

Civil Engineering Seminar

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Jonathan Hopkins
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Date: Feb 20, 2019

Time: 11:30 am – 12:30 pm

Place: KAP 209

Enabling Engineered Properties via Architected Materials

Abstract: Architected materials (a.k.a. mechanical metamaterials) achieve properties that derive primarily from their microstructure instead of their composition. Preliminary experimental and simulated results obtained from sub-millimeter-sized samples of such materials show promise for achieving currently unobtainable combinations of super properties that would enable a host of next-generation technologies, but two major barriers are preventing their practical implementation. *(i)* Design tools are currently limited in their ability to sufficiently enable the topological synthesis and optimization of architected materials because their complex features span multiple orders of magnitude and sometimes don't repeat with manageable periodicity. *(ii)* Fabrication approaches do not currently exist that can fabricate practical volumes of such materials while also achieving their architecture's submicron-sized features. Fabricating such features in a repeatable way using multiple constituent materials is also a challenge.

Professor Hopkins' *Flexible Research Group* has focused much of their efforts at UCLA toward overcoming these challenges. This seminar will provide an overview of the design and fabrication tools that they have generated in the context of practical architected-material applications. These design tools leverage the simplified mathematics of the Freedom and Constraint Topologies (FACT) synthesis approach to rapidly search the full design space of both periodic and aperiodic architected topologies to achieve desired combinations of properties. The group's fabrication tools utilize custom-developed components (e.g., a flexure-based micro-mirror array) to generate multiple optical traps that are independently controlled to assemble large numbers of different material micro-particles simultaneously for rapidly constructing desired microstructures.

About the speaker

Jonathan Hopkins is an assistant professor at the University of California, Los Angeles and is the director of the *Flexible Research Group*. The aim of his group is to enable the creation of flexible structures, mechanisms, and materials that achieve extraordinary capabilities via the deformation of their constituent compliant elements. Prior to coming to UCLA, Jonathan was a postdoc at Lawrence Livermore National Laboratory from 2010 to 2013 and received his Ph.D. (2010), Masters (2007), and Bachelors (2005) degrees all in mechanical engineering at the Massachusetts Institute of Technology. He was honored by President Barack Obama at the White House with a DOE-nominated PECASE award for his work involving the design and fabrication of architected materials. Additionally, he is a recipient of ASME's 2016 Freudenstein/General Motors Young Investigator Award, the V.M. Watanabe Excellence in Research Award, and the Northrop Grumman Excellence in Teaching Award. Website: <https://www.flexible.seas.ucla.edu>

