LSU DEPARTMENT OF MECHANICAL ENGINEERING

The Robert W. Courter Seminar Series

3:00-4:00pm, Friday, November 22, 2019
Frank Walk Room

Embodied Energy & Intelligence in Composite Materials, and their Applications to Improved Endurance & Adaptability in Robotic Systems

by Robert Shepherd*

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Embodied Intelligence is the principle that describes autonomous mechanical responses to external environmental inputs (e.g., stress causes strain). This concept has been explored in depth previously and has resulted in a variety of compliant mechanisms and smart materials that combine, for example, the functions of structure and actuation. Energy (e.g., Chemical, Mechanical, Electrical, Optical) sources can also be put to multifunctional use; for example, a lead-acid battery being used a counterweight in a forklift. A more principled approach to Embodied Energy, however, does not presently exist. This talk will introduce this concept and focus on specific examples of forming these energy sources at a finer scale, into structural and other functional components and composite materials that provide benefits in the form of reduced SWaP tradeoffs. Examples of how these energetic composites and their chemo-electro-opto-mechanical responses can be tuned to perform work autonomously or in cooperation with higher level sensing and control for augmenting, supplementing, or replacing some robotic systems, including morphing structures, will be presented, and identification of gaps and future needs will also be discussed. Further, in a very new development, the ability to communicate data across the energy storing medium will demonstrate how we can begin to replace wires in our Autonomous Material systems.

* Rob Shepherd is an associate professor at Cornell University in the Sibley School of Mechanical & Aerospace Engineering. He received his B.S. (Material Science & Engineering), Ph.D. (Material Science & Engineering) under Professor Jennifer Lewis, and M.B.A. from the University of Illinois in Material Science & Engineering. He pursued his postdoctoral research at Harvard University in the department of Chemistry & Chemical Biology under Professor George Whitesides. At Cornell, he runs the Organic Robotics Lab (ORL: http://orl.mae.cornell.edu), which focuses on using methods of invention, including bioinspired design approaches, in combination with material science to improve machine function and autonomy. We rely on new and old synthetic approaches for soft material composites that create new design opportunities in the field of robotics. Our research spans three primary areas: bioinspired robotics, advanced manufacturing, and human-robot interactions. He is the recipient of an Air Force Office of Scientific Research Young Investigator Award, an Office of Naval Research Young Investigator Award, and his lab's work has been featured in popular media outlets such as the BBC, Discovery Channel, and PBS's NOVA documentary series.