Webinar of the IEEE TC Micro/Nano Robotics and Automation

The IEEE Technical Committee for Micro/Nano Robotics and Automation presents a series of online seminars. **One selected speaker will present cutting-edge research** in the micro/nano robotics field. Join us **Tuesday, May 19th, at 5:30 AM (UTC),** for one hour. We will welcome:

Prof. Guo Zhan Lum

Associate Professor, School of Mechanical & Aerospace Engineering, Nanyang Technological University

Title: Highly functional miniature soft robots: towards transformative medicine

Abstract: Magnetic miniature robots (MMRs) are small-scale, untethered actuators which can be controlled by magnetic fields. As these actuators can non-invasively access highly confined and enclosed spaces, they have great potential to revolutionize numerous applications in robotics, materials science and biomedicine. While the creation of MMRs with six-degrees-of-freedom (six-DOF) represents a major advancement for this class of actuators, these robots are not widely adopted due to two critical limitations: (i) under precise orientation control, these MMRs have slow sixth-DOF angular velocities (4 degree/second) and it is difficult to apply desired magnetic forces on them; (ii) such MMRs cannot perform soft-bodied functionalities. Here we introduce a fabrication method that can magnetize optimal MMRs to produce 51–297 folds larger sixth-DOF torque than existing small-scale, magnetic actuators. We also propose a universal actuation method that is applicable for rigid and soft MMRs with six-DOF. Under precise orientation control, our optimal MMRs could execute full six-DOF motions reliably and achieve sixth-DOF angular velocities of 173 degree/second. Our soft MMRs could display unprecedented functionalities; our six-DOF jellyfish-like robot could swim across barriers impassable by existing similar devices and our six-DOF gripper was 20 folds quicker than its five-DOF predecessor in completing a complicated, small-scale assembly. We had also created a soft MMR which can dispense four types of drugs with reprogrammable drug-dispensing sequence and dosage. This six-DOF MMR has great potential to enable advanced targeted combination therapy, where four types of drugs must be delivered to various disease sites, each with a specific sequence and dosage of drugs. This MMR has great prospects to transform targeted combination therapy since it can realize significantly higher efficacy than those demonstrated by existing treatments.

Bio: Guo Zhan Lum received his B.Eng. with first class honors in mechanical engineering from Nanyang Technological University in 2010. He went on to pursue his postgraduate studies in mechanical engineering under the dual Ph.D. program of Nanyang Technological University and Carnegie Mellon University. He received his M.Sc. degree from Carnegie Mellon University in 2015, and dual Ph.D. degrees in 2016. From 2016 to 2017, he was a post-doctoral researcher at the Max Planck Institute for Intelligent Systems. Since 2018, he is a faculty member in Nanyang Technological University and he is currently a tenured Associate Professor. To date, he has published twenty journal papers, including multi-disciplinary journals such as Nature (1x), PNAS (1x), Advanced Materials (6x) and Science Advances (1x). Several of his works have been featured as the Cover for Advanced Materials. His works on magnetic miniature robots, soft robots, and highly reversible and switchable adhesives have been reported by more than 130 international media, including but not limited to The BBC, The New York Times and The Wall Street Journal. His Nature paper with Professor Sitti has also been awarded the prestigious 2025 Frontiers of Science Award.

Lab website: https://dr.ntu.edu.sg/entities/person/Lum-Guo-Zhan

Link for the connection:

https://visio.numerique.gouv.fr/ozz-kypz-bdm

More information on the IEEE Technical Committee for Micro/Nano Robotics and Automation webpage: https://www.ieee-ras.org/micro-nano-robotics-and-automation/activities

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