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Asymmetric Elastic Wave Propagation in Tensegrity Metastructure Controlled by Prestress

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ABSTRACT

In this presentation, a metastructure is designed based on tensegrity structure to realize asymmetric elastic wave propagations. Tensegrity is a type of prestress-controlled structure with its shapes and stiffness determined by the stretched string components. Therefore, the tensegrity metastructure can be designed by distributing the prestresses in the corresponding string components to achieve in-situ tunability and easy processing ability. The research is conducted in the following steps. First, a theoretical model with coupled axial-torsional effective stiffness, which is depend on the prestress, is developed to study the unique axial-torsional coupled wave propagation in the metastructure consisting of prismatic tensegrity cells. Then, the asymmetric wave propagation is realized in the tensegrity metastructure with specific distributions of prestresses based on the wave mode conversion and selection mechanism. Finally, non-reciprocal wave propagation is achieved by applying the time modulated prestresses on the tensegrity metastructure. The proposed prestress-controlled tensegrity metastructure could be useful in the applications of directional wave reflectors and vibration isolators.