MAE *Seminar* Series

Wave Motion in 1-D Viscoelastic Phononic Crystals

Thursday,

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4:00 PM

Zoom Information

Meeting ID: 983 6137 4638

Password: MAE

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ABSTRACT

Phononic crystals are engineered materials made of periodic structures designed to control mechanical waves, specifically phononic band-gaps, through Bragg scattering. Compared to elastic (i.e., metallic) phononic crystals that have been thoroughly investigated, much of viscoelastic phononic crystals remain unexplored although they could be adopted for practical applications in the acoustic frequency range (i.e., < 20kHz).

The presentation will provide a comprehensive introduction to the fundamental wave characteristics of 1-D viscoelastic phononic crystals. Firstly, a closed-form dispersion relation of 1-D viscoelastic phononic crystals is presented for oblique wave motion in the sagittal plane. Then, a long-standing issue of fictitious wave modes in the numerical dispersion relations in the finite-element (FE) framework is resolved by identifying spatial aliasing originated from an artificial periodicity in FE models. The study also provides a guideline based on spatial anti-aliasing condition and an effective modulus theory to prevent spectral distortions in FE-driven dispersion relations. Lastly, the study presents a hybrid split Hopkinson pressure bar (SHPB) apparatus as a tool to identify the nonlinear wave characteristics of 1-D viscoelastic phononic crystals. For the considered specimen, the application of the hybrid SHPB apparatus reveals new low transmission frequency zones, which are neither predicted from the analytical solution nor observed from the conventional electrodynamic shaker tests. This experimental study demonstrates that the impulse-dependent wave transmission behavior can be investigated by adopting a hybrid SHPB apparatus.

BIO SKETCH

Jongmin Shim is an Associate Professor in the Department of Civil, Structural, and Environmental Engineering at the University at Buffalo. He received his Ph.D. in Engineering Mechanics at MIT. He is broadly interested in elastic instability and pattern transformation to be applied for the design of resilient structural components and mechanical metamaterials. The current research focus includes pattern-transformable granular crystals, weakening-induced snap instability, 3-D reconfigurable auxetic solids, and shape optimization using reinforcement learning.