MIT Industrial Liaison Program Faculty Knowledgebase Report

2019 MIT Shenzhen Symposium

January 9, 2019 9:30 am - 5:00 pm

9:30am

Registration & check-in

10:30am

Welcome Remarks
Graham Rong
Program Director, MIT Industrial Liaison Program

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Dr. Rong is a Program Director of Corporate Relations at MIT. He currently supervises a group of ILP program directors who promote and manage the interactions and relationships between the research at MIT and companies worldwide to help them stay abreast of the latest developments in technology and business practices.

Previously, Dr. Rong founded IKA, LLC. He has led corporate development and product innovation and provided strategic advice to companies in corporate strategy, IT leadership, digital transformation, AI, enterprise content management, and customer relationships. He held senior roles in Harte-Hanks and Vignette Corporation. He held an EU postdoctoral research fellowship at the University of Edinburgh in Scotland where he started global collaborative research.

Dr. Rong is on the board of multiple organizations, including the MIT Sloan Alumni Association of Boston from 2009 to 2012. He chaired MIT Sloan CIO Symposium from 2009-2011. He is a senior expert invited by international organizations.

Dr. Rong holds an M.B.A. in global and innovation leadership from the MIT Sloan School of Management and a Ph.D in numerical computing from the University of Guelph in Canada.

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10:50

Robots for Physical Interaction
Sangbae Kim

Associate Professor of Mechanical Engineering
MIT Department of Mechanical Engineering

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Sangbae Kim, is the director of the Biomimetic Robotics Laboratory and an associate professor of Mechanical Engineering at MIT. His research focuses on the bio-inspired robot design by extracting principles from animals. Kim's achievements on bio-inspired robot development include the world's first directional adhesive inspired from gecko lizards, and a climbing robot, Stickybot, that utilizes the directional adhesives to climb smooth surfaces featured in TIME's best inventions in 2006. Recent achievement includes the development of the MIT Cheetah capable of stable outdoor running up to 13mph and jumping over any obstacles autonomously. This achievement was covered by more than 200 media articles. He is a recipient of best paper award from International Conference on Robotics and Automation (2007), King-Sun Fu Memorial Transactions on Robotics (2008) and IEEE/ASME transactions on mechatronics (2016), DARPA Young Faculty Award (2013), NSF CAREER award (2014), and Ruth and Joel Spira Award for Distinguished Teaching (2015).

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While robots dominates repetitive works in factories, the design and controller of these robots are not suitable for relatively complex tasks that humans do easily. These tasks typically require force sensing and interaction force control. Conventional robots are not built to control force or being flexible to perform like human arms.

The talk will discuss how the new design paradigm allows such dynamic interactive force control with environments. As an embodiment such robot design paradigm, the latest version of cheetah robot and force feedback teleoperation arms will be presented. This new class of robots will play a crucial role in future robot applications such as elderly care, home service, delivery, and services in unfavorable environments for human.

11:40am

Three Dimensional Photonic Manufacturing - From Catalytic Gas Converters to Vascular Tissue Scaffolding
Nicholas Fang

Professor of Mechanical Engineering
MIT Department of Mechanical Engineering

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Nicholas X. Fang received his BS and MS in physics from Nanjing University, and his PhD in mechanical engineering from University of California Los Angeles. He is currently professor of Mechanical Engineering at MIT. Prior to MIT, he worked as an assistant professor at the University of Illinois Urbana-Champaign from 2004 to 2010. Professor Fang's areas of research look at nanophotonics and nanofabrication. His recognitions include the ASME Chao and Trigger Young Manufacturing Engineer Award (2013); the ICO prize from the International Commission of Optics (2011); an invited participant of the Frontiers of Engineering Conference by National Academies in 2010; the NSF CAREER Award (2009) and MIT *Technology Review Magazine's* 35 Young Innovators Award (2008).

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Three-dimensional lightweight material building blocks, through the combination of molecular design of material behavior and microscale geometric patterning, show promise to revolutionize the ability to dissipate energy and manipulate wave propagation. Such materials are desirable for a broad array of applications such as structural components, catalysts supports and energy efficient materials.

In this seminar, I will present our development of three dimensional micro/nanofabrication technique, projection microstereolithography (PuSL), to enable design and exploration of digitally coded multifunctional and multimaterial lightweight metastructures at unprecedented dimensions. The ultra-high resolution and multi-material capabilities of the 3D printing system and the modeling tools developed can be used to design and fabricate architected materials for combined functions, including energy absorption, actuation/morphing, and micro-scale bioreactors for tissue engineering. These structures show promise on focusing and rerouting acoustic waves through broadband and highly transparent metamaterials. I will also discuss the development of engineered, three dimensional arrays of copolymer fibers that serve as mimetics of neuronal axons, using a combination of materials engineering and high resolution 3D microfabrication, which enable study of OPC engagement and subsequent myelination in vitro.

