THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
WINTER COLLOQUIUM SERIES PRESENTS:

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The role of anisotropy in the failure and function of 3D printed soft composites

Spatial variations in fiber alignment produce mechanical anisotropies that are essential in determining the failure and function of many biological materials. In this work, we consider the effect of fiber alignment in 3D printed short fiber soft composites, which can be controlled by the print path and nozzle characteristics in extrusion-based printing processes. First, we will discuss the extension of classic shear lag models to understanding the failure of unidirectional glass-fiber polydimethylsiloxane (PDMS) composites printed via direct ink writing (DIW), and the critical effect of fiber volume fraction. Then we will consider the effect of more complex arrangements of fibers, including fiber arrangements inspired by the aorta. By combining the lessons learned from the above studies, we show how glass-fiber- PDMS composites can achieve a combination of toughness, stretchability, and stiffness comparable to that of biological materials such as skin. Additionally, anisotropies in fiber alignment have significant effects on function. With that in mind, time permitting, we will discuss how anisotropic swelling in these (and related materials) can be exploited to produce stimuli-responsive mechanical logic, with potential applications in soft robotics.

Jordan R. Raney is an Associate Professor and the Graduate Chair of the Department of Mechanical Engineering & Applied Mechanics at the University of Pennsylvania. He received a B.S. in Physics and a B.S. in Computer Science from the University of Minnesota, before joining the staff at MIT Lincoln Laboratory. Subsequently, he attended Caltech for graduate school, where he received a M.S. and Ph.D. in Materials Science. Before joining Penn, he was a postdoctoral fellow at Harvard, in the John A. Paulson School of Engineering & Applied Sciences and the Wyss Institute for Biologically Inspired Engineering. At Penn, his research focuses on nonlinear dynamics, additive manufacturing, mechanics of bioinspired composites and architected materials, soft robotics, and mechanical computing. Raney's work has been recognized with an NSF CAREER Award, a 3M Non-Tenured Faculty award, and a DARPA Young Faculty Award. Raney is a member of the editorial boards of the journals npj Metamaterials and Communications Engineering.

Tuesday, March 3rd • 4 pm CT • Ford ITW

In person only; no Zoom

Questions? Contact allison.macknick@northwestern.edu

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