 ICCES, vol.10, no.1, pp.9-9

Propagation of Lamb waves in stubbed phononic plates

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Summary

Recently, propagation of bulk and surface acoustic waves in periodic structures called phononic crystals (PCs) has attracted a lot of interests. The existence of band gaps, the frequency ranges in which acoustic wave propagation is forbidden, in such periodic structures has demonstrated many potential applications to acoustic-wave devices, such as filters, resonators, efficient acoustic waveguides, etc.

In this paper, Lamb wave propagation in a thin plate with a periodic stubbed surface is investigated numerically and experimentally. A detailed evolution of how the band structure form the complete band gaps as the increase of the stub height is studied numerically using the finite element (FE) method. Results show the existence of complete band gaps and flat bands of elastic waves in the structure. With the complete band gap, the propagation of guided mode in the stubbed phononic plate with a line defect, and the laser ultrasonic experiments are conducted accordingly to demonstrate the guiding effect of Lamb waves in the line-defect PC structure. Results show very good agreements between the measurements and numerical predictions. Finally, based on the guiding effect, a design for the frequency selection of broadband Lamb waves in the PC with a poly-linear bent waveguide is proposed and demonstrated by laser ultrasonic experiments.

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