12:30

Lunch

1:40pm Best Practices for Commercialization of University Technology and Working with Industry
Jim Freedman

Associate Director, MIT Technology Licensing Office

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James Freedman has been at the MIT Technology Licensing Office since 2006. He previously managed patents and licensing issues for Chemicals, Chemical Engineering, and Material Science, particularly in areas of chemical catalysts, nanomaterials, and water technologies, as a Licensing Officer. Now, Freedman is Associate Director for Consumer Products, Chemicals, and Instruments. He also serves as liaison between the TLO and multiple large corporate and university research alliances. Freedman has been involved in various aspects of the ecosystem that drives the Institute's entrepreneurship culture, including the Deshpande Center for Innovation, the MIT Enterprise Forum, iTeams, the Massachusetts Technology Transfer Center, Mass Clean Energy Center, and the Boston Chapter of LES (past co-chair). Prior to coming to MIT, Freedman worked in research, development, manufacturing, and customer support functions at Polaroid Corporation, Spectra Incorporated, and Presstek Corporation, all aimed at bringing chemical-based products and systems into the market. He has Chemistry degrees from Harvard and Columbia Universities and a Masters in Management from Boston University.

Universities are fertile environments for discovering new technologies, proving new concepts and disseminating information. Companies are focused organizations for understanding commercial markets and developing viable products to meet the needs of their customers. Collaboration between the two types of organizations can be a very productive way of making early-stage technologies a reality in the market to benefit society and to create economic value.

2:10pm

Robotic Dexterous Picking. Why is grasping not a solved problem?

Alberto Rodriguez
Class of 1957 Associate Professor
Mechanical Engineering Department

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Alberto Rodriguez is the Class of 1957 Associate Professor at the Mechanical Engineering Department at MIT. Alberto graduated in Mathematics ('05) and Telecommunication Engineering ('06) from the Universitat Politecnica de Catalunya, and earned his PhD ('13) from the Robotics Institute at Carnegie Mellon University. He leads the Manipulation and Mechanisms Lab at MIT (MCube) researching autonomous dexterous manipulation, robot automation, and end-effector design. Alberto has received Best Paper Awards at conferences RSS'11, ICRA'13, RSS'18, IROS'18, and RSS'19, the 2018 Best Manipulation System Paper Award from Amazon, and has been finalist for best paper awards at IROS'16, IROS'18, ICRA'20 and RSS'20. He has led Team MIT-Princeton in the Amazon Robotics Challenge between 2015 and 2017, and has received Faculty Research Awards from Amazon in 2018, 2019 and 2020, and from Google in 2020. He is also the recipient of the 2020 IEEE Early Academic Career Award in Robotics and Automation.

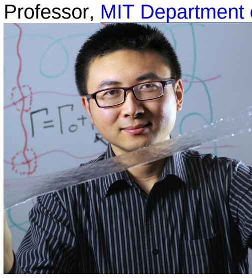
Manipulation is the process by which we rearrange the world around us, most often using our hands. It is a very wide and unstructured problem with high impact potential applications, from manufacturing to home assistance, from food production to waste management. Like many other human skills, its apparent simplicity is largely deceiving. It sits right between art and science, and replicating it by an artificial agent has proven a very challenging endeavor. The main goal of this talk is to describe some capabilities that I believe are essential to develop autonomous robotic manipulation systems. I will start by briefing on recent advancements and limitations in autonomous pick-and-place of novel objects in cluttered environments that came out of three years of focused efforts in the Amazon Robotics Challenge. I will then discuss the path forward from the current interest in unstructured picking in warehouse automation to tasks that require more dexterous part handling such as packing, feeding, kitting, or assembly.

3:00pm

Networking Break

3:20pm

Merging Humans and Machines on Biomedicine, Manufacture and Robotics Frontiers
Xuanhe Zhao
Professor, MIT Department of Mechanical Engineering



Xuanhe Zhao
Professor
MIT Department of Mechanical Engineering

Xuanhe Zhao is a Professor of Mechanical Engineering at MIT. The mission of Zhao Lab is to advance science and technology between humans and machines to address grand societal challenges in health and sustainability. A major current focus is the study and development of soft materials and systems. Dr. Zhao has won early career awards from NSF, ONR, ASME, SES, AVS, Adhesion Society, JAM, EML, and Materials Today. He has been a Clarivate Highly Cited Researcher since 2018. Bioadhesive ultrasound, based on Zhao Lab's work published in Science, was named one of TIME Magazine's Best Inventions of the year in 2022. SanaHeal Inc., based on Zhao Lab's work published in Nature, was awarded the 2023 Nature Spinoff Prize. Over ten patents from Zhao Lab have been licensed by companies and have contributed to FDA-approved and widely-used medical devices.

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While human tissues and organs are mostly soft, wet and bioactive; machines are commonly hard, dry and biologically inert. Bridging human-machine interfaces is on the technological and industrial frontiers of biomedicine, manufacture and robotics, as well as of imminent importance in addressing grand societal challenges in healthcare, security, sustainability, education and joy of living. However, interfacing human and machines is extremely challenging due to their fundamentally contradictory properties. At MIT SAMs Lab, we propose to harness "hydrogel technology" to form long-term, high-efficacy, compatible and seamless interfaces between humans and machines. On one side, hydrogels with similar mechanical and physiological properties as tissues and organs can naturally integrate with human body over the long term, greatly alleviating the foreign body response and mechanical mismatches. On the other side, the hydrogels with intrinsic or integrated electrodes, optical fibers, sensors, actuators and circuits can effectively bridge external machines and human bodies via electrical, optical, chemical and mechanical interactions. In this talk, I will focus on the impacts of human-machine interfaces on biomedicine, manufacturing and robotics, in terms of new capabilities and new applications. Examples include 3D printing of customized and personalized medical devices and drugs for precision medicine, ingestible soft machines capable of continuously monitoring core-body physiological conditions over months, and untethered soft robots controlled by magnetic fields for future minimal invasive operations. I will conclude the talk by proposing a perspective on the future society with humans and machines seamlessly merged together.

4:10pm

Advanced Materials and Systems at the Energy and Water Nexus
Gang Chen
Carl Richard Soderberg Professor of Power Engineering, MIT Department of Mechanical Engineering

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Carl Richard Soderberg Professor of Power Engineering
MIT Department of Mechanical Engineering

Gang Chen is the Carl Richard Soderberg Professor of Power Engineering at the Massachusetts Institute of Technology (MIT). He served as the Department Head of the Department of Mechanical Engineering at MIT from 2013 to 2018. He obtained his PhD degree from the Mechanical Engineering Department at UC Berkeley. He was a faculty member at Duke University and UCLA before joining MIT in 2001. He received an NSF Young Investigator Award, an R&D 100 award, an ASME Heat Transfer Memorial Award, an ASME Frank Kreith Award in Energy, a Nukiyama Memorial Award by the Japan Heat Transfer Society, a World Technology Network Award in Energy, an Eringen medal from the Society of Engineering Science, and the Capers and Marion McDonald Award for Excellence in Mentoring and Advising from MIT. He is a fellow of the American Association for the Advancement of Science, the American Physical Society, The American Society of Mechanical Engineers, and the Guggenheim Foundation. He serves on the board of the Asian American Scholar Forum (aasforum.org). He is an academician of Academy Sinica, a fellow of the American Academy of Arts and Sciences, a member of the US National Academy of Engineering, and a member of the US National Academy of Sciences.

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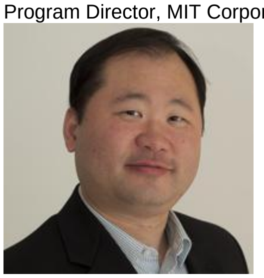
This talk will present some of our recent work on advanced materials and systems at the energy and water nexus, including thermoelectric and thermogalvanic materials and systems for direct conversion of heat into electricity, high thermal conductivity semiconductors and polymers, optically opaque and infrared transparent fabrics, clean water technologies, photovoltaics and grid level energy storage systems. Thermoelectric materials have seen significant improvements over last two decades, but innovations are needed to develop their applications since their heat-to-electricity conversion efficiencies are still limited. In addition, electrochemical systems such as batteries can also be used to convert heat into electricity, which could be especially attractive for low temperature waste heat recovery. Although thermoelectric energy conversion calls for low thermal conductivity materials, many other applications require high thermal conductivity materials. We are developing materials with high thermal conductivity ranging from semiconductors to polymers, including BAs which has second highest thermal conductivity behind diamond. Although polymers are usually thermal insulators, we show that they can be made as thermally conductive as metals by aligning molecular orientations. After these examples, we turn attention to energy and water technologies based on engineering thermal radiation. With properly chosen polymer fiber diameters, we design fabrics so that they are opaque to visible light and yet allow thermal radiation from human body to escape to environment for passively cooling of human body. We also demonstrate the ability of boiling water and even creating super-heated steam under unconcentrated sunlight. The talk will conclude with a discussion of our work on crystalline silicon based photovoltaics and their potential applications in energy storage.

5:00pm

Closing remarks & Adjournment
David Zhu
Program Director, MIT Corporate Relations



David Zhu
Program Director, MIT Corporate Relations

David Zhu has extensive experience in the technology and energy industries ranging from research and development, operations management, M&As and investments.

As a Program Director, Zhu manages the interactions and collaborations between MIT and companies worldwide to address challenges in technological innovations and business practices.

Previously, Zhu was a Managing Director at Maxis Capital. At Maxis, he worked with a number of Chinese and US companies and managed private equity investment opportunities in the technology, telecom, semiconductor and clean energy industries.

Before he was at Maxis Capital, Zhu was an Technology banker at Key Bank where he focused on mergers and acquisitions transactions in the software and financial technology areas. He has also held positions at Virtual Back Office Software Inc. and Kana Inc. in the Boston area where he managed software development and client engagements, and provided solutions to global companies.