Semi-sesquicentennial of mecheng @ IISc Distinguished Seminar Series

Learning from the building blocks of nature in the design of periodic architected materials

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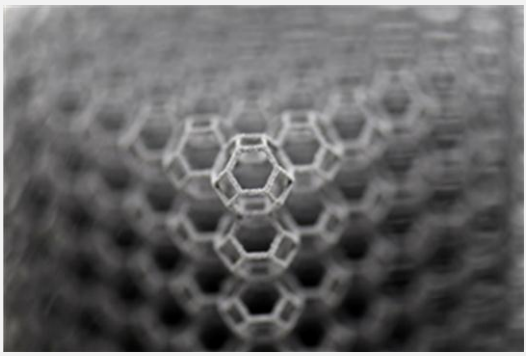
ABSTRACT



Architected materials (or mechanical metamaterials) derive their macroscopic properties from a carefully engineered small-scale structural architecture – rather than from composition and microstructure as in conventional materials. What started with acoustic metamaterials for controlling linear waves has since been extended to material systems with, e.g., optimized stiffness, strength, toughness, and damping for a myriad of engineering applications. Being a playground for experimentalists and modelers alike, this area makes the interface between materials and structures dissolve, while offering a tremendous design space for enhanced material functionality. In this seminar, we will discuss opportunities and challenges in the development of architected cellular solids with interesting, peculiar, and beneficial mechanical properties stemming from the careful design of the underlying periodic or functionally-graded unit cell. We draw inspiration from nature and adopt material-level design principles at the structural level, which results in lightweight solids with beneficial and tunable stiffness, strength, and toughness. Moreover, we show how reconfigurable and adaptive unit cells can be exploited to provide structural-level analogs of solid-solid phase transformations (not only qualitatively but also quantitatively mimicking material-level microstructural phenomena). Such systems show potential for soft robots, mechanical logic, and deployable structures.

ABOUT THE SPEAKER

Dennis Kochmann received his education at Ruhr-University Bochum and at the University of Wisconsin-Madison. After postdoc positions at Wisconsin and at Caltech, he joined the Aerospace Department at Caltech as Assistant Professor in 2011; from 2016 to 2019 he was Professor of Aerospace at Caltech. Since April 2017 he has been Professor of Mechanics and Materials at ETH Zürich, where he served as Head of the Institute of Mechanical Systems and is currently Deputy Head of the Department of Mechanical and Process Engineering. His research focuses on the link between structure and properties of a variety of (natural and architected) materials, which includes the development of theoretical, computational and experimental methods to bridge across scales from nano to macro. He was a Fulbright and Feodor-Lynen fellow; his research has been recognized by, among others, the Bureau Prize in Solid Mechanics form IUTAM, the Richard von Mises Prize by GAMM, an NSF CAREER Award, the T.J.R. Hughes Young Investigator Award by the ASME, and an ERC Consolidator Grant.

Session chair: Prof. R. Narasimhan, mecheng @ IISc