

Materials Science and Engineering Winter 2020 Seminar Series
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A COMPUTATIONAL APPROACH TO THE CREATION OF DIGITAL MATTER

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The grand challenge in manufacturing is to create a process that is economical, fast, repeatable, and that enables complete design freedom in both geometric complexity and choice of materials. While some of these aspects have been perfected over many decades in conventional processes, these typically subtractive processes often struggle with geometric and material complexity. On the other end, Additive Manufacturing (AM) is considered by many the holy grail that could transform manufacturing as we know it today. Despite the hype, however AM still lacks behind these expectations and is often not able to handle the complexity generated by sophisticated, computational design tools, which significantly limits progress in major research fields.

In my talk I will focus on both (a) the digital design of materials and structures with outstanding properties and new functionalities, and, (b), the fabrication thereof. Specifically, in (a) I will present examples from recent research that show how the mutual exclusivity between stiffness and toughness can be overcome in mechanical metamaterials and how we can integrate (multi-)functionality, such as actuation and sensing, on a materials-level, among others. In (b), I will demonstrate AM-based solutions tailored to these specific paradigms that cannot be fabricated in any other way. (b) will further address the general limitations of AM and show how they can be overcome, with the ultimate goal of solving the grand challenge. Finally, I will provide a perspective on the future direction of the field and outline potential next steps for my research.

Jochen Mueller is a postdoctoral fellow at Harvard University and the Wyss Institute for Biologically Inspired Engineering, where he has a joint appointment with Katia Bertoldi and Jennifer Lewis. Jochen's research focuses on the computational design and fabrication of mechanical metamaterials and structures with outstanding physical properties and new functionalities. Examples include the development of innovative 3D printing processes, energy-absorbing lattice materials for aerospace structures, and novel design optimization algorithms. As a result, Jochen's work has been published in journals such as *Advanced Materials*, *Nature*, and *PNAS*, and covered by major media outlets, such as the *Boston Globe* and *NBC*.

Prior to joining Harvard University, Jochen obtained a doctorate with Kristina Shea from the Engineering Design and Computing (EDAC) group at ETH Zurich and has been awarded the ETH medal for outstanding dissertations. Jochen graduated with a Bachelor's and a Master's degree with distinction from Albstadt-Sigmaringen University and Imperial College London, respectively, both in Mechanical Engineering.

LIGHT REFRESHMENTS WILL BE PROVIDED.