College of Engineering
Department of
Mechanical & Industrial Engineering

The Robert W. Courter Seminar Series

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1221 Patrick F Taylor Hall

New Actuation and Design Approaches for Continuum Robots

by Hunter Gilbert*

Department Mechanical & Industrial Engineering

Continuum robots, which change their shape with elastic deformations rather than mechanical joints, are designed to elastically deform under forces encountered during normal operation. They have strong advantages in many environments where geometry may be complex and not well-known in advance of operations, which is common in non-factory environments. They leverage contact with their environment to complete tasks, relying on passive mechanical behaviors rather than complex software intelligence and large numbers of sensors and actuators. For example, robots with slender, snake-like, elastic bodies can navigate the tortuous human anatomy like the colon or the esophagus to perform surgery, or they can navigate through challenging industrial environments like insulated pipelines and machinery to perform "minimally invasive" inspection and maintenance. However, in comparison to rigid articulated systems with only a few joints, slender bodies and mechanical softness come with distinct engineering challenges. Most slender-bodied soft robots have adopted remote actuation approaches that suffer from exponentially worsening friction as they bend. Additionally, prior approaches to actuation result in geometric coupling effects that cause difficulty in both design and control. In this seminar, I will describe research in the Innovation in Control and Robotics Engineering (iCORE) lab at LSU that is focused on improving the understanding of mechanically compliant manipulation and manipulator design. Specifically, I will discuss our ongoing fundamental studies which are aimed at (i) reducing the effects of friction and hysteresis in slender robots with remote actuators and solid-material transmission mechanisms, and (ii) enabling the shape and stiffness control of compliant robots with tendons/cables that optimally couple to independent elastic structural modes of deformation, which will decrease system complexity while improving capability.

*Dr. Hunter B. Gilbert received the B.S. degree in mechanical engineering in 2010 from Rice University (Houston, Texas), and the Ph.D. degree in mechanical engineering in 2016 from Vanderbilt University (Nashville, Tennessee). After completing the Ph.D. degree, he was appointed Research Assistant Professor at Louisiana State University while supported by an Alexander von Humboldt Stiftung postdoctoral fellowship performing research on miniature medical systems in the Physical Intelligence Department, Max Planck Institute for Intelligent Systems (Stuttgart, Germany). He was appointed Assistant Professor of mechanical engineering at LSU in 2017, where he is co-director of the Innovation in Control and Robotics Engineering (iCORE) research laboratory. His research interests are centered around two major themes: mechanically "soft" or deformable robots, and systems and technologies focused on human health and safety. His research has been funded by the LA Board of Regents, the Louisiana Space Consortium/NASA, the National Science Foundation, and industry.