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# Harnessing instability to control wave propagation in phononic crystals and acoustic metamaterials

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## ABSTRACT

Artificially structured composite materials have the ability to manipulate the propagation of elastic waves due to the existence of band gaps, i.e., frequency ranges of strong wave attenuation. However, most configurations proposed to date cannot be tuned after the manufacturing process. We propose new strategies using elastic buckling mechanisms to design novel devices with in-situ adaptive properties that can be reversibly tuned. Buckling and large deformations can be effectively exploited to reversibly tune not only the width and location of band gaps, but also the directional preferences of the wave propagation, even for low-frequency elastic waves. Our proof-of-concept demonstrations also indicate that the proposed mechanisms work robustly over a wide range of length scales, opening avenues for the design of smart systems for applications, such as vibration/noise reduction, wave guiding, frequency modulation, and acoustic imaging.