# Non-linear waves in an array of bistable flexible cells


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**Abstract**

Multistable systems, such as buckled beams, are attracting growing interest in the field of elastic metamaterials. At the scale of a bistable unit cell, we generally observe a double-well potential characterized by an unstable state between two stable regions. This intrinsically non-linear potential induces amplitude-dependent stiffness, which can be negative. Assembled in a network, these cells form a medium favorable to the propagation of nonlinear waves, such as solitons or transition waves. While the propagation of transition waves has been successfully studied, the response of these flexible metamaterials to periodic or sustained excitations remains less explored. In the context of the ANR project ExFLEM (Exploiting Extreme Wave Events in Nonlinear Flexible Elastic Metamaterials), we are studying the mechanical behavior of an array of bistable cells to analyze and exploit wave phenomena localized in time and space. Initially, we focus on the study and characterization of a single cell under quasi-static and dynamic loading. The quasi-static response is measured by tensile-compression tests coupled with displacement field analysis, in relation with the Euler-von Kármán beam model. The dynamic response, marked by Duffing-type softening in a weakly non-linear regime, is analyzed via a frequency response function using a shaker together with accelerometers. In a second step, we extend the analysis to a network of bistable cells connected by linear springs, subjected to harmonic excitation. We first present a model/test comparison of the mechanical response of a system coupling two elementary cells, before showing some preliminary observations concerning the propagation of weakly non-linear waves in a periodic network containing a finite number of elements.


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sciencesconf.org:esmc2025:603398