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Weiqiu Chen

Zhejiang University, China

Tuning wave propagation in soft phononic crystals via large deformation and multi-field coupling effect

Soft electroactive materials can deform to a large extent in a reversible way under mechanical or electrical loading. This unique ability makes them very attractive to be the material candidates for designing smart and tunable devices, structures and systems. We will report some recent advances in tunable soft Phononic Crystals (PCs) in which waves can be manipulated according to the application purpose. In particular, attention will be paid to a simple one-dimensional soft PC cylinder made of dielectric elastomer. A series of mechanically negligible soft electrodes are placed periodically along the dielectric elastomer cylinder and hence the material is actually uniform in the undeformed state as well as in the uniformly pre-stretched state subjected to a static axial force only. The periodicity of the structure that is required for a PC is acquired via two different loading paths. In the first path, we fix the longitudinal stretch and then apply an electric voltage over any two neighboring electrodes. In the second path, the axial force is kept unchanged and then the voltage is applied. The outstanding performance regarding the band gap (BG) property of the soft dielectric PC is well demonstrated through the comparison with the conventional design adopting the hard piezoelectric material. We also illustrate that the snap-through instability of the axially free PC cylinder made of a generalized Gent material may be used to trigger a sharp transition in the BGs.

Biography

Weiqiu Chen received his BS and PhD degrees from Zhejiang University in 1990 and 1996, respectively. He worked as a postdoctoral Research Associate at The University of Tokyo during 1997-1999. He was promoted as an Associate Professor in 1999 and a full Professor in 2000. He has engaged himself in the mechanics of smart materials/structures and vibration/waves in structures for over twenty years. He has co-authored over 350 peer reviewed journal articles and three monographs. He now serves as the Editorial Member/Associate Editor in chief of 12 academic journals including Mechanics of Advanced Materials and Structures, Journal of Thermal Stresses and Composite Structures.

chenwq@zju.edu.cn

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