THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
FALL COLLOQUIUM SERIES PRESENTS:

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Bioinspired protein materials for adaptive soft machine

Enabled by soft matter engineering, the field of robotics is experiencing a revolution transitioning from hard/rigid to compliant machines by integrating soft and flexible components in their design. However, to fully realize its potential, such a “soft” revolution presents interdisciplinary challenges across length scales in the search for new robotic materials that can replicate biological functions and behaviors (such as sensing, healing, powering, biointerfacing, degrading, etc.) with various degrees of autonomy and complexity. Proteins are uniquely well-positioned to bring new solutions to these challenges, as they offer high versatility, specificity, and control in their self-assembly to regulate their emergent structures and properties. In this talk, we will introduce cephalopod-inspired proteins with a segmented block design that self-assemble into β-sheet nanocrystalline structures. These β-sheet nanocrystals act as physical and reversible crosslinking structures in supramolecular protein networks that regulate the physical properties. We demonstrate the dynamic properties of squid-inspired polypeptides in self-healing networks with healing strength and kinetics surpassing those typically found in other natural and synthetic soft polymers. This family of cephalopod proteins and their biosynthetic derivatives have opened new opportunities in bioinspired design for adaptive functional materials, and we will demonstrate their implementation in self-healing and reconfigurable soft actuators in artificial muscles and manipulators, as well as in self-powered microrobots for aquatic locomotion.

Abdon Pena-Francesch is an assistant professor in the Department of Materials Science & Engineering, Macromolecular Science & Engineering, and Robotics Institute at the University of Michigan. He leads the BioInspired Materials Lab, an interdisciplinary research group working on biological materials science, polymer chemistry, and soft matter engineering to develop solutions for healthcare, robotics, and the environment. He obtained his PhD from Penn State University, and was a Humboldt Postdoctoral Fellow at the Max Planck Institute for Intelligent Systems. His work has been recognized by multiple awards including the ACS PRF New Investigator Award, MRS Sustainability in Action Award, LG Chem Global Innovation Challenge Award, PSU Dissertation Award, and the Alexander von Humboldt Fellowship for Postdoctoral Researchers.

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In person only; no Zoom

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