# Dispersion properties of a non-dissipative one-dimensional lattice with non-linear microstructure

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## Abstract

Lattice materials possess a regular microstructure characterized by a periodic elementary cell. The free propagation of elastic waves through these media can be described by formulating synthetic Lagrangian models of the periodic cell and enforcing the Floquet-Bloch conditions [1]. The pass and stop bands of the dispersion spectrum can be altered – to some extent – by properly modifying the microstructural parameters [2,3]. Consequently, passive mechanical systems can be realized to favor (waveguides) or limit (filters) the propagation of elastic waves [4,5]. Nonetheless, the desired guiding or filtering performance can be affected by the presence of geometric nonlinearities [6,7]. The work focuses on the dispersion properties of a minimal nonlinear acoustic metamaterial (Figure 1), realized by elastically coupling the massive rigid bodies (rings) of a non-dissipative one-dimensional lattice with undamped, geometrically nonlinear (Duffing-like) oscillators. The spectral properties (dispersion relations and waveforms) of the periodic lattice are determined by means of computational methods and perturbation techniques [8]. Particularly, the amplitude-dependent effects of the cubic nonlinearities characterizing the ring-oscillator interaction are discussed.

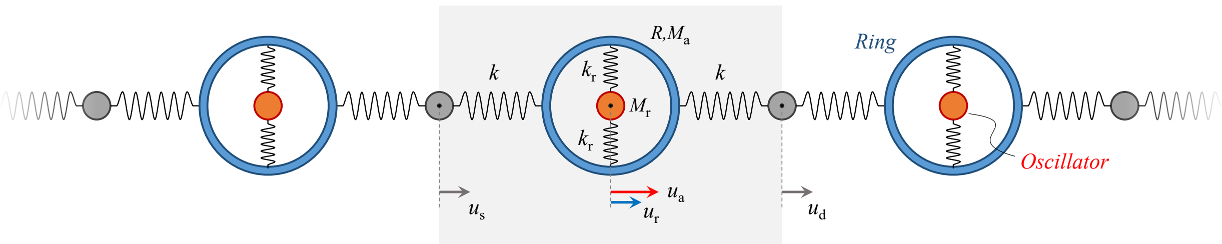


**Figure 1:** Acoustic metamaterial made by a one-dimensional lattice coupled with nonlinear oscillators

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