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Instability and Wave Propagation in Structured 3D Composites NARGES KAYNIA, NICHOLAS X. FANG, MARY C. BOYCE, Massachusetts Inst of Tech - MIT — Many structured composites found in nature possess undulating and wrinkled interfacial layers that regulate mechanical, chemical, acoustic, adhesive, thermal, electrical and optical functions of the material. This research focused on the complex instability and wrinkling pattern arising in 3D structured composites and the effect of the buckling pattern on the overall structural response. The 3D structured composites consisted of stiffer plates supported by soft matrix on both sides. Compression beyond the critical strain led to complex buckling patterns in the initially straight plates. The motivation of our work is to elaborate the formation of a system of prescribed periodic scatterers (metamaterials) due to buckling, and their effect to interfere wave propagation through the metamaterial structures. Such metamaterials made from elastomers enable large reversible deformation and, as a result, significant changes of the wave propagation properties. We developed analytical and finite element models to capture various aspects of the instability mechanism. Mechanical experiments were designed to further explore the modeling results. The ability to actively alter the 3D composite structure can enable on-demand tunability of many different functions, such as active control of wave propagation to create band-gaps and waveguides.

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