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Modeling strategies for nonlinear, time-modulated, and quasi-periodic elastic metasurfaces

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Room	**2R, DICAM Mesiano**

The quest for compact devices to control the propagation of elastic waves is fueling the research interest in the design of elastic metasurfaces, a class of thin resonant metamaterials patterned on the surface of an elastic waveguide or at the junction between two different elastic media. When realized over the free surface of a half-space, metasurfaces can manipulate the propagation of surface waves enabling complex wave phenomena, such as mode conversion, mode localization, waveguiding, and cloaking. Modeling these phenomena is fundamental to design advanced technological applications for signal processing, energy harvesting, and lab-on-chip devices, among others. For linear elastic, time-invariant, and periodic metasurfaces, several analytical formulations are already available to predict the wave dispersive properties and compute the related elastic wavefields. Conversely, the dynamic response of nonlinear, nonperiodic, and time-modulated metasurfaces is typically investigated via numerical techniques (e.g., FEM) given the lack of analytical tools.
In this talk, I will present some analytical modeling strategies developed in our research group to describe the dynamics of nonlinear, nonperiodic, and time-modulated metasurfaces. Using these approaches, we investigated: (1) the existence of directional band gaps and frequency conversion phenomena in time-modulated metasurfaces; (2) the effect of hardening and softening nonlinearity on the dispersive properties and on the filtering bandwidth of metasurfaces; (3) the existence of localized surface edge modes in the spectrum of quasi-periodic metasurfaces. Understanding the effects of non-periodicity, nonlinearity, and time-modulation on the dispersive properties of metasurfaces opens new opportunities to realize advanced devices for localization and uni-directional propagation of surface waves.

The seminar is organized by the Solid and Structural Mechanics Group D. Bigoni, F. Dal Corso, L. Deseri, D. Misseroni, M.F. Pantano, A. Piccolroaz, N.Pugno, R. Springhetti