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Tuning a material's properties through the excitation of localized defect modes MARC SERRA GARCIA, ETH Zurich, JOSEPH LYDON, California Institute of Technology, CHIARA DARAIO, ETH Zurich — Technological applications such as acoustic super-lenses and vibration mitigation devices require materials with extreme mechanical properties (Very high, zero, or negative stiffness). These properties can be achieved through buckling instabilities, local resonances and phase transitions, mechanisms that are limited to particular frequencies, strains or temperatures. In this talk I will present an alternative mechanism to tune the stiffness of a lattice. The mechanism is based on the excitation of a nonlinear localized defect mode. The oscillation of the defect mode affects the bulk properties of the lattice. This is due to the thermal expansion of the defect mode and the nonlinear coupling between the mode amplitude and the strain of the lattice. Due to the singular properties of nonlinear systems near bifurcation points, the lattice can achieve an arbitrarily large stiffness. It is possible to select point of the force-displacement relation that is being tuned by selecting the defect's excitation frequency and amplitude. Depending on the nonlinear interaction potential at the defect site, the stiffness can be tuned to extremely positive or extremely negative values. While our theoretical and experimental results have been obtained in a granular crystal, the analysis suggests that an equivalent effect should be present in other lattices with localized modes and nonlinearity.

Marc Serra Garcia
ETH Zurich

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