

**Department of Structural Engineering
University of California, San Diego
SE 290 Seminar**



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“Field Responsive Mechanical Metamaterials”
Wednesday, February 13, 2019
1:00 pm - 1:50 pm, Cognitive Science Building, Room 001

<https://structures.ucsd.edu/seminars>

Abstract

Mechanical metamaterials possess previously unobtainable structural mechanical properties, primarily derived from their underlying three-dimensional (3D) architecture. Typically, metamaterial properties are programmed and set when the architecture is designed and constructed, and do not change in response to shifting environmental conditions or application requirements. This static nature will ultimately limit the deployment of mechanical metamaterials to well-known (and well-forecasted) use-cases. This talk presents a new class of field responsive mechanical metamaterials (FRMM's) that exhibit dynamic control and on-the-fly tunability enabled by careful design and selection of both material composition and architecture. To demonstrate the FRMM concept, we print complex structures composed of polymeric tubes infilled with magnetorheological (MR) fluid suspensions. Modulating remotely applied magnetic fields results in rapid, reversible, and sizable changes of the effective stiffness of our metamaterial motifs. MR fluid-filled cuboctahedron unit cells and lattices exhibit sub-second response times with up to 344%/T and 318%/T increase in effective stiffness, respectively, in the linear response regime before saturation. To aid with future design optimization efforts, we developed an analytical model that predicts the coupled magneto-mechanical behavior of our metamaterials during load-deformation testing. In the future, FRMM's might be employed for flexible and stretchable armor, next-generation helmets, adaptable soft robotics and active vibration-canceling systems.

Biography

Julie Mancini been an employee at the Lawrence Livermore National Laboratory (LLNL) for 7 years. During her time at LLNL she has worked in multiple areas including the Weapons and Complex Integration Directorate and the Materials Engineering Division (MED) in the Engineering Directorate. In MED, Julie works for the Center for Engineered Materials and Manufacturing (CEMM) at LLNL where she focuses her research on the advanced manufacturing of smart materials.

*Sponsored by Professor Ken Loh
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