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NON-RECIPROCAL WAVE PROPAGATION IN PERIODICALLY STRUCTURED TIMOSHENKO BEAMS

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ABSTRACT

In this paper we will investigate non-reciprocal wave propagation in Timoshenko beams, due to space and time modulation of its elastic properties. To that end, an analytical approach is used: the Bloch theorem is applied when choosing the solution form for displacement components and the angle of rotation, which figure in the equations of motion along with the elastic properties. Also, the Fourier expansion is used to express the periodic nature of the modulation. By solving the eigenvalue problem for different modulation parameters, we obtain the band diagrams which can be used to analyze the directionality of wave propagation. These diagrams clearly represent the breakage of symmetry as a consequence of modulation. Thus, a modulated beam behaves as a kind of metamaterial, in which one-way propagation of elastic waves is possible. When shear and rotational effects are neglected, these results converge to the results for the Euler-Bernoulli beam, which are already present in scientific literature.

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