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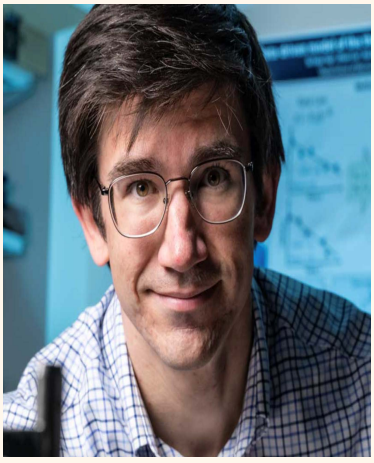
Material-Enabled Technologies for Soft and Fluidic Robots



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ABSTRACT:

The emerging field of soft robotics, which incorporates unconventional, compliant materials in autonomous systems, has simultaneously reshaped traditional robotics applications and introduced new use cases for robots. However, the vast majority of soft robotics research has targeted actuation and sensing, with power and control schemes still relying on rigid components. For instance, assistive wearable robots currently rely on bulky and hard control systems and power supplies, or alternatively require cumbersome tethers to external infrastructure. To address this limitation, my group has developed completely soft fluidic digital logic components fabricated entirely from textile sheets. Our fluidic logic platform enables integrated memory, decision making, and the ability to interact with and adapt to stimuli and the environment, all without the use of rigid valves or electronics. Meanwhile, we address limitations in power delivery by developing "self-powered" textile-based wearable robots that harvest energy from the motion of the human body. The integration of fluidic logic and energy harvesting in sheet-based textile architectures represents an important step toward fully soft, self-sufficient wearable robots that are as comfortable, resilient, and practical as everyday clothing.

BIOGRAPHY:

Dr. Daniel J. Preston directs the Preston Innovation Laboratory at Rice University conducting research at the intersection of energy, materials, and fluids. He is a recipient of the NSF CAREER Award, the ASME Old Guard Early Career Award, and the Energy Polymer Group Certificate of Excellence. His group's recent work has been published in PNAS, Science Advances, Science Robotics, Nano Letters, and Advanced Science. His lab is funded by NASA, the National Science Foundation, and the Department of Energy, among other sources. Dr. Preston earned his B.S. (2012) in mechanical engineering from the University of Alabama and his M.S. (2014) and Ph.D. (2017) in mechanical engineering from the Massachusetts Institute of Technology. Following his graduate degrees, he trained as a postdoctoral fellow from 2017–2019 at Harvard University in the Department of Chemistry and Chemical Biology prior to joining Rice University as an assistant professor in July 2019.