Wireless Miniature Soft Robots for In-Situ Sensing Physiological Properties of Biological Tissues

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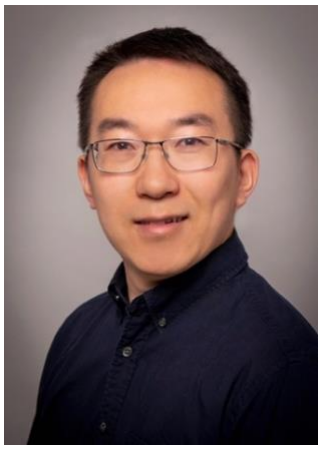
Abstract

Implanted electronic sensors, compared with conventional medical imaging, allow monitoring advanced physiological properties of tissues continuously, such as adhesion, pH, viscoelasticity, and biomarkers for disease diagnosis. However, they are typically invasive, requiring being deployed by surgery, and frequently cause inflammation. In this talk, a minimally invasive method of using wireless miniature soft robots to in-situ sense the physiological properties of the tissue. By controlling robot-tissue interaction using external magnetic fields, visualized by medical imaging, we can recover tissue properties precisely from the robot shape and magnetic fields. We demonstrate that the robot can traverse tissues with multi-modal locomotion and sense the adhesion, pH, and viscoelasticity on porcine and mice gastrointestinal tissues ex vivo, tracked by X-ray or ultrasound imaging. With the unprecedented capability of sensing tissue physiological properties with minimal invasion and high resolution deep inside our body, this technology can potentially enable critical applications in both basic research and clinical practice. This talk will also discuss our vision of developing shape-morphable wirelessly actuated miniature robots in general to enable unprecedented critical application in minimally invasive biomedicine, lab- or organ-on-a-chip, microfluidics, and biomechanics.

Biography of Presenter



Dr. Xiaoguang Dong is an Assistant Professor of Mechanical Engineering and a core member of the Vanderbilt Institute for Surgery and Engineering at Vanderbilt University, US. He received his Ph.D. degree from the Department of Mechanical Engineering (specialized in Robotics) at Carnegie Mellon University. Before joining Vanderbilt University, he worked as a postdoctoral researcher at the Max Planck Institute for Intelligent Systems, Stuttgart, Germany. His group is working on the computational design, advanced fabrication, and intelligent control of novel functional miniature mechanism, devices, and robots, as well as the development of their wireless actuation, control, and sensing systems, aiming at resolving challenging technical and societal problems in health care, environmental exploration, and other critical areas.