Phononic band gaps and vibrations in one- and two-dimensional mass-spring structures

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The vibrational response of finite periodic lattice structures subjected to periodic loading is investigated. Special attention is devoted to the response in frequency ranges with gaps in the band structure for the corresponding infinite periodic lattice. The effects of boundaries, viscous damping, and imperfections are studied by analyzing two examples; a 1-D filter and a 2-D wave guide. In 1-D the structural response in the band gap is shown to be insensitive to damping and small imperfections. In 2-D the similar effect of damping is noted for one type of periodic structure, whereas for another type the band gap effect is nearly eliminated by damping. In both 1-D and 2-D it is demonstrated how the free structural boundaries affect the response in the band gap due to local resonances. Finally, 2-D wave guides are considered by replacing the periodic structure with a homogeneous structure in a straight and a 90° bent path, and it is shown how the vibrational response is confined to the paths in the band gap frequency ranges.

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