

IEEE ICMA 2016 Conference Workshop

World Premium Workshops on Robotics

Sunday, August 7, 2016

13:30 - 17:00

Beijing Room, 2F

Shangri-La Hotel, Harbin, China

Robotics and its Real-world Applications: State of the Art

Venue: Beijing Room (Conference Room 1), 2F
Shangri-La Hotel, Harbin

Date and Time: 13:30 - 17:00, August 7, 2016

Organizers:

Toshio Fukuda, Beijing Institute of Technology, Beijing, China

Hong Liu, Harbin Institute of Technology, Harbin, China

Shuxiang Guo, Beijing Institute of Technology, Beijing, China

About the workshop:

The Robotics is significantly changing the way people live and work. Robots are being widely employed for personal assistance, healthcare, extreme environment applications, etc. In the 1st World Premium Workshops on Robotics, we assembled a group of experts, who are the Expert of the Recruitment Program of Global Experts in China (1000 Talents Program Professor), have been pursuing cutting-edge research on robotics for universal manipulation, humanoid walking and health promotion. From their experience and discoveries, the state of the art in robotics and its application will be introduced and presented.

List of Speakers and Schedule

Time	Topics	Speaker List
13:30-13:40	Welcome speech	
13:40-14:20	Multi-agent Smart Society with Robots	Prof. Kaoru Hirota, Beijing Institute of Technology, China
14:20-15:00	Collaborative Robotics	Prof. Liu, Li Michael, Director, Centre of Excellence for Intelligent Mechanical Systems Peking University, Beijing, China
15:00-15:20	Coffee break	
15:20-16:00	Visual Robot Navigation: Recent Trends and Developments	Prof. Hong Zhang Department of Computing Science, University of Alberta Edmonton, Alberta, Canada
16:00-16:40	Micro Robotics Advances Bio Science and Bio Technology	Prof. Tatsuo Arai, Beijing Institute of Technology, China
16:40-17:00	Panel Discussion	Moderators: All speakers

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Talk 1

Multi-agent Smart Society with Robots

Kaoru Hirota

1000 Talents Program Professor

School of Automation, Beijing Institute of Technology

Director of Japan Society for the Promotion of Science, Beijing Office

Professor Emeritus, Tokyo Institute of Technology

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Abstract: The presenters' group has been studying on humans-robots interaction in the frame work of multiagent smart society, where a concept of Fuzzy Atmosfield (FA) is proposed to express the atmosphere in humans-robots communication. The FA is characterized by a 3D fuzzy cubic space with “friendly-hostile”, “lively-calm”, and “casual-formal” based on a cognitive science experiments and PCA. To understand easily such movement of the atmosphere, a graphical representation method is also proposed. To illustrate the FA and its visualization method, a demonstration scenario “enjoying home party by five eye robots and four humans” is introduced/demonstrated. Then a part of recent research results on Smart Distance Education System is mentioned, where a virtual classroom is supposed to be set up, and the atmosphere information of the classroom is observed by using multi-modal interface (e.g., kinect) attached to each learner's education terminal and is utilized to improve the education efficiency based on the fuzzy atmosfield concept. As a field test, a few experiments have been done, e.g., by utilizing presenter's developed CAI (Computer Aided System) entitled "six concepts in Computational Intelligence".

Dr. Hirota received Dr. E. degrees from Tokyo Institute of Technology in 1979. After his career at Sagami Institute of Technology (1979-1982), Hosei University (1982-1995), Tokyo Institute of Technology (1995-2015), he is currently a professor emeritus at Tokyo Institute of Technology, a director of Japan Society for the Promotion of Science Beijing Office, and a professor at Beijing Institute of Technology (in the framework of 1000 global experts program, Chinese government). His research interests include fuzzy systems, intelligent robot, and image understanding. He experienced president and fellow of IFSA (International Fuzzy Systems Association), and president of SOFT (Japan Society for Fuzzy Theory and Systems.) He is a chief editor of J. of Advanced Computational Intelligence and Intelligent Informatics. Banki Donat Medal, Henri Coanda Medal, Grigore MOISIL Award, SOFT best paper award, Acoustical Society of Japan best paper award, honorary/adjunct professorships from “de La Salle University (Philippine), Changchun Univ. of Science & Technology (China), Harbin University of Science and Technology (China), the University of Nottingham (UK), Beijing Institute of Technology (China), and Chinese University of Geosciences Wuhan (China)”, and Honoris Causa from “Bulacan state university (Philippine), Budapest Technical University (Hungary), and Szechenyi Istvan University (Hungary)” were awarded to him. He organized more than 10 international conferences/symposiums as a founding/general/program chair. He has been publishing more than 290 journal papers, 55 books, and 550 conference papers.

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Talk 2

Collaborative Robotics

Liu, Li Michael, Ph.D., Senior Member IEEE

Director, Centre of Excellence for Intelligent Mechanical Systems

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Abstract

The collaborative robots, which interact with the Humans, have been attracted great attention recently. This is primarily due to their potential in exploiting the new robotic applications in wide ranges, and the complexities in system settings. The collaborative robots distinguish themselves from the traditional robotic devices, and have to be systematically designed from full spectrum of engineering. A two armed collaborative robotic system named WEE has been designed, developed and function verified at Peking University. It will be presented at the conference the WEE system design perspectives, which is derived from the anticipated operations. WEE operations have focus on both safety and efficiency. WEE hardware design is featured with Pitch/Roll joint modulation, which is similar to those of Human arms. To enhance the performance while facing complex unknown environment, WEE controls consist three layers: At the inner layer, a subsystem based adaptive full dynamics compensation approach was adopted to maximize the system bandwidth; At the second layer, the arm is equipped with constrained motion control algorithms including active force as well as impedance controls; The third layer of controls are used with selectable strategies to handle dual arm operation as well as human/robot co-manipulation. System function verifications will be presented with extensive hardware test results. It is believed that the collaborative robots representing the next generation robotics will have significant impact on both industry evolution as well as daily life of Humans.

Dr. Li Michael Liu has been the Director of Center of Excellence for Intelligent Mechanical Systems, at College of Engineering, Peking University (PKU), Beijing China since 2012. His research group at PKU focuses on the mechanisms and controls for efficient robotic manipulation and locomotion, including high bandwidth dual arm robotic system especially for Human-machine collaborations, and bipedal robot for fast walking. Prior joining PKU, Dr. Liu was a recognized technical leader within Canadian robotics community with twenty-five years of professional experiences. He joined Spar Aerospace Ltd. (presently MDA Cooperation), Toronto Canada in 1989 with engagement of concept design of the dexterous robotic systems for International Space Station (ISS). Subsequently, Dr. Liu was the technical leader, controls & simulations, for the state-of-the-art space dexterous robot (Dextre) launched on to the orbit in March 2008, and led the ground based operation support from 2008 to 2011. The control algorithm Dr. Liu developed has become the standardized flight controls software for NASA and Canadian Space Agency robotics initiatives. He has been the principle control designer and team leader for several space and medical robotic systems including Hubble space telescope rescue robotic system, neuro-surgical robot NeuroArm2, and specially designed minimum invasive surgical robot KidsArm for children. Dr. Liu has received his Ph.D. degree in Electrical and Computer Engineering from McMaster University, Ontario, Canada in 1987. Dr. Liu has authored over 50 technical papers in the fields of robotics and controls in professional journals/conferences.

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Talk 3

Visual Robot Navigation: Recent Trends and Developments

Hong Zhang, Ph.D.

Professor

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Abstract:

Research and development in mobile robotics has been extremely active in the past three decades. Much understanding of the theoretical issues in the field has been gained, and many successful robots have been developed and some commercialized including those roaming the factory floors and the skies. One specific area of significant progress is the use of visual sensing by mobile robots to map and navigate an environment, as well as to detect and recognize objects. This progress is mostly attributed to the rich textural information in visual sensory data, the low cost and omnipresent cameras, and, most importantly, the great strides made in the development of efficient and robust computer vision algorithms. In this talk, I will give an overview of the recent research progress in visual robot navigation, highlight the state-of-the-art methods and techniques, and describe the challenges facing mobile robotics research, including the need to handle dynamic changes that occur in their environments, during long-term deployment of practical mobile robots.

Dr. Hong Zhang

Dr. Hong Zhang received his B.S. from Northeastern University (Boston) in 1982, and Ph.D. from Purdue University in 1986, both in Electrical Engineering. Subsequently he spent 18 months with the GRASP Lab at the University of Pennsylvania as post-doctoral fellow before joining the University of Alberta, Canada, in 1988, where he is currently a Professor in the Department of Computing Science. Dr. Zhang's research interests include robotics, computer vision, and image processing, and he has published over 200 papers in international journals and conferences in these areas. Among his numerous professional activities, Dr. Zhang is currently a member of IEEE Robotics and Automation Society Administrative Committee, and is serving as the General Chair of 2017 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), to be held in Vancouver, Canada. Dr. Zhang holds the NSERC Industrial Research Chair in Intelligent Sensing Systems. He is a Fellow of the IEEE, and a Fellow of the Canadian Academy of Engineering.

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Talk 4

Micro Robotics Advances

Bio Science and Bio Technology

Tatsuo Arai, Ph.D.

Professor

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Abstract:

Our micro robotics covers dexterous high speed micro manipulation, micro assembly, cell characterization, and 3D cellular system construction. The basic idea is to devise and to utilize dexterous two finger micro hands, and to achieve total micro manipulation system with high speed vision and interfaces for bio applications. Our system is multi-scalable and can manipulate micro object with the size ranging from one to hundreds micron meters seamlessly. Our constant system improvement and refinement have achieved wide range of workspace with real time 3D information, simple finger setting-up procedure, fine force sensing capability as well as automated calibration, automated picking-and-placing, etc.

Based on these activities and our collaboration experiences with biologists and medical doctors we have carried out 5 year national project on “Bio Assembler” in 2011-2016, whose target is a challenge of constructing artificial 3D cellular system (tissues) in vitro. The major topics are high speed cell characterization & sorting, 3D cellular system construction, and cell functionalization analysis. Total 32 research groups joined the consortium and worked together in the internal and/or external research collaborations.

Now we are looking at further researches and developments in new bio application fields, such as causality of various stresses in differentiation, proliferation, generation, development, and disease. The mechano biology is one of the examples of such activities and currently so active in biology and medical, however, we are looking for more than that, not just limited to the mechanical matter.

Professor Tatsuo ARAI received B.S. M.S. and PhD degrees from the University of Tokyo in 1975, 1977, and 1986, respectively. He joined the Mechanical Engineering Laboratory, AIST in 1977, and was engaged in research and development of new arm design and control, mobile robot, teleoperation, and micro robotics. He stayed at MIT as a visiting scientist in 1986-1987. He was an adjunct lecturer at Chiba University and gave a course on robotics. He moved to Osaka University in 1997 and since then he has been a full professor at the Department of Systems Innovation, Graduate School of Engineering Science. His current research topics are mechanism design including parallel mechanisms, legged working robot, micro robotics for bio application, humanoid robot, haptic interface. He has published more than 400 journals and reviewed conference papers on robotics, 5 books, and has 37 patents including foreign 8. The publication list is on <http://www-arailab.sys.es.osaka-u.ac.jp/result.html>. He is IEEE Fellow, IAARC (International Association of Automation and Robotics in Construction) Director, RSJ (Robotic Society of Japan) Fellow, and JSME (Japan Society of Mechanical Engineers) Fellow. He is a deputy editor-in-chief of the Robomech Journal. He worked for the Cabinet Office as a chair of the Technical Advisory Committee of the Destruction of Abandoned Chemical Weapon in 2000-2007. He was a project leader of National Project on Hyper Bio Assembler in 2011-2016.