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Thin sound absorbers based on space-coiling and coupled resonator mechanisms

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Abstract

Acoustic metamaterials offer unprecedented opportunities for controlling low-frequency sound and the development of compact devices with broadband acoustic performance. The ability of resonant-based metamaterials to induce the slow sound propagation has recently been exploited for the design of thin panels absorbing sound at deep subwavelength frequencies. In this work, we show that the combination of the slow sound conditions with the space-coiling and/or coupled-resonator mechanisms allows further reducing the panel thickness and overcoming the narrow-band performance imposed by the resonant nature of a metamaterial. The space-coiling implies here spatial folding of the wave propagation path or the resonator geometry with the aim to reduce structural sizes, while a coupled resonator is represented by a Helmholtz resonator with a cavity partitioned into two or more parts by one or several supplementary necks. The both mechanisms allow introducing an additional absorption peak at low frequencies that can be tuned by varying the geometry of a folded cavity or supplementary neck(s). The advantages of the proposed design ideas are demonstrated numerically; experimental verification for 3D-printed prototypes is foreseen. Our results further increase the potential of acoustic metamaterials for a wide range of engineering applications.

The speaker

Anastasiia Krushynska has a M. Sc. degree in Applied Mathematics from Donetsk National University, Ukraine, and PhD degree in Mechanics of Deformable Solids from Kyiv National Taras Shevchenko University, Ukraine. During her PhD study, she also worked as a guest researcher at National Taiwan University in Taiwan. Later Dr. Kruhynska was a post-doctoral fellow at Institute of Telecommunications in Ukraine (2008-2010) and at Eindhoven University of Technology in the Netherlands (2013-2015). In 2010-2011, she enjoyed an independent research path with the focus on the analysis of wave propagation in complicated waveguides. From 2015 to 2017, she was a Marie Sklodowska-Curie post-doctoral researcher in the framework of the FP7-People COFUND program "2020 Researchers: Train 2 Move". Currently she works a researcher at University of Trento in Italy. Her research interests are within elastic waves propagataion and vibrations, piezoelectrics and mechanical metamaterials.