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# MULTIOBJECTIVE TOPOLOGY OPTIMIZATION OF CELLULAR MATERIALS

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The ability to control and manufacture materials has improved significantly in recent years, resulting in increasing attention on material topology design. The two main questions are how the material topology influences the bulk material properties at macro scale (the forward problem) and what material topologies optimize these effective properties (the inverse problem). Here we focus on the design of cellular materials as an inverse problem solved using topology optimization. Topology optimization is a freeform, systematic approach to optimizing the distribution of materials across a design domain, which for periodic materials is the characteristic unit cell. An educated guess is not required to initialize the design process and therefore topology optimization is capable of identifying new, high performance material structures. For the design of cellular materials, the design domain is discretized with finite elements and then it is determined whether each finite element contains material or represents a void. SIMP [1] penalization is used to guide the solution to binary and the Heaviside Projection Method [2] provides length scale control of features and connects solutions to the manufacturing process. While optimizing the elastic properties of single length scale materials is well-established (e.g., [3,4]), this paper will discuss more recent work concerning design for multiple objectives, including combinations of competing mechanical properties, properties governed by different physics, and multiple length scale topologies. Actual fabricated specimens and results from experimental verification will also be presented.

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