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Tunable phononic crystals through dielectric elastomers DAVID HENANN, KATIA BERTOLDI, Harvard University — Phononic crystals are periodic materials that display phononic band gaps – frequency ranges in which elastic waves are prohibited. Through deformation of the periodic structure the frequency ranges of band gaps may be adjusted or new band gaps may be created. Phononic materials made from elastomers enable large reversible deformation and, as a result, significant tunability of the phononic properties. Dielectric elastomers may be used in phononic crystals, in which deformation is actuated through the application of an electrical voltage, opening the door for easily tunable phononic crystals. In order to realize these exciting capabilities, robust simulation and design tools are needed. We have developed finite-element technology to address this problem and have applied these tools to designing phononic crystals with band gaps tuned through the application of voltage. The key ingredients of our finite-element tools are (i) the incorporation of electro-mechanical coupling, (ii) large-deformation capability, and (iii) an accounting for inertial effects. We present an application of our simulation capability to the design of a phononic crystal consisting of a square array of circular-cross-section threads embedded in a dielectric elastomeric matrix.

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