Dynamics of multistable mechanical metamaterials: recent results on nonlinear waves, transition fronts and their interactions

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Abstract

Multistable metamaterials, composed for example of bistable mechanical units elastically coupled to their nearest neighbors, have recently been conceived in diverse ways, particularly within the family of flexible mechanical metamaterial architectures. Such multistable metamaterials can support progressive fronts, also called transition waves, switching sequentially its multistable units front one equilibrium to another, and resulting in the local or global reconfiguration of the medium. In addition, these nonlinear metamaterials are also known to support a rich variety of nonlinear waves, as vector solitons, breathers, cnoidal waves, among others. In this presentation, I will highlight the fundamentals and a selection of recent results on transition waves: how they can be triggered, what can be their propagation properties, and how they interact with other nonlinear waves. In general, these reconfiguration fronts obey nonlinear reaction-diffusion equations and show specific properties not necessarily found in other waves supported by periodic and/or nonlinear media, e.g., strong nonreciprocity, robustness, extreme amplitude dependent behavior... They can consequently be implemented for applications involving local or global reconfiguration of a medium, manipulating mechanical memory, controlling waves in space and time, mechanical computing or be the vector for material embedded intelligence.

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