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Editorial: Advances in Mechanical Metamaterials

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Editorial on the Research Topic

Advances in Mechanical Metamaterials

After their introduction in the field of electromagnetics at the beginning of the century, the principles of metamaterials have been applied for manipulation of elastic and acoustic waves (Deymier, 2013; Laude, 2015). In recent years, they have been the focus of research in an increasingly large community. Many fascinating effects such as cloaking, negative refraction, focusing, or the generation of band gaps have been replicated, with the peculiarity of the large range of size and frequency scales at which these can occur (Hussein et al., 2014), leading to applications in fields as diverse as ultrasonics for nondestructive testing (e.g., Miniaci et al., 2017), noise abatement (e.g., Krushynska et al., 2017), and seismic protection (e.g., Miniaci et al., 2016). In turn, this has involved the research efforts of wide and heterogeneous communities of civil engineers, physicists, mathematicians, geologists. One of the main goals of the field is presently to bring together these different research areas and to enhance cross-fertilization of ideas and approaches. This was also the aim of a recently organized workshop "Advances of Mechanical Metamaterials" held on 10-11 October, 2016, in Trento, Italy (http://www.ing.unitn.it/~pugno/news/AMM16.pdf).

This Research Topic was therefore organized to document 5 out of 24 contributions to this workshop, and more in general to provide a platform for researchers working in the field of mechanical metamaterials to disseminate their ideas on the design and characterization of new configurations, to highlight novel dynamic phenomena and explore additional promising applications, but also to stimulate the interest of other readers of the journal, with the aim of finding new potential fields of application. This is reflected in the variety of the considered structures, including meta-foundations, subwavelength rod-like resonators, tensegrity prisms, polymeric waveguides and lattices containing tilted resonators, each with different applications in mind. The contributions also span from theoretical studies to applied research.

Tallarico et al. present a study of waves in a structured geometrically chiral solid characterized by a doubly periodic high-contrast lattice containing tilted resonators. By means of Bloch-Floquet analysis, a Dirac-like dispersion band structure is identified and exploited to study wave-guiding and wave-defect interaction problems. The investigation is carried out via an adaptive finite element computation to model a transient propagation of a crack in the micro-structured material. The influence of a geometrically chiral multi-scale lattice on the field around the crack and on the edge waves propagating along structured interfaces is discussed. The authors propose these meta-structures as filters/polarizers of elastic waves and identify several potential applications.

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