts.

Dr. Kazuhiro Kosuge (Fellow, IEEE) received the B.S., M.S., and Ph.D. in control engineering from the Tokyo Institute of Technology, in 1978, 1980, and 1988 respectively. After having served as a R&D Staff of the Production Engineering Department, Nippon Denso Company, Ltd., a Research Associate at Tokyo Institute of Technology and an Associate Professor at Nagoya University, he joined Tohoku University as Professor in 1995 and served as Distinguished Professor from 2018 to March 2021. He is now serving as the Director of the Center for Transformative AI and Robotics, Specially Appointed Professor of Graduate School of Engineering, Tohoku University. He has recently joined the University of Hong Kong as Chair Professor in the Department of Electrical and Electronic Engineering. He received Medal of Honor, Medal with Purple Ribbon, from the Government of Japan in 2018 - a national honor in recognition of his prominent contributions to academic and industrial advancements. He also received IEEE RAS George Saridis Leadership Award in Robotics and Automation in 2021 for his exceptional vision of innovative research and outstanding leadership in the robotics and automation community through technical activity management. He is an IEEE Fellow, JSME Fellow, SICE Fellow, RSJ Fellow, JSAE Fellow and a member of the Engineering Academy of Japan. He was the President of the IEEE Robotics and Automation Society, from 2010 to 2011, the IEEE Division X Director, from 2015 to 2016 and the IEEE Vice President for Technical Activities for 2020.

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Plenary Talk 3

Post-Da Vinci Surgical Robots: Possibility and Expectations

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Abstract:

Research on surgical robotics is attracting more and more public attention and research efforts during the past decades. Recent revolutionary development and drastic progress in robotic technology in terms of both hardware capability and software power have made it possible for researchers to redefine what surgical robotics is capable of achieving to facilitate complicated medical procedures with much less pain and surgical procedures without even external scars. In this talk, we will start with an introduction to how research on minimally invasive surgical robotics started and what the milestone achievements are, and then move onto our own research efforts on post-Da Vinci surgical robots with several case study examples. Personal thoughts and outlook on future research efforts and potentials in surgical robotics will be outlined to conclude the talk.

Max Q.-H. Meng is currently a Chair Professor and the Head of the Department of Electronic and Electrical Engineering at the Southern University of Science and Technology in Shenzhen, China, on leave from the Department of Electronic Engineering at the Chinese University of Hong Kong. He received his Ph.D. degree in Electrical and Computer Engineering from the University of Victoria, Canada, in 1992. He joined the Chinese University of Hong Kong in 2001 as a Professor and later the Chairman of Department of Electronic Engineering. He was with the Department of Electrical and Computer Engineering at the University of Alberta in Canada, where he served as the Director of the ART (Advanced Robotics and Teleoperation) Lab and held the positions of Assistant Professor (1994), Associate Professor (1998), and Professor (2000), respectively. He is an Honorary Chair Professor at Harbin Institute of Technology and Zhejiang University, and also the Honorary Dean of the School of Control Science and Engineering at Shandong University, in China. His research interests include robotics, perception and intelligence. He has published more than 750 journal and conference papers and book chapters and led more than 60 funded research projects to completion as Principal Investigator. He has been serving as the Editor-in-Chief and editorial board of a number of international journals and as the General Chair or Program Chair of many international conferences, including the General Chair of IROS 2005 and General Chair of ICRA 2021 to be held in Xi'an in June 2021. He served as an Associate VP for Conferences of the IEEE Robotics and Automation Society (2004-2007), Co-Chair of the Fellow Evaluation Committee and an elected member of the AdCom of IEEE RAS. He is a recipient of the IEEE Millennium Medal, a Fellow of IEEE, a Fellow of Hong Kong Institution of Engineers, and an Academician of the Canadian Academy of Engineering